Operating instructions

Surge arresters
Type POLIM®-D..PI-2/-3
Type POLIM®-D..PI-3 OUTDOOR
# Content

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1 About this document
These operating instructions are part of the POLIM®-D..PI-2, POLIM®-D..PI-3, POLIM®-D..PI-3 OUTDOOR surge arresters and describe safe and proper use for all phases of operation.
Language of the original operating instructions: German

1.1 Validity
These operating instructions are valid only for the POLIM®-D..PI-2, POLIM®-D..PI-3, POLIM®-D..PI-3 OUTDOOR surge arresters.

1.2 Target group
The target group of these operating instructions is professionals in the field of high-voltage technology.
The POLIM®-D..PI-2, POLIM®-D..PI-3, POLIM®-D..PI-3 OUTDOOR may only be commissioned and maintained by persons instructed in proper use and handling.

2 Safety

2.1 Symbols and advice
Important information and technical notes are emphasised in order to illustrate the correct operation.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>!</td>
<td>This is a safety sign. It warns you of the danger of injury and material damage. Follow all measures marked with the safety sign to avoid injuries, death and damage to materials.</td>
</tr>
<tr>
<td>!</td>
<td>This safety sign warns you of the danger of death or serious injury from electric shocks. Follow all measures marked with the safety sign to avoid injuries and death.</td>
</tr>
<tr>
<td>▶</td>
<td>This mark indicates that an action is to be performed.</td>
</tr>
</tbody>
</table>

Warnings in these operating instructions indicate special dangers and list measures for prevention of the danger. There are three levels of warning:

<table>
<thead>
<tr>
<th>Warning word</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>DANGER</td>
<td>Immediate, impending endangerment of your life and health</td>
</tr>
<tr>
<td>WARNING</td>
<td>Possible impending endangerment of your life and health</td>
</tr>
<tr>
<td>CAUTION</td>
<td>Possible impending danger of light injuries or damage to materials</td>
</tr>
</tbody>
</table>

Warnings are structured as follows:

WARNING WORD!
The type and source of danger appear here.
Possible consequences, which could occur if the measures are not followed, appear here.
▶ Measures for avoiding the danger appear here.
2.2 Basic safety precautions

2.2.1 Product safety

The POLIM®-D..PI-2, POLIM®-D..PI-3, POLIM®-D..PI-3 OUTDOOR has been constructed using state-of-the-art technology and officially recognised safety-related rules. Danger to life and health of the user or third parties could arise or damage of the POLIM®-D..PI-2, POLIM®-D..PI-3, POLIM®-D..PI-3 OUTDOOR and other property could occur while the POLIM®-D..PI-2, POLIM®-D..PI-3, POLIM®-D..PI-3 OUTDOOR is in use, however.

- The POLIM®-D..PI-2, POLIM®-D..PI-3, POLIM®-D..PI-3 OUTDOOR is only to be used when it is in technically sound condition, for the intended purpose, and with safety and the possible dangers in mind while observing the operating instructions.
- Keep the operating instructions intact and fully readable and store them in such a way that they are accessible to operating personnel at all times.
- Decommission and replace overloaded or damaged POLIM®-D..PI-2, POLIM®-D..PI-3, POLIM®-D..PI-3 OUTDOOR units.

2.2.2 Personnel-related measures

- Train personnel in professional and safe working with high-voltage technology.
- Train and instruct personnel in working on the POLIM®-D..PI-2, POLIM®-D..PI-3, POLIM®-D..PI-3 OUTDOOR using the operating instructions.
- Personnel being trained, instructed or provided with general education may only work with the POLIM®-D..PI-2, POLIM®-D..PI-3, POLIM®-D..PI-3 OUTDOOR under constant supervision by an experienced high-voltage technology professional.

2.2.3 Organisational measures

- Observe all safety- and danger-related information regarding the POLIM®-D..PI-2, POLIM®-D..PI-3, POLIM®-D..PI-3 OUTDOOR.
- The safety rules of the owner of the high- and medium-voltage system and all regulations of the respective national safety authorities are to be observed.
- Only trained and instructed professionals may be authorised.
- Clearly assign areas of responsibility for working with the POLIM®-D..PI-2, POLIM®-D..PI-3, POLIM®-D..PI-3 OUTDOOR, make them known and adhere to them.
- Only personnel who have read and understood the operating instructions, especially the "Basic safety precautions" section may be allowed to carry out activities with the POLIM®-D..PI-2, POLIM®-D..PI-3, POLIM®-D..PI-3 OUTDOOR.
- Check to ensure that work is being performed in a safety-conscious way with awareness of possible dangers and while observing the operating instructions.

3 Description

3.1 Intended use

The POLIM®-D..PI-2, POLIM®-D..PI-3, POLIM®-D..PI-3 OUTDOOR is a surge arrester for use in metal-encapsulated medium-voltage systems with sockets of the cone sizes 2 and 3 in accordance with EN 50181. The POLIM®-D..PI-2, POLIM®-D..PI-3 is specified for indoor, the POLIM®-D..PI-3 OUTDOOR for outdoor applications. Surge arresters protect the insulation of medium-voltage equipment against overvoltages which are caused by lightning or switching operations.

The manufacturer is not liable for resulting damage from further, unintended use. The owner is solely responsible for the risk here.
3.2 Structure and function

The POLIM®-D..PI-2, POLIM®-D..PI-3, POLIM®-D..PI-3 OUTDOOR surge arrester is constructed from serially connected, non-linear metal-oxide (MO) resistors. These MO resistors have an extremely non-linear characteristic. At the maximum operating voltage of $U_c$, only a small capacitive current will flow in the mA range. With an increase in voltage, the MO resistors enter a highly-conductive state practically without delay. Thus any further increase in voltage is limited to the specified residual voltage values. After the decline of the overvoltage the arrester immediately turns back to the non- or slightly-conductive state. The MO arrester converts the energy of the surge into heat, which it transfers to the surrounding air.

The stack of MO resistors and connection equipment is held together with lugs made of fibre-glass-reinforced plastic. The stacks are directly moulded-in with silicone as insulation against metal housing. The aluminium housing is earthed. These plug-in arresters can be installed in medium-voltage systems with pluggable inner-cone bushings in accordance with EN 50181 Type 2 and Type 3.

The POLIM®-D..PI-2, POLIM®-D..PI-3, POLIM®-D..PI-3 OUTDOOR surge arrester is particularly suitable for the overvoltage protection of:

- Transformers
- Cables, capacitors
- Generators, motors
- Other high- and medium-voltage apparatuses and systems

3.3 Figure of the arrester

- 1 Spring contact
- 2 Silicone cone
- 3 Screws M8x45
- 4 Area of pressure-relief in case of overload and indication of arrester position
- 5 Aluminium tube
- 6 Red sleeve made of plastic
- 7 Disk
- 8 M12 or M16
- 9 Earthing bolt
- 10 Transparent protective jacket
- 11 Screws M8x20
- 12 Adapter ring
3.4 Technical data

The technical data, dimensions and weights are specified in the following documents:
- POLIM®-D..PI-2, POLIM®-D..PI-3, POLIM®-D..PI-3 OUTDOOR surge arrester for applications in a.c. systems in the document 1HC0075869 / 3273
- Dimensional drawings of the POLIM®-D..PI-2, POLIM®-D..PI-3, POLIM®-D..PI-3 OUTDOOR

3.4.1 Technical data on the surge arrester

The rating plate contains the following data:

<table>
<thead>
<tr>
<th>Data</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>POLIM®-D..PI-2,</td>
<td>Complete type designation with specification of the maximum</td>
</tr>
<tr>
<td>POLIM®-D..PI-3,</td>
<td>permissible continuous operating voltage $U_c$</td>
</tr>
<tr>
<td>POLIM®-D..PI-3 OUTDOOR</td>
<td></td>
</tr>
<tr>
<td>$U_c = ..$ kV</td>
<td>Maximum permissible continuous operating voltage $U_c$</td>
</tr>
<tr>
<td>$U_r = ..$ kV</td>
<td>Rated voltage $U_r$</td>
</tr>
<tr>
<td>$I_n = ..$ kA</td>
<td>Nominal discharge current $I_n$</td>
</tr>
<tr>
<td>$I_{s}$ during 0.2 s</td>
<td>Nominal short-circuit current $I_{s}$ during 0.2 s</td>
</tr>
<tr>
<td>Dat.</td>
<td>Date of manufacture</td>
</tr>
<tr>
<td>No. ...</td>
<td>Serial number</td>
</tr>
</tbody>
</table>

3.4.2 Application guidelines

The following application guidelines for the use of the POLIM®-D..PI-2, POLIM®-D..PI-3, POLIM®-D..PI-3 OUTDOOR surge arresters:
- "Application guidelines - Overvoltage Protection"
  Dimensioning, testing and application of metal-oxide surge arresters in medium-voltage systems, document 1HC0075561

3.4.3 Recommended torques and screw-in depths

The tightening torques to be used respectively are specified in the figures as follows:

- **M8 13Nm**

  **Meaning:**
  The screw of the designated size is to be tightened with the specified torque.

3.4.4 Behaviour in fire

The silicone housing of the surge arrester is self-extinguishing.
4 Transportation, unpacking and storage

4.1 Transportation

**CAUTION!**

Surge arresters not secured during transportation.
Damage to surge arresters through falling.
- Secure surge arresters against sliding or falling before transportation.
- Observe safety precautions printed on the packaging for proper handling during transportation and storage.

4.2 Unpacking

The surge arresters provided are packaged in stable cardboard boxes. Each package consists of 2 boxes that are tied together. One box contains the surge arrester, the other the accessories.

If the surge arrester is supplied with a surge counter, this is packed in an additional box including accessories.

**Supplied accessories:**

<table>
<thead>
<tr>
<th>Accessories</th>
<th>POLIM®-D..PI-2</th>
<th>POLIM®-D..PI-3</th>
<th>POLIM®-D..PI-3 OUTDOOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adapter ring</td>
<td>1x</td>
<td>1x</td>
<td>-</td>
</tr>
<tr>
<td>Screw M8x20</td>
<td>3x</td>
<td>3x</td>
<td>-</td>
</tr>
<tr>
<td>Screw M8x45</td>
<td>3x</td>
<td>3x</td>
<td>3x</td>
</tr>
<tr>
<td>Silicone grease, tube</td>
<td>1x</td>
<td>1x</td>
<td>1x</td>
</tr>
<tr>
<td>Nut 0.5d-M12</td>
<td>1x</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Nut 0.5d-M16</td>
<td>-</td>
<td>1x</td>
<td>1x</td>
</tr>
<tr>
<td>Washer for M16</td>
<td>-</td>
<td>2x</td>
<td>2x</td>
</tr>
</tbody>
</table>

The routine test reports for the final electrical inspection are included in the packaging material.
- After receiving the shipment, compare the order and delivery documents immediately to check for completeness and accuracy of the shipment. In case of incompleteness or deviations, inform the supplier and shipper immediately.

**WARNING!**

Damaged surge arresters.
Material damage and personal injury due to the installation and commissioning of damaged surge arresters.
- Do not use damaged surge arresters.
- Examine shipment immediately to check for damage.
- Notify the insurance company, the shipper and the supplier of the damage immediately and create a damage log.

4.3 Storage

The original packaging materials can be used for storage.
- Store surge arresters in a well-ventilated, clean room.
- Remove plastic film to prevent the formation of condensation water.
- Storage temperature: −20 .. 70 °C
5 Commissioning

5.1 Safety

DANGER!
System uses high voltage.
Death, serious bodily harm and damage to the switchgear may result from an electric shock.

- Allow only authorised professionals to perform work on the surge arrester.
- Observe the safety rules of EN 50110-1 before working on the system:
  - Disconnect the system from the power supply.
  - Secure the system against being switched on again.
  - Ensure that the system is deenergised.
  - Earth the system and short-circuit it.
  - Cover or cordon off neighboring energised parts.

5.2 Electrical check before commissioning

Each surge arrester is tested by the manufacturer. The routine test report is included with the packaging. Additional electrical testing before commissioning is not necessary.

5.3 Installation location and protective distance

DANGER!
Danger of fire and injury via arc with overloading of the surge arrester.
Ignition of flammable materials by an arc and flying burning parts.

- Do not store flammable materials near the surge arrester.
- When working near the surge arrester, do not wear easily flammable clothing.

Surge arresters only protect high- and medium-voltage apparatuses when they are located within the protective distance. The protective distance is only a few meters.
- Always mount surge arresters as close as possible to the apparatus to be protected within the protective distance. The length of the connecting cables are decisive here.
- In cases of doubt, calculate the protective distance according to the formulas in the "Application guidelines".
## 5.4 Mounting

### CAUTION!
**Incorrect system voltage.**
Damage to the switchgear and the surge arrester.
- Do not use surge arresters intended for AC systems in DC systems.
- The test voltage of the insulation test of the switchgear can damage the surge arrester.
- Observe the "Application guidelines".
- Before mounting, ensure that the characteristic data on the rating plate of the surge arrester matches the requirements of the power system.
- Ensure that the system voltage applied at the terminals of the arrester does not exceed the maximum permissible continuous operating voltage of the surge arrester.
- Remove the surge arrester from the switchgear when the insulation test of the switchgear is carried out.

### CAUTION!
**Plug socket or mounting plate does not fit.**
Damage to the switchgear and the surge arrester.
- Do not install the surge arrester in an unsuitable plug socket.
- Ensure that the plug-in arrester is inserted in a pluggable inner-cone bushing (plug socket) that corresponds to EN 50181 Section 4.6.2 Connection type 2 or Connection type 3.
- Install POLIM®-D..PI-2 only in plug sockets conforming to EN 50181 Connection type 2.
- Install POLIM®-D..PI-3 / PI-3 OUTDOOR only in plug sockets conforming to EN 50181 Connection type 3.

### 5.4.1 Mounting preparation
- Unpack the plug-in arrester.
- Check the silicone cone for damage such as scratches.
- Check the visible black conductive paint and the metal housing for damage.
- Mount only undamaged plug-in arresters.

### 5.4.2 Cleaning of the silicone cone and the plug socket
- Clean the silicone cone of the plug-in arrester and the plug socket with isopropyl alcohol or cable cleaner (from ABB).
  If the plug connection already exists, the plug connection was only disconnected briefly and no soil- ing is visible, the silicone grease film can remain in the plug socket and the plug socket does not need to be cleaned.
  - Moisten a clean, soft and lint-free cloth with isopropyl alcohol or cable cleaner (from ABB) and wipe the silicone cone of the plug-in arrester under low pressure. If necessary, the silicone cone can be dried with a dry cloth. The silicone cone will swell slightly through this cleaning process, but will subside within a few minutes.
- Let the silicone cone of the plug-in arrester dry in the air for 15 minutes.
- Let the plug socket dry in the air for 5 minutes.
5.4.3 Greasing of the silicone cone of the plug-in arrester

In order to ensure the dielectric strength of the boundary layer between the silicone cone of the plug-in arrester and of the plug socket, it has to be greased.

- Clean the silicone cone (1) before mounting and grease with the enclosed silicone grease.
- Use only the silicone grease in the enclosed tube.
- Grease only directly before mounting in order to avoid soiling of the greased parts.
- Apply the silicone grease evenly on the silicone cone of the plug-in arrester.
- Required amount of silicone grease for POLIM®-D..PI-2: Half a tube, corresponding to 5 g
- Required amount of silicone grease for POLIM®-D..PI-3 / PI-3 OUTDOOR: Complete tube, corresponding to 10 g

5.4.4 Mounting the plug-in arrester POLIM®-D..PI-2/-3

Mounting of the adapter ring

The plug-in arrester can be mounted both horizontally and vertically or inclined.

If the plug socket is equipped with a capacitive voltage pick-up, it has to be connected in accordance with the instructions of the system manufacturer before the adapter is mounted.

(1) Tightening torque according to specification of switchgear manufacturer.
- Place the adapter in the desired position and fasten using the 3 screws M8x45 in the threaded holes of the pluggable bushings of the switchgear. When positioning the adapter take the optional cable to the capacitive voltage pick-up into account.
- Tighten the screws with the tightening torque specified by the system manufacturer. The screws have the strength 12.9 in accordance with DIN-ISO 898.
Mounting the plug-in arrester POLIM®-D..PI-2/-3

The plug-in arrester is supplied ex works in a pretensioned state so that it can be mounted with little effort.

- Insert the plug-in arrester into the plug socket without canting or bending the lamellar contact.
- Screw the metal housing of the plug-in arrester onto the adapter ring with the premounted 3 screws M8x20 (1). The tightening torque amounts to 13 Nm.
- Remove the nuts, washers and the red plastic sleeve from the earthing bolt (2). To do so, insert a hexagonal key in the hexagon socket of the earthing bolt to counterhold.

Keep the red plastic sleeve for any future removal of the plug-in arrester. If lost, it can be ordered from ABB Switzerland Ltd. (Material Number 1HC0018814). This red plastic sleeve serves only as a mounting aid.
5.4.5 Mounting the plug-in arrester POLIM®-D..PI-3 OUTDOOR

The plug-in arrester is supplied ex works in a pretensioned state so that it can be mounted with little effort.

(3) Tightening torque to specifications of the switchgear manufacturer.

- Insert the plug-in arrester into the plug socket without canting or bending the lamellar contact.
- Fasten the metal housing of the plug-in connector with the screws M8x45 (1) in the threaded holes of the switchgear. When positioning the adapter take the optional cable to the capacitive voltage pick-up into account.
- Remove the nuts, washers and the red plastic sleeve from the earthing bolt (2). To do so, insert a hexagonal key in the hexagon socket of the earthing bolt to counterhold.

Keep the red plastic sleeve for any future removal of the plug-in arrester. If lost, it can be ordered from ABB Switzerland Ltd. (Material Number 1HC0018814). This red plastic sleeve serves only as a mounting aid.

DANGER!
Incorrectly mounted plug-in arrester.
Damage to the surge arrester and the switchgear.
- Do not energise if the plug-in arrester is not mounted correctly.
- Check correct mounting of the surge arrester in the plug socket.

- Check correct mounting of the surge arrester in the plug socket.

There are 6 openings on the circumference of the aluminium tube. A surge arrester is mounted correctly when the red marking of the inner part is visible under the openings (3) and this red marking covers at least 50% of the surfaces under the openings (3).

5.4.6 Earthing the plug-in arrester

- Observe national regulations and the requirements of the system owner with regard to earthing.
- Connect surge arresters to the system ground via the shortest path.
Observe the minimum cross-sections at POLIM®-D..PI-2/-3, POLIM®-D..PI-3 OUTDOOR:
- Copper Ø 20 mm²
- Aluminium Ø 40 mm²

Earthing the plug-in arrester when no monitoring device is connected

The earthing connection bolt E is connected to the MO resistors and carries the leakage current. The earthing connection bolt E is isolated from the aluminium tube of the surge arrester and has to be earthed.

- To earth the surge arrester use a flexible earthing cable with sufficient length so that no tension acts on the earthing connection bolt (E).

POLIM®-D..PI-2

POLIM®-D..PI-3 / PI-3 OUTDOOR

- POLIM®-D..PI-2:
  - Fasten the earthing cable to the earthing connection bolt (E) with the two nuts (I) and (II) and the two washers. The nut (II) is of the type 0.5d-M12. Observe a minimum space of 8 mm between the aluminium tube and the nut.
  - Counter-tighten the nuts against each other with a torque of 40 Nm.

- POLIM®-D..PI-3/PI-3 OUTDOOR:
  - Fasten the earthing cable to the earthing connection bolt (E) with the two nuts (III) and the two washers. The nuts (III) are of the type 0.5D-M12. Use the thin washers supplied. Observe a minimum space of 8 mm between the aluminium tube and the nut.
  - Counter-tighten the nuts against each other with a torque of 40 Nm.

Only the dead weight of the earthing cable but no additional forces may act on the earthing connection bolt (E).

Earthing the plug-in arrester when a monitoring device is connected

- For the connection of a monitoring device see operational instructions of the relevant device (e.g. SAM 3.0 1HC0051333).
5.4.7 Removing the plug-in arrester

Removal of the plug-in arrester only in a deenergised earthed state of the system. Observe the safety measures as specified in Chapter 5.1.

**POLIM®-D..PI-2**

![Diagram of POLIM®-D..PI-2](image)

- Screw off and remove the earth cable and sensor with articulated piece if the plug-in arrester was equipped with monitoring.
- **POLIM®-D..PI-2:**
  Slide the red plastic sleeve and the 2 washers over the earthing bolt (E) and screw on the two 0.8d-M12 nuts that belong to the scope of supply of the arrester. Counterhold with the hexagon socket in the earthing bolt and turn on until the stop.

**POLIM®-D..PI-3 / PI-3 OUTDOOR**

![Diagram of POLIM®-D..PI-3 OUTDOOR](image)

- POLIM®-D..PI-3/PI-3 OUTDOOR:
  Slide the red plastic sleeve and the 2 large washers that belong to the scope of supply of the plug-in arrester over the earthing bolt (E) and screw on the 0.8d- and 0.5d-M16 nuts. Counterhold with the hexagon socket in the earthing bolt and turn on until the stop.
- Check whether the red markings in the openings (3) have disappeared.
- If the red markings have disappeared, turn out the 3 M8x20 screws that hold the aluminium tube on the flanged ring.

**WARNING!**

Danger of injury through falling surge arrester and of damage to the surge arrester through falling.

- Hold the surge arrester firmly while removing it.

Caution, hold the arrester firmly. It can fall.

- Pull the plug-in arrester gently out of the plug socket in the axial direction without damaging the silicone cone.
- Store in the original packaging in a clean and dry location.
6 Maintenance, upkeep

**DANGER!**

System uses high voltage.
Death, serious bodily harm and damage to the switchgear may result from an electric shock.

- Allow only authorised professionals to perform work on the surge arrester.
- Observe the safety rules of EN 50110-1 before working on the system:
  - Disconnect the system from the power supply.
  - Secure the system against being switched on again.
  - Ensure that the system is deenergised.
  - Earth the system and short-circuit it.
  - Cover or cordon off neighboring energised parts.

The surge arresters do not contain wearing parts and are therefore maintenance-free. Replacement parts are not needed.

6.1 Replacing after overload

Overloading during operation can lead to damaging (e.g., traces of fire, fractures) of the surge arrester from arcs.

**CAUTION!**

Damage to the surge arrester.
Damaged surge arresters no longer protect the switchgear.

- Check the surge arresters visually on a regular basis to ensure that they are in sound condition.
- Replace damaged surge arresters.

- Keep as many surge arresters in reserve as there are in operation.
Disposal

POLIM®-D..PI-2, POLIM®-D..PI-3, POLIM®-D..PI-3 OUTDOOR surge arresters are environmentally-friendly products which must be disposed of based on the respective applicable regional regulations in an environmentally-friendly manner. The materials should be given up for recycling.

Constituent components are:

- Silicone rubber (not halogenated) for the insulation
- Tubes and other parts made of aluminium
- Flange and mounting hardware made of steel
- Metal-oxide varistors
- Fiberglass-reinforced plastic lugs
- Insulating material made of polymer

Silicone rubber (non halogenated)

The silicone rubber can break down into SiO$_2$ and CO$_2$, thus uncovering the encased metal-oxide varistors.

Metal-oxide varistors

The metal-oxide varistors are sintered ceramics consisting of about 90% of ZnO. The following additions are also contained within:

- percent by weight between 1 and 4%: Bi$_2$O$_3$ and/or Sb$_2$O$_3$, which are considered to be dangerous substances according to EU ordinances
- percent by weight between 0.1 and 1%: NiO and Cr$_2$O$_3$, which are considered poisonous and dangerous materials pursuant to EU Directive 91/689/EEC

Metal-oxide varistors are coated with a thin glass coating containing lead-oxide (<0.1% of the weight of the metal-oxide varistor).

The substances are ligated as a mixed oxide in metal-oxide varistors. A wash-out test in accordance with an EPA specification (Federal Register/vol. 45, No 98 /Rules and regulations) has shown that the sintered metal-oxide varistors can be disposed of as industrial waste without infringing on EEC directives.

No danger to personal health or the environment is present during normal operation.
For more information please contact:

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