

Operating Instructions No. 2108 (EN)

Device:	Earthing Switch
Type:	B, E, M
Rated Voltage:	72.5 kV - 170 kV
Rated Normal Current:	---
Rated Short-Time Current:	31.5 kA / 40 kA

Manufacturer: AREVA Energietechnik GmbH
High Voltage Products
Lilienthalstr. 150
34123 Kassel
Germany

Note: Please read the operating instructions carefully before beginning installation and commissioning.

Table of Contents

1	Technical Data
2	Description
2.1	General Information
2.2	Design
2.3	Method of Operation
2.4	Special Options
3	Transport and Storage
3.1	Packaging
3.2	Transport and Handling
3.3	Storage
4	Installation
4.1	General Instructions
4.2	Bolted Joints
4.3	Installing Earthing-Only Switches
4.4	Mounting the Operating Mechanism
4.5	Operating Linkages
4.6	Mounting the Thrust Bearing
4.7	Adjusting the Mechanism Linkages
4.8	Connecting the Earthing Switch Poles
4.8.1	Connection in Side-by-Side Configuration
4.8.2	Connection in Tandem Configuration
4.9	Completing Installation
5	Maintenance
6	Inspections
7	Replacement Parts

List of Figures

- Figure 1.1 a: Main components (I) with directly mounted operating mechanism
Figure 1.1 b: Operating mechanism in lowered position
Figure 1.2: Main components (II) in tandem configuration
Figure 2: Rope configuration
Figure 3: Mounting a lowered operating mechanism (motor-operated or manually operated mechanism)
Figure 4 a: Connecting the mechanism linkage when mechanism is mounted on base frame
Figure 4 b: Connecting the mechanism linkage when mechanism is in lowered position
Figure 5 a: Operating mechanism mounted directly on base frame
Figure 5 b: Operating mechanism mounted in lowered position
Figure 6: Alignment dimension for connection
Figure 7: Connecting linkage for side-by-side configuration
Figure 8: Connecting linkage for tandem configuration

1 Technical Data

Type		B, E, M			
Rated voltage	kV	72.5	123	145	170
Rated short-time withstand current	kA		31.5/40		
Rated peak withstand current	kA		80/100		
Rated power frequency withstand voltage	kV	140	230	275	325
Rated lightning impulse withstand voltage	kV	325	550	650	750
Rated mechanical terminal load					
– Static	N		1500		
– Static plus dynamic	N		5500		
Ice load					
– Class			10/20		
Temperature range					
– I	°C		-25/40		
– II	°C		-50/50		
Contact pressure	N		400 + 10 (40 kA) 300 + 10 (31.5 kA)		
Operating mechanism			CMM motor-operated mechanism Manually operated mechanism		

For mechanism specifications, see the operating instructions for the specific unit.

Other values available on request.

2 Description

2.1 General Information

Earthing or grounding switches (either add-on earthing switches or earthing-only switches) can be used in single-pole or multipole applications. They can be installed in side-by-side configurations, tandem configurations or mounted on the wall or ceiling. These devices are designed for the straight loads and cross-loads listed in IEC 129, Table III.

Multipole earthing switches are operated by only one operating mechanism, which in the standard design is mounted on the middle pole (other mechanism configurations are also possible). Motor-operated mechanisms are preferable, but manually operated mechanisms can also be used, if requested. Operating mechanisms are described in separate operating instructions.

A disconnecter pole may be equipped with one or two add-on earthing switches operated in a single-pole or multipole configuration. Add-on earthing switches are installed and adjusted separately from the disconnecter.

The earthing switches described below are also suitable as field add-ons for retrofitting existing center-break disconnectors. They can also be converted from earthing switch E1 to earthing switch E2 and vice versa.

The earthing switches conform to the current editions of DIN VDE 0670:

- Part 1000: “Common Specifications for High Voltage Switchgear and Controlgear” (equivalent to IEC Publication 694),
- Part 2: “Alternating Current Disconnectors and Earthing Switches” (equivalent to IEC Publication 129).

This document and the equipment described herein are subject to change without notice in the interest of further development. No claims may be derived from the specifications, figures, or descriptions. AREVA Energietechnik GmbH shall not be liable for any errors contained in this document.

2.2 Design

The main components of an earthing switch are shown in Figures 1.1 and 1.2. A bearing block (2) with a shaft (2.2) to which the conducting path (5) is attached is mounted on a base frame (1).

The fixed contact (7) of the earthing switch is located on the head of a post insulator (3) or on the main circuit of a disconnecter.

An operating mechanism (4) mounted on the base frame (1) moves the conducting path (5) of the earthing switch via the mechanism rocker arm (4.1), the mechanism linkage (9), and the connecting linkage.

Add-on earthing switches are factory-mounted according to pole on the base frame of the corresponding disconnecter and are also factory-adjusted.

Base Frame (1)

The hot dip galvanized base frame (used only with stand-alone earthing-only switches) consists of two U sections with welded-in connecting webs.

Rotary Unit

The rotary unit consists of a bearing block (2) in which are located bearing shells, setting collars, and a shaft (2.2). The bearings can carry current up to the maximum rated short-time current so that additional earthing strips are not necessary. The bearings are greased for life and protected from environmental influences.

Mechanism Linkage (9)

This linkage connects the mechanism to the earthing switch conducting path that is mounted on the rotary unit of the directly operated pole. The mechanism rocker arm (4.1) mounted on the operating mechanism is equipped with an eccentric bushing that is used to adjust the rocker arm radius.

Connecting Linkage and Coupling Shaft (10)

In multipole earthing switches with group drive, this linkage transmits the operating motion from the directly operated pole to the other poles.

Post Insulators

The post insulators (3) of separate earthing switches are dimensioned for operating requirements with respect to overall height, creepage path and specified failing load.

Referenced standards:

IEC Publication 273 or VDE 0674, Part 4

IEC Publication 815

Conducting Path

The conducting path (5) of the earthing switch is mounted on the shaft (2.2) of the rotary unit and locked against rotation. It consists of a corrosion-resistant aluminum alloy.

Contact System (6)

A finger contact system (6) is located at the end of the conducting path. The contact force or pressure of the finger contacts is factory-set by means of contact springs. In closed position, the finger contact system encloses a fixed contact (7).

Contact parts in maintenance-free contact systems (optional) are marked for identification purposes with a permanent blue stripe or dot.

Terminal Heads

The terminal heads (8) on the post insulators are designed as flat-type or bolt-type screw terminals.

Operating Mechanisms

Motor-operated mechanisms, if provided, are mounted preferably on the base frame. A lowered mounting configuration involving an upper drive bearing is also possible as an option.

Motor-operated mechanisms are described in separate operating instructions.

2.3 Method of Operation

For the following description of the principle of operation, please refer also to Figures 1.1 and 1.2.

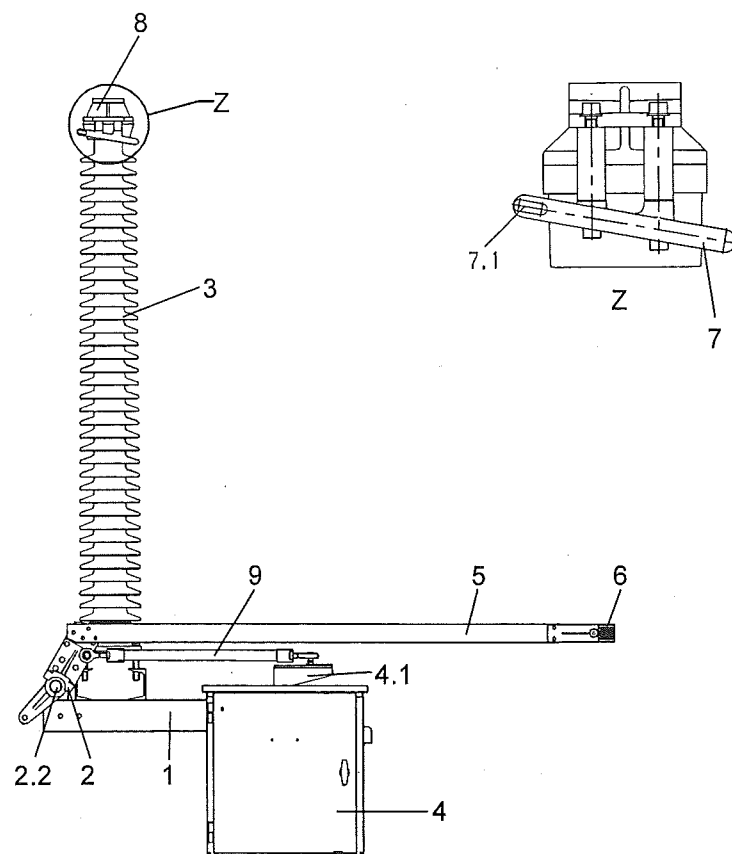
When the operating mechanism (4) is actuated, the rotary motion of the mechanism shaft is converted via the mechanism rocker arm (4.1), the mechanism linkage (9), and the shaft (2.2) to a slewing motion of the conducting path (5) of the operated pole. In multipole earthing switches, the rotary motion of the shaft of the operated pole is transmitted by connecting linkages to the other poles. In side-by-side configurations, the connecting linkages are connected to the shafts by clamped couplings. In tandem configurations, the power is transmitted by means of thrust linkages.

When the contact fingers are spread apart on the fixed contact (7), the required contact force is built up by a contact spring. A self-cleaning effect occurs during both closing and opening of the contact system. Dirt deposits and coatings of ice are removed.

The angle of rotation of the mechanism rocker arm is 192° . Thus the mechanism linkage moves beyond the dead-center point to reach the two end positions and mechanically locks the earthing switch against the effects of external forces.

2.4 Special Options

- Mechanical interlock between disconnector and earthing switch
- Lowered motor-operated mechanism
- Mounting on wall or ceiling



- | | | | |
|-----|----------------------|-----|-----------------------|
| 1 | Base frame | 5 | Conducting path |
| 2 | Bearing block | 6 | Finger contact system |
| 2.2 | Shaft | 7 | Fixed contact |
| 3 | Post insulator | 7.1 | Stop |
| 4 | Operating mechanism | 8 | Terminal head |
| 4.1 | Mechanism rocker arm | 9 | Mechanism linkage |

Figure 1.1 a: Main components (I) with directly mounted operating mechanism

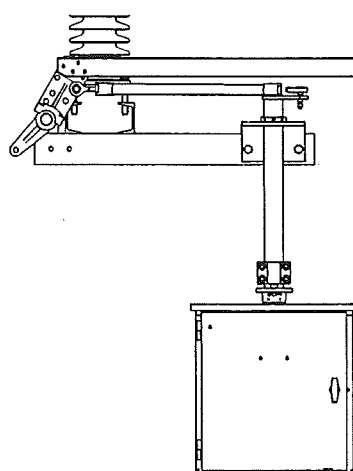
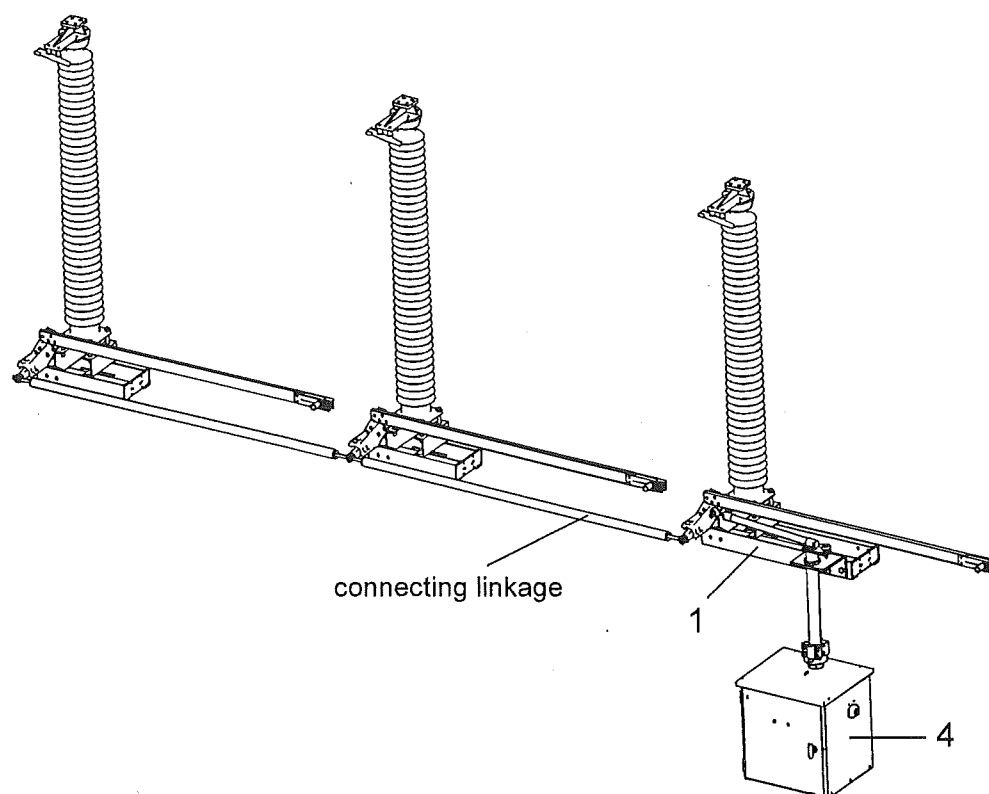


Figure 1.1 b: Operating mechanism in lowered position



- 1 Base frame
- 4 Operating mechanism

Figure 1.2: Main components (II) in tandem configuration

3 Transport and Storage

3.1 Packaging

For shipping purposes, earthing switches are broken down into the following subassemblies, which are easier to transport:

- Completely assembled and adjusted single-pole earthing-only switch, not including operating mechanism. Each pole is securely bolted to two square timbers to prevent tilting or tipping. Earthing-only switches are delivered in closed position, add-on earthing switches in open position.
- Operating mechanisms
- Connecting linkages and accessories

Packaging consists of timber beams, crates, or boxes. Operating mechanisms are shipped on pallets wrapped in sheeting. The number, dimensions, and weights of the packing units are given in the shipping documents. The manufacturer may select special types of packaging depending on the shipping route and the climatic conditions of the specific regions through which or to which the equipment will be shipped.

3.2 Transport and Handling

- Packing units must be transported to the installation site as intact packages.
- Secure the packing units to prevent tilting and shifting when loading them onto vehicles or other means of transport.
- Use hemp or synthetic rope for hoisting the subassemblies. The use of steel cable is prohibited since it may damage anti-corrosion coatings and porcelain insulators.
- Rope configuration (Figure 2) when handling post insulators: between the 3rd and 4th sheds of the post insulator.
- Check shipments against the shipping documents (packing list) for completeness and possible shipping damage. Notify both the freight carrier or forwarder and the manufacturer if there is any visible damage.
- Comply with the instruction and warning labels on the packaging.

3.3 Storage

- The operating mechanisms are delivered in separate transport units. They require special storage conditions. Always follow the instructions given in the mechanism operating manuals.

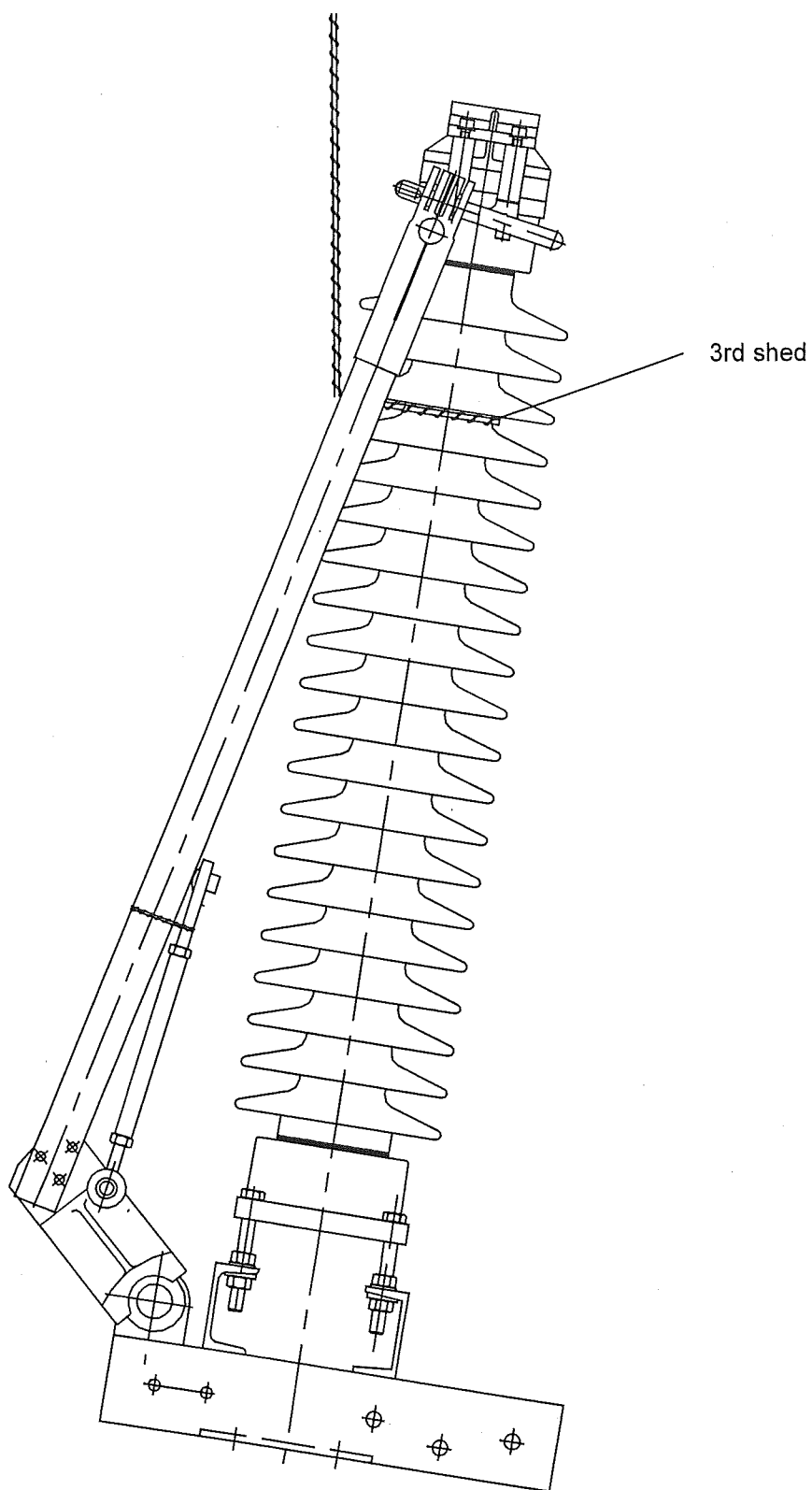


Figure 2: Rope configuration

4 Installation

4.1 General Instructions

Only personnel familiar with the contents of these operating instructions shall be permitted to assemble and install this equipment.

Earthing-only switches and add-on earthing switches have been assembled and adjusted at the factory. Add-on earthing switches are shipped as a unit together with the disconnecter. Operating mechanisms are shipped as separate transport units. On-site installation involves the following main steps:

- installing the earthing switches,
- mounting the operating mechanisms,
- connecting the mechanism linkages to the operating mechanisms and making adjustments,
- connecting and adjusting the connecting linkage between poles.

The serial number of the earthing switch is shown on the nameplates. Nameplates are located on the base frame of the operating pole and inside the mechanism covers.

4.2 Bolted Joints

Lubricate bolted joints with Molykote BR 2 Plus, a lubricating grease, before assembly. Apply it to the thread flanks and to the contact surfaces between nut and washer. Tighten all bolted joints using a torque wrench. Always apply torque to the nut. The required tightening torques are given in the following table.

Thread	Tightening Torque [Nm]		
	Strength Class		
	8.8	A2-70	A2-80
M6	10	10	14
M8	25	25	33
M10	49	49	65
M12	86	83	110
M14 x 1.5	---	140	---
M16	210	202	270
M20	410	394	525
M24	710	377	---

4.3 Installing Earthing-Only Switches

Proceed as follows:

- Remove the shipping packaging.
- Clean the contacts and lubricate them with Molykote BR 2 Plus, a lubricating grease (unless contacts are maintenance-free).
- Place the poles on the support structures in accordance with pole labeling.
- Align the base frames of multipole switchgear:
 - + Equal distance between poles
 - + Parallel alignment for side-by-side configuration, maximum deviation from parallelism 3 mm
 - + In line for tandem configuration, maximum lateral deviation 3 mm
 - + Top surface of base frames must be in-plane and level, maximum height deviation 3 mm at rated voltage.
- Fasten the base frame to the support structure using bolts, washers and nuts, and re-check the adjustment of adjacent poles. The fasteners are not supplied with the equipment.

4.4 Mounting the Operating Mechanism

Mounting the Mechanism on the Base Frame

- Match up the operating mechanism with the corresponding operating pole as shown in the dimension drawing.
- Mount the operating mechanism in the three holes in the base frame that are provided for this purpose. Make sure that the plane of movement of the mechanism rocker arm is parallel to the plane of the base frame. Adjust the position of the operating mechanism by inserting shims, if necessary.

Mounting the Mechanism in Lowered Position

The standard option for mounting an operating mechanism in lowered position below the base frame is shown in Figure 3 and applies both to motor-operated and manually operated mechanisms:

- Fasten the bracket (30) to the holes in the base frame (1) using hexagon bolts (29). This bracket supports the bearing for the extension of the mechanism shaft.
- Fasten the operating mechanism to its support structure (not supplied with the equipment).

Note

In order to mount operating mechanisms in lowered position, the mechanism tube must be shortened to the proper length. Surface protection (cold galvanizing) must then be applied to the cut face of the tube.

- Move the operating mechanism to closed position. Then turn the tube until the mechanism rocker arm (4.1) is also in closed position. Before the mechanism tube can be connected to the operating mechanism, the thrust bearing must be fitted onto the mechanism tube from below in the following sequence:
 - Thrust washer
 - Thrust bearing ring
- Connect the mechanism tube (25) to the operating mechanism by means of the mechanism coupling (26).
- Tighten the bolts to the specified torque. Make sure to maintain the alignment dimensions given in Figure 6. It may be necessary to utilize the clearance in the holes for fastening the bracket (30) to the base frame (1).
- Make sure that the axes of the operating shaft (27) and the mechanism tube are aligned and at right angles to the upper surface of the base frame. Adjust the position of the operating mechanism by inserting shims, if necessary.

4.5 Operating Linkages

As-Delivered Assembly Condition

- The mechanism linkage (9) of the earthing switch is mounted on the operating lever (9.1).
- The connecting linkages to be installed between the poles of multipole earthing switches are packaged separately.

4.6 Mounting the Thrust Bearing

- Push the thrust bearing ring and thrust washer up against the bracket until the position shown in Figure 3 is reached.
- Insert a setscrew on one side and tighten it slightly so that the thrust bearing ring can no longer slide.
- Using a 7.2-diameter drill bit, drill a hole through the opposite side into the mechanism tube.
- Insert the setscrew and tighten it slightly (until the point engages in the drilled hole).
- Drill a hole in the opposite side.
- Then connect the thrust bearing to the mechanism tube using the setscrews.

Note

Tightening torque for setscrews: 10 Nm. Lock the screws with Loctite blue (locking adhesive). Apply surface protection to drilled holes before final assembly.

4.7 Adjusting the Mechanism Linkages

Adjustment of the mechanism linkages (Figures 4 and 5) ensures that the end positions (closed or open) of the earthing switch on the operated pole are reached exactly and that dead-center interlocking occurs in both end positions. This is done by adjusting an eccentric bushing (31) in the mechanism rocker arm (4.1).

The following adjustment instructions apply both to motor-operated mechanisms mounted on the base frame and to motor-operated or manually operated mechanisms mounted in lowered position.

Note

When the operating mechanism is mounted in lowered position, there is only one half of an eccentric bushing (Figure 4 b).

To adjust, loosen the bottom nut until the eccentric bushing can be turned (adjust as for the operating mechanism mounted directly on the base frame).

Tighten the bottom nut to the proper torque. Hold the top nut steady using an open-end wrench.

Figure 4 shows a side view of the area where the mechanism linkage is connected to the mechanism rocker arm (4.1), and Figure 5 shows a top view of the same area.

Carry out the following steps:

- Move the disconnecter pole, if there is one, to the open position.
Note: The mechanism rocker arm (4.1) on the operating mechanism will be in open position when delivered.
- Move the conducting path (5) on the operated earthing switch pole to the open position.
- Insert the bolt (33) mounted on the mechanism linkage (9) and the eccentric bushing into the mechanism rocker arm by unscrewing the two hexagon nuts (32). Set the eccentric bushing at 0° so that the shortest possible mechanism rocker arm radius is achieved.
- If necessary, re-adjust the operating mechanism in the holes in the base frame (1).
- Slowly close the conducting path manually and check to see whether the finger contact system (6) is resting against the stop (7.1) on the fixed contact (7).
- If the stop is not reached, open the conducting path again and proceed as follows:
 - Loosen the mechanism linkage again, turn the eccentric bushing clockwise 45°, and then re-tighten the mechanism linkage.
 - Repeat these steps (in 45° increments) until the finger contact system rests against the stop (7.1) on the fixed contact.

4.8 Connecting the Earthing Switch Poles

The following specifications given in sections 4.8.1 and 4.8.2 regarding dimension X (Figure 6, detail Z) only apply when the operating mechanism is mounted on the middle pole. If the operating mechanism is mounted on an outer pole, then set dimension 2*X on the operated pole, dimension X on the middle pole, and make sure that the contact system on the non-operated outer pole completely touches the stop of the fixed contact.

4.8.1 Connection in Side-by-Side Configuration

1. Depending on the position of the operated earthing switch pole (i.e. middle or outer pole), move the conducting path manually to closed position so that the finger contact system (6) either rests against the stop (7.1) or is separated from the stop (7.1) by distance X, as shown in Figure 6.
Note: Dimension X may only be measured during the closing motion. If the finger contact system has been moved too far onto the fixed contact, move the finger contact system completely away from the fixed contact and then execute the closing motion again.
2. Once all finger contact systems are aligned with the fixed contact stop, insert the mechanism tube (25) in the mechanism coupling (26) and fasten it.
3. By operating the earthing switch manually, check to see whether all finger contact systems of the earthing switch are resting against the fixed contact stops when the operating mechanism is in closed position.
4. If any of the stops are not reached, open the earthing switch again and proceed as follows:
 - a) Loosen the mechanism linkage (9) again, turn the eccentric bushing (31) clockwise (Figure 4), and then re-tighten the mechanism linkage (9).
 - b) If the maximum mechanism rocker arm radius is reached, then readjust by increasing the length of the mechanism linkage (9).
5. If only one pole has not reached final position, then dimension X must be checked and adjusted, if necessary.

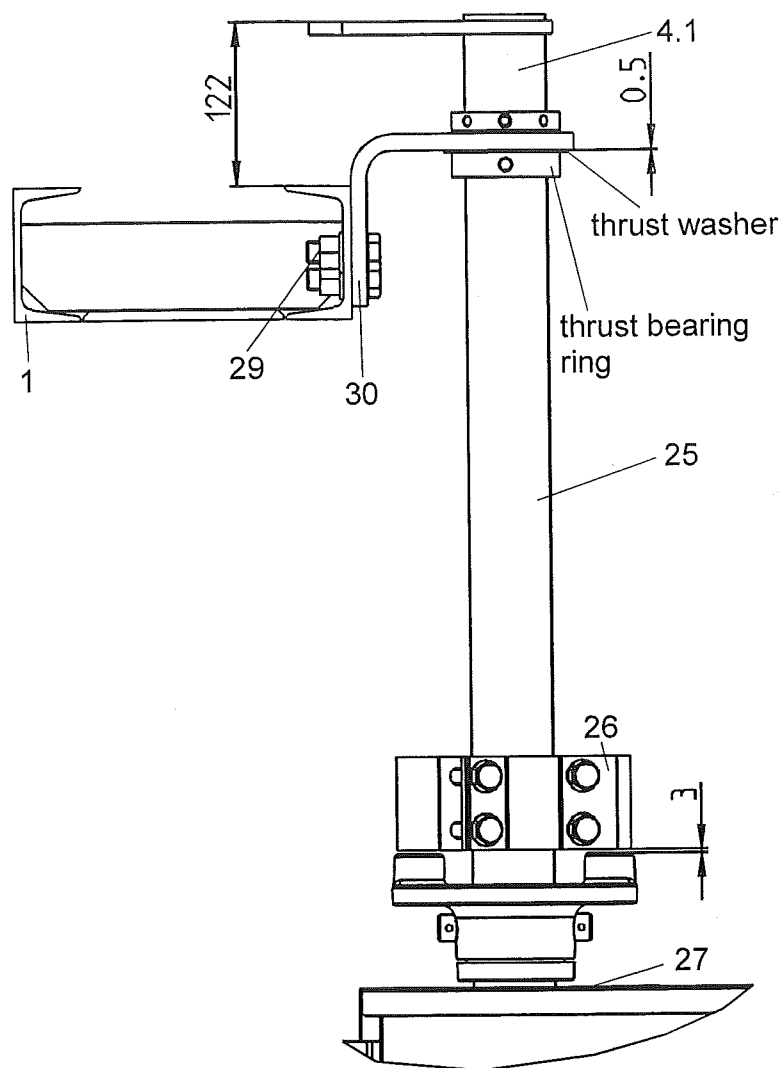
4.8.2 Connection in Tandem Configuration

1. Depending on the position of the operated earthing switch pole, move the current path manually to closed position so that the finger contact system (6) either rests against the stop (7.1) or is separated from the stop by distance X, as shown in Figure 6.
2. Once all finger contact systems are aligned with the fixed contact stop, proceed as follows:
 - c) Unscrew the hexagon bolts (40) from all stud bolts (38).
 - d) Remove the plate seal (39).
 - e) Connect the connecting rods to the connecting linkage (35) at the double eyebolt and adjust the length to correspond to the center-to-center distance between poles.
 - f) Place the eyebolts (37) of the connecting linkage on the stud bolts, mount the plate seals, and fasten using the hexagon bolts.
3. By operating the earthing switch manually, check to see whether all finger contact systems of the earthing switch are resting against the fixed contact stops when the operating mechanism is in closed position.
4. If any of the stops are not reached, open the earthing switch again and proceed as follows:
 - g) Loosen the mechanism linkage again, turn the eccentric bushing (31) clockwise (Figure 4), and then re-tighten the mechanism linkage.
 - h) If the maximum mechanism rocker arm radius is reached, then readjust by increasing the length of the mechanism linkage.
5. If only one pole has not reached final position, then dimension X must be checked and adjusted, if necessary.

4.9 Completing Installation

- Check to make sure that all bolted joints have been tightened to the required tightening torques (see Section 4.2) during installation and adjustment.
- Before connecting the high voltage lines, brush all aluminum terminal faces and then immediately apply a thin coating of SF 1377 silicone grease and connect the lines.
- Connect the earth (ground) conductors after first cleaning and lubricating the terminal faces.
- Connect the control and supply voltages to the terminal strips of the operating mechanisms.
- Check all electrical functions.
- Touch up any surface finish damage that may have occurred during installation. Use the paint supplied with the equipment.
- Perform several test operations manually in order to check the movement sequences.

Do not operate the control contactors of the motor-operated mechanisms manually.



- | | | | |
|-----|---|----|---|
| 1 | Base frame | 27 | Operating shaft |
| 4.1 | Mechanism rocker arm | 29 | Hexagon bolts M16x45
(with washers and hexagon nuts) |
| 25 | Mechanism tube | 30 | Bracket |
| 26 | Mechanism coupling
(with hexagon nuts and
clamping members) | | |

Figure 3: Mounting a lowered operating mechanism
(motor-operated or manually operated mechanism)

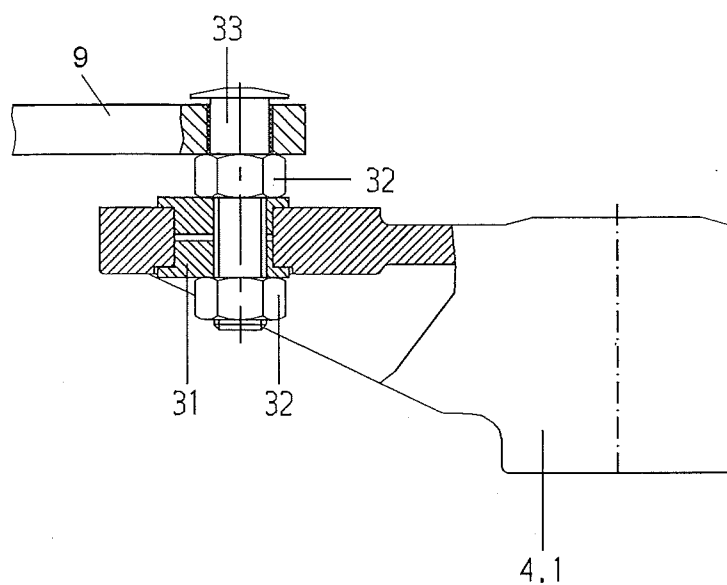
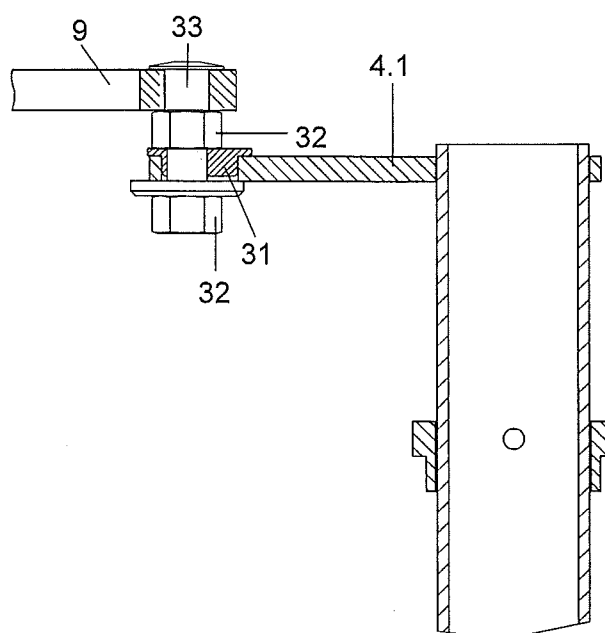
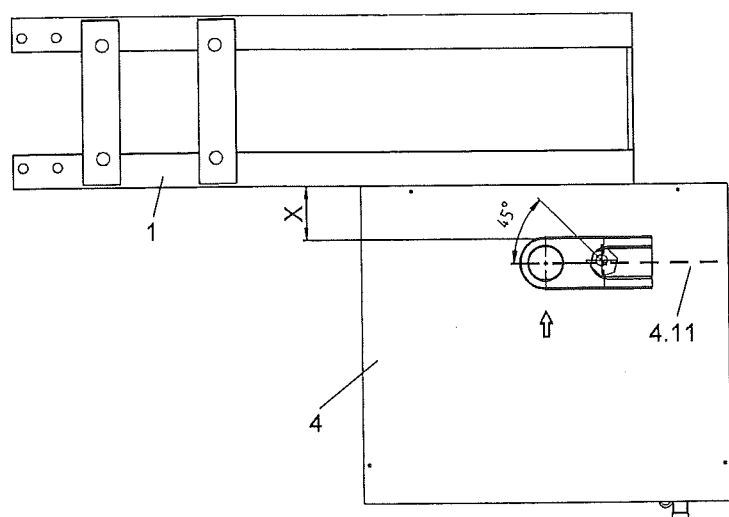


Figure 4 a: Connecting the mechanism linkage when mechanism is mounted on base frame



- | | | | |
|-----|----------------------|----|-------------|
| 4.1 | Mechanism rocker arm | 32 | Hexagon nut |
| 9 | Mechanism linkage | 33 | Bolt |
| 31 | Eccentric bushing | | |

Figure 4 b: Connecting the mechanism linkage when mechanism is in lowered position



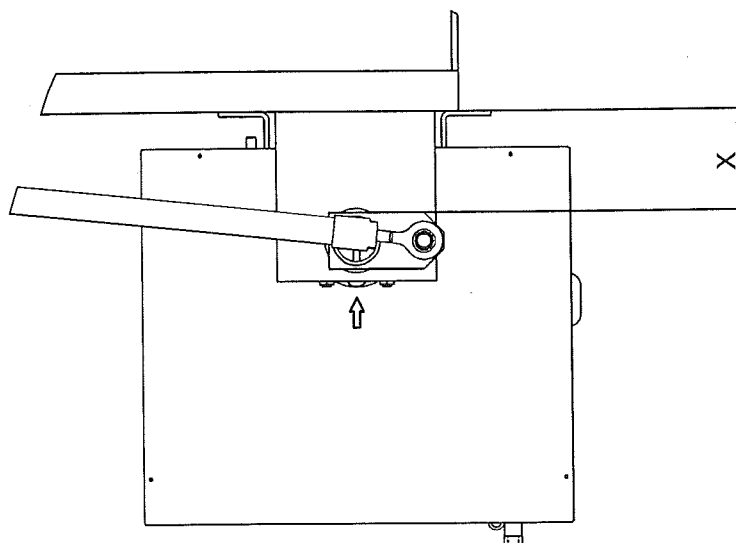
S = thickness of intermediate plate, $X = 79 + S$

1 Base frame

4.11 Longitudinal axis of mechanism
rocker arm

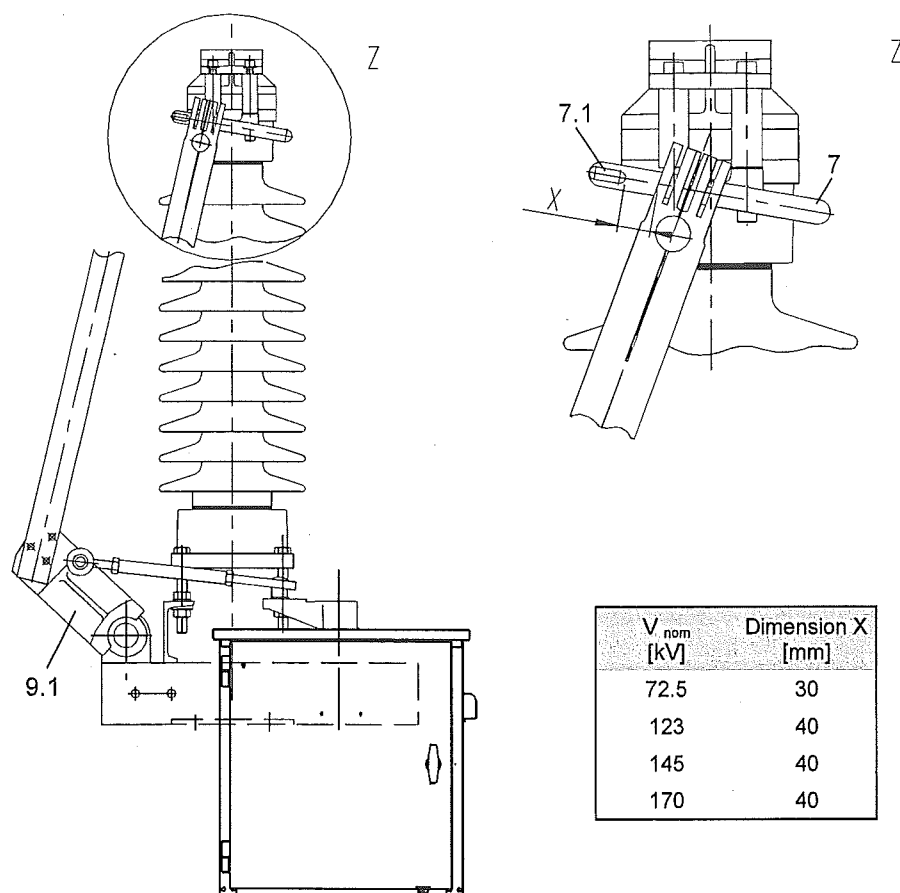
4 Operating mechanism

Figure 5 a: Operating mechanism mounted directly on base frame



S = thickness of intermediate plate, $X = 125 + S$

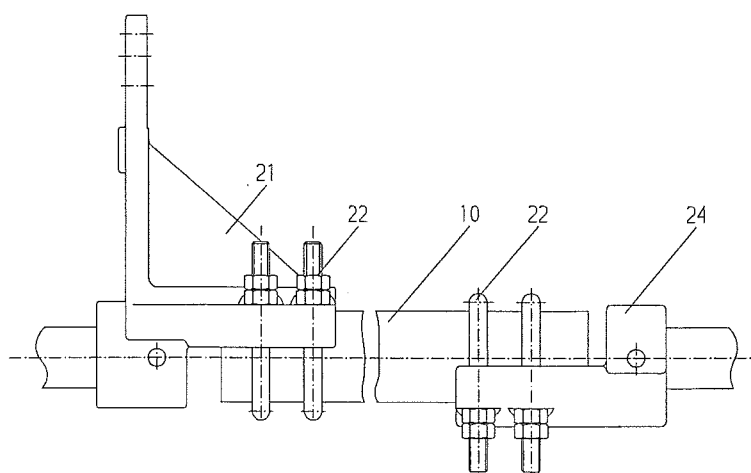
Figure 5 b: Operating mechanism mounted in lowered position



7 Fixed contact
7.1 Stop

9.1 Operating lever

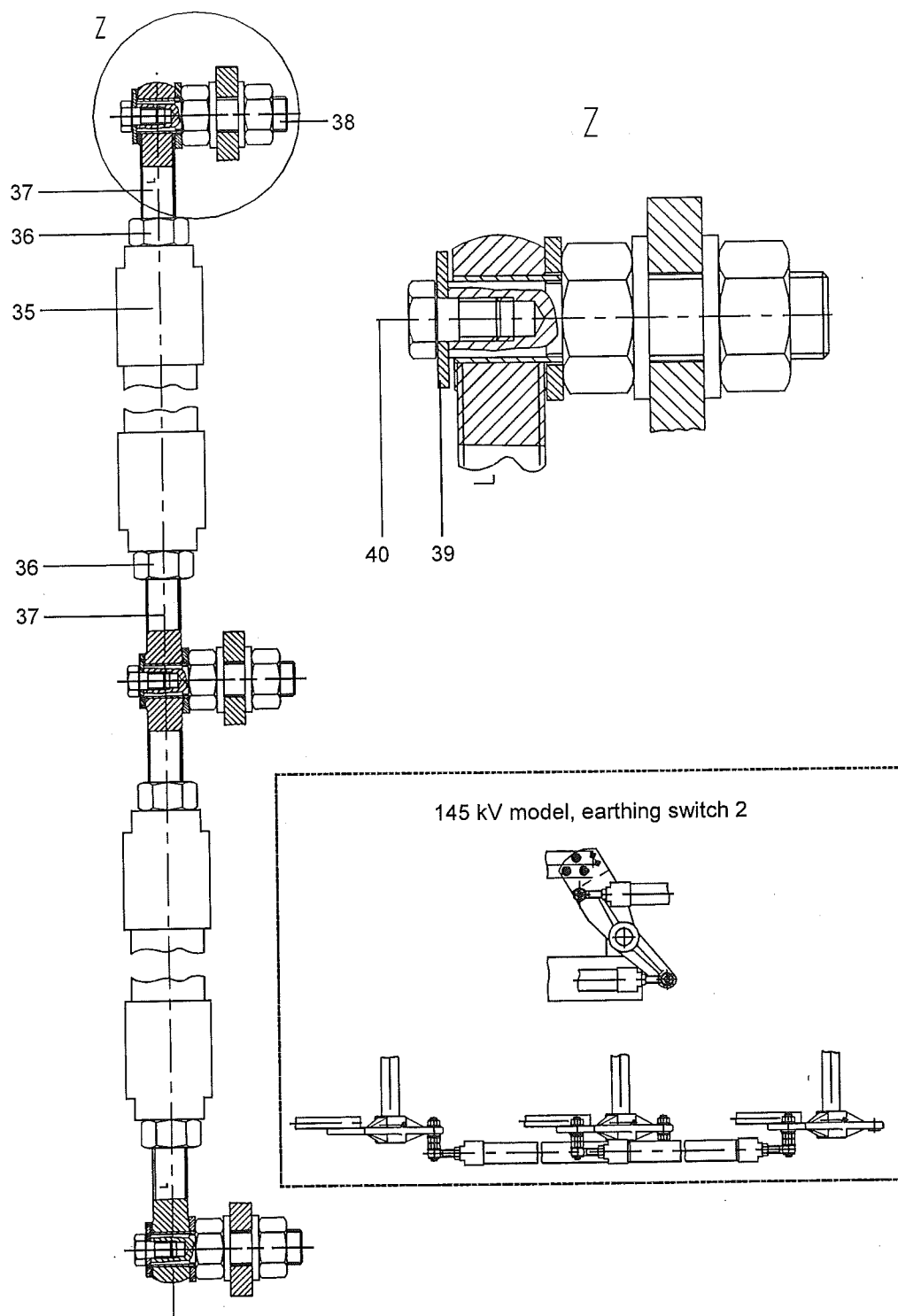
Figure 6: Alignment dimension for connection



10 Coupling shaft
21 Conducting path clamp

22 U-bolts (with hexagon nuts and washers)
24 Coupling shaft clamp

Figure 7: Connecting linkage for side-by-side configuration



35	Connecting linkage for earthing switch	38	Stud bolt (M16, with hexagon nut and washer)
36	Hexagon nut (M16)	39	Plate seal
37	Eyebolt (M16)	40	Hexagon bolt (M8x12)

Figure 8: Connecting linkage for tandem configuration

5 Maintenance

Under normal conditions, the equipment must be serviced about every 5 years. Service shall include the following procedures at a minimum:

- Inspect the equipment visually for damage caused by unacceptable external influences.
- Clean the insulators.
- Inspect the paint finish and touch up, if necessary.
- Clean and lubricate the main contact system with Molykote BR 2 Plus (not necessary with maintenance-free contacts).
- Check all electric control functions.
- Perform test operations.
- Check to make sure the vent holes on the operating mechanisms are not stopped up.

Required Materials

- Molykote BR 2 Plus lubricating grease (not required with maintenance-free contacts)
- SF 1377 silicone grease

6 Inspections

Perform inspections

- at intervals of 5-10 years, depending on operating conditions;
- when the operating frequency is very high, but after 2,000 operations maximum;
- after several instances of stress approximating the rated short-time current;
- when environmental conditions have been severe.

Procedures to be performed:

- Check the main contact system and replace it if major wear is found.
- Check the bearing shaft to make sure it moves easily.

7 Replacement Parts

- Contact system (6) including fixed contact
- Post insulators
- Molykote BR 2 Plus lubricating grease (not necessary with maintenance-free contacts)
- SF 1377 silicone grease
- Motor-operated mechanism (see separate operating instructions)

In the event of questions, orders for replacement parts, or equipment malfunction, please contact your nearest AREVA representative, citing the information listed on the nameplate.