The installation, connection, operation, checking, commissioning, decommissioning and maintaining of medium-voltage switchgear should only be carried out by suitably qualified personnel.
<table>
<thead>
<tr>
<th>Administrative data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Issue number:</td>
</tr>
<tr>
<td>Date of issue:</td>
</tr>
<tr>
<td>Language:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Checked by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position:</td>
</tr>
<tr>
<td>Name:</td>
</tr>
<tr>
<td>Date:</td>
</tr>
<tr>
<td>Initials:</td>
</tr>
</tbody>
</table>
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1. INTRODUCTION

1.1 General description of the system

The SVS/08 system is a metal-enclosed, epoxy resin insulated switchgear system with fixed vacuum circuit breakers. The system is suitable not only for electricity companies, but also for industrial and utility connections. The system is suitable for the medium voltage range, namely for rated voltages up to a maximum of 24 kV, with the panels operating at a rated current of 630 A.

1.1.1 Modular construction

The SVS/08 system is based on a modular concept. This means that any combination and sequence of panels is possible. A system is supplied in sections of maximum 6 panels. The sections are mounted, assembled, wired and tested as complete units. The modular construction means that existing systems can also be extended with one or more panels.

1.1.2 Design

The SVS/08 system complies with current regulations regarding safety, operating reliability and the environment. The main design features are summarised below.

Insulation

The primary components under voltage are epoxy resin insulated. This prevents faults due to open arcing. All connections between the primary components are provided with rubber sleeves. This ensures that the same level of insulation safety is maintained throughout the system. As such the SVS/08 system is classified under the "LSC2B - PI" (IEC 62271-200) category. The earthed metal enclosure guarantees the safety of personnel during normal operation (IEC 62271-200).

Mechanical interlocks

Thanks to built-in, mechanical interlocks, activities such as the earthing of cables and changing of fuses can only be carried out in a safe manner. The mechanical interlocks also mean that improper switching actions are impossible.

Connections

The SVS/08 panels can be connected in three ways:

- Via cables with T-plug connectors. For this the SVS/08 has connection cones (DIN 47636 and CENELEC pr EN 50181/1994).
- With Eaton Magnefix cable boxes, max 12 kV. In this case the SVS/08 is fitted with locked cable entry ports. These remain closed until the cable is safely earthed.
- With terminal blocks with locked cable entry ports for cable lug connection, max. 12 kV.

Materials

In accordance with current requirements, all materials used in the SVS/08 system are environment-friendly, not only while in use but also at the end of their technical service life.

Transport

An SVS/08 system can be transported in sections of maximum 6 panels. Each section has four integrated lifting eyes and must be lifted with a traversing hoist or similar unit. If no lifting facilities are present, the sections can also be transported with a fork lift truck, with braces and transport wheels or with steel rollers.

Set-up

The panels must be positioned on a level floor and secured with wedge bolts. All assembly work is carried out from the front of the system.

1.1.3 Operation

Each panel is equipped with an operation panel. This contains the mimic diagram and the necessary controls and indicators. The type of panel is clearly recognisable from the mimic diagram.

1.1.4 Separate compartment for secondary equipment

Secondary equipment, such as protection relays and measuring instruments, can be accommodated in a separate compartment on top of the panel. The auxiliary cables are connected to the terminal strips which are also in this compartment.
1.2 Using this manual

1.2.1 Target group

The SVS/08 system is designed to be used by personnel who are expert or adequately trained in carrying out electrical operations. These persons include: authorised personnel, shift leaders, operators and other responsible experts. For definitions of these terms, see Chapter 8 Glossary. This user manual takes into account this target group.

1.2.2 Structure of the manual

The manual contains 9 chapters. Chapters 1 and 2 contain general information about the system (design and construction), the manual and general safety aspects. The information is presented in the form of descriptive texts, supported by illustrations as necessary. Illustrations are numbered consecutively for each chapter, and are captioned if necessary. Chapters 3 to 7 consist mainly of step-by-step procedures. These procedures contain step-by-step descriptions of actions in the order in which they should be carried out. Illustrations are on the same page as the relevant step and have the same number.

Tip
Read through all actions first, using the relevant figures. Contact Eaton if you do not understand what you have to do.

Note
Never take any action without knowing what effect it will have.

Further information regarding Chapters 3 to 7 is given below.

• Chapter 3 – Setting up the system
  This chapter contains instructions on transport, assembly. It also describes the requirements for the switchroom and provides an overview of possible connection configurations.

• Chapter 4 - System operation
  This chapter is aimed at the operator who is expected to operate and monitor the system independently. For that reason, these activities are described in detail.

• Chapter 5 - System commissioning and decommissioning
  Chapter 5.1 sets out the actions required before the system can be commissioned. These actions should be carried out in conjunction with Eaton. Chapter 5.2 deals with decommissioning the system. It also includes recommendations for the safe disposal of the system.

• Chapter 6 - Inspection, maintenance and repair of the system
  This chapter only describes those operations that may be carried out by the user.

Note
Operations not included in the manual must be carried out by or under the supervision of Eaton.

• Chapter 7 – Accessories
  This chapter contains a list of available accessories.

The other chapters, namely 8 and 9, are by way of general explanation.

• Chapter 8 - Glossary
  This chapter contains short descriptions of specific terms used in the manual but not explained further.

• Chapter 9 – Appendices
1.2.3 Applicable regulations

The SVS/08 switchgear has been designed in compliance with EU safety directives.

The SVS/08 switchgear satisfies:
- **IEC 62271-1**: Common specifications for high voltage switchgear and control gear standards (prHD448).
- **IEC 62271-100**: High voltage alternating current circuit breakers, as circuit-breakers.
- **IEC 62271-102**: Alternating current disconnectors and earthing switches.
- **IEC 60265-1**: High voltage switches for rated voltages above 1 kV and less than 52 kV, as a switch combination for general use.
- **IEC 62271-105**: High voltage alternating current switch-fuse combinations, as a switch with fuses.
- **IEC 62271-200**: Alternating current metal enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV, in the LSC 2B-PI version based on the insulated connections method.
- **IEC 62271-201**: Insulation enclosed switchgear <= 38 kV
- **IEC 62271-308**: Additional requirements for enclosed switchgear and control gear from 1 kV to 72.5 kV to be used in severe climatic conditions.

1.3 Safety instructions

1.3.1 Safety measures

Safety measures are a combination of the safety aspects incorporated into the design of the system, and the precautions to be taken before and during use.

A. DESIGN

A number of aspects are mentioned below. These are explained in Chapters 1.1 and 4.1.

A.1 Safe
- Earthed metal enclosure and full primary insulation protect against electric shock
- Mechanical interlocks prevent unauthorised switching operations.
- Continuous voltage indication
- Mechanical interlocks protect access to the cable connections for changing fuses and floor contacts
- Environment-friendly materials

A.2 User-friendly
- Uniform and simple operation panels
- Easy access to the cable connection
- Sufficient space for cable termination
- Easy to transport
- Easy to install in the operating area

B. USE

This includes aspects relating to:
- switchroom
- personnel
- execution of work
- fire-fighting

B.1 Switchroom

For the construction and related aspects of switchrooms, local regulations must be complied with.
Eaton also gives the following advice with regard to clear spaces, escape routes and entrances:

### Clear space

In front of switchgear installations or between two facing switchgear installations there must be a clear space along the whole length. This clear space must not be less than 1 m in front of the installation (1.5 m for a face-to-face arrangement).

For the height, a clear space of at least 2 m is required from the floor or the platform in front of the installation.

### Escape routes

In front of switchgear installations or between two facing switchgear installations there must be an escape route at least 0.5 m wide and 2 m high along the whole length. Escape routes must be as straight as possible.

There must be no projecting parts within these escape routes.

The height must be measured from the floor or from the platform in front of the switchgear.

### Dimensions

For the dimensions of the SVS/08 system see section 2.4.2.
**Entrances**

Entrances must be provided at suitable places to rooms in which switchgear installations are set up. These entrances must be at least 0.75 m wide and 2 m high. Finally, they must be accessible from the escape routes via connecting routes which are at least 0.5 m wide and 2 m high.

Doors must:
- open outwards.
- be able to be opened from the inside without tools.

**B.2 Personnel**

The installation, connection, operation, checking, commissioning and decommissioning and maintenance of SVS/08 medium-voltage switchgear should only be carried out by suitably qualified personnel.

**B.3 Execution of work**

- Work which may be carried out by the user independently or under the supervision of Eaton is described in this manual.

**NOTE**

Only this work may be carried out by the user, and the described procedures must be precisely followed.

- For work in which installations or parts of installations must be disconnected from the power supply, the working area must be clearly indicated.
- All parts that have not been made dead must remain closed and must carry warning signs on the front panel.
- Before starting work, be absolutely certain that the installation is dead.
- Once the work has been completed, only reconnect the installation when you are sure this can be done safely.
- Before removing safety measures put in place for the work, make sure that the work has been completed and finished in all the appropriate places and that all protection covers/guards have been fitted.

**B.4 Fire-fighting**

For the construction and related aspects, local regulations must be complied with.

- **Recommendations for the user:**
  - Before starting construction works or modifications, you must contact the local fire brigade to obtain approval of your design.
  - The manager of the system, in consultation with the fire brigade and other bodies, must prepare and maintain a safety plan indicating all steps to be taken in the event of a disaster.
  - Entrances to electrical switchrooms must be kept clear. Furthermore, clear spaces and escape routes must be kept free of obstacles.
  - Only materials belonging to the installation set up in electrical switchrooms may be stored there.
  - Flammable materials and propane or butane gas cylinders must not be stored in electrical switchrooms.
  - Fire-fighting must not begin until the whole system has been made dead. Attention must be paid to incoming cables, low-voltage cables, feedback via low-voltage side etc.
  - Extinguishing materials may conduct electrical current; personnel and bystanders may be electrocuted if, in contravention of the rules, attempts are made to extinguish a fire in a system that has not been made dead.
  - Water must not be used to put out fires in or near electrical switchrooms.
1.3.2 Explanation of warnings and symbols used

**DANGER OF DEATH**
There is a direct threat to the lives of the user and bystanders.

**WARNING**
The user can seriously injure himself or seriously damage the product. A warning means that the user can be injured or the product can be damaged if the user does not follow the procedures carefully.

**CAUTION**
The product may be in danger. Caution means that the product can be damaged if the user does not follow the procedures carefully.

**NOTE**
A comment with additional information for the user. The user’s attention is drawn to possible problems.

**TIP**
The user is given suggestions and advice to make certain tasks easier or more convenient.

1.3.3 Safety instructions and warnings

**A. Safety instructions**
**A.1 Organisational instructions**
It is up to the user to follow organisational instructions such as:
- assigning authority
- procedures for entering electrical switchrooms
- reporting procedures at the beginning and end of work
- stipulations relating to the execution of work
- drawing up a safety plan
- stating risks in the form of warnings on the system

All these items depend on the nature and policy of the business.

**A.2 Operational instructions**
Operational instructions are "system-specific" instructions and are set down in this manual. They are in the form of instructions (such as warnings, hazards etc.) which appear before or within the relevant operation in the step-by-step procedures. For a more detailed explanation see Chapter 2.3 Safety (system-specific).

**B. Warnings**
**B.1 Warning signs**
- Labels and warning and information signs must be clearly legible, affixed in clearly visible places and kept in good condition.
- When they are no longer necessary, they must be removed.
- Warnings must be brief and clear. The use of standardised expressions should be considered.
- Warning signs must never be mounted on live parts.

**B.2 Danger warnings**
What to do at a relative humidity of 99%?
Do not use the system if the relative humidity ≥ 99%.

What to do in case of flooding?
If the system is standing in water, leave the building at once and switch off the power supply to the system as soon as possible. There is a danger of electrocution due to the high step voltage.

What to do in case of fire?
Any fire gives off harmful gases and substances; obviously it is important to avoid exposure to these. The correct equipment must be used to fight fires (see also Chapter 1.3.1, B.4 - Fire-fighting).

The manager responsible for the installation must have a complete safety plan, specifying the appropriate measures.
1.4 Product information

The main system specifications are indicated on the type plates. Further information is available from the information package that includes this manual.

1.4.1 The type plate

A complete type plate is made up of a main type plate with supplementary type plates if required.

### Main type plate (example)

<table>
<thead>
<tr>
<th>Eaton Electric B.V. Medium Voltage</th>
<th>P.O. box 23, 7550 AA Hengelo, The Netherlands</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>M.V. SWITCHGEAR</strong></td>
<td><strong>IEC 62271-200</strong></td>
</tr>
<tr>
<td>system: SVS/08 rel.2.0</td>
<td>w.o. no. 301106 Serial no. 3625</td>
</tr>
<tr>
<td>Year of construction 2007</td>
<td>Instruction book reference 2.0</td>
</tr>
<tr>
<td>$U_e$ 17.5 kV $U_p$ 95 kV $U_d$ 38 kV $I_e$ 800 A $I_k$ 20 kA $t_k$ 1 s $U_a$ V</td>
<td>$I_{k,off}$ 630 A $I_o$ 50 kA</td>
</tr>
</tbody>
</table>

### Supplementary type plate for circuit-breaker (example)

<table>
<thead>
<tr>
<th>Eaton Electric B.V. Medium Voltage</th>
<th>P.O. box 23, 7550 AA Hengelo, The Netherlands</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Circuit-Breaker</strong></td>
<td><strong>IEC 62271-100</strong></td>
</tr>
<tr>
<td>Type NVS20BA-1706 r.2.0</td>
<td>class E2 C2</td>
</tr>
<tr>
<td>Operating sequence: O - 3min. – CO – 3min. - CO</td>
<td></td>
</tr>
<tr>
<td>$U_e$ 17.5 kV $U_p$ 95 kV $I_e$ 630 A $I_k$ 20 kA 35% $I_p$ 50 kA</td>
<td></td>
</tr>
<tr>
<td>$I_c$ 31.5 A $I_d$ 5 kA $t_k$ 1 s</td>
<td></td>
</tr>
</tbody>
</table>

### Supplementary type plate for switch (example)

<table>
<thead>
<tr>
<th>Eaton Electric B.V. Medium Voltage</th>
<th>P.O. box 23, 7550 AA Hengelo, The Netherlands</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General Purpose Switch</strong></td>
<td><strong>IEC 60265</strong></td>
</tr>
<tr>
<td>Type SVS14BA-1706 r.2.0</td>
<td>class E3</td>
</tr>
<tr>
<td>$U_e$ 17.5 kV $U_p$ 95 kV $I_e$ 630 A $I_k$ 20 kA $t_k$ 1 s</td>
<td></td>
</tr>
<tr>
<td>$n$ 100 $I_{ma}$ 40 kA</td>
<td></td>
</tr>
</tbody>
</table>

### Supplementary type plate for switch-fuse combination panel (example)

<table>
<thead>
<tr>
<th>Eaton Electric B.V. Medium Voltage</th>
<th>P.O. box 23, 7550 AA Hengelo, The Netherlands</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Switch Fuse Combination</strong></td>
<td><strong>IEC 62271-105</strong></td>
</tr>
<tr>
<td>Type VSVS14BA-1706A1 r.2.0</td>
<td>Year of construction 2007</td>
</tr>
<tr>
<td>$U_e$ 17.5 kV $U_p$ 95 kV $I_e$ max A $I_{ma}$ 40 kA</td>
<td></td>
</tr>
</tbody>
</table>

The main type plate is headed with the Eaton logo and address. The main type plate is on the outside of the leftmost panel of the installation. The supplementary type plates are on the inside of the door of each individual panel and on the drawer of the secondary compartment. In addition, the panel number is noted on a sticker on the bottom of the top plate of the primary cable compartment (top right).
### Supplementary type plate for metering panel (example)

<table>
<thead>
<tr>
<th>Measuring panel</th>
<th>IEC 62271-200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year of construction</td>
<td>2007</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$U_r$</td>
<td>rated voltage</td>
<td>kV</td>
</tr>
<tr>
<td>$f_r$</td>
<td>rated frequency</td>
<td>Hz</td>
</tr>
<tr>
<td>$I_r$</td>
<td>rated normal current</td>
<td>A</td>
</tr>
<tr>
<td>$I_{\text{r,T-off}}$</td>
<td>rated normal current switch/circuitbreaker</td>
<td>A</td>
</tr>
<tr>
<td>$I_k$</td>
<td>rated short time withstand voltage</td>
<td>kA</td>
</tr>
<tr>
<td>$T_k$</td>
<td>rated duration of short-circuit</td>
<td>s</td>
</tr>
<tr>
<td>$I_p$</td>
<td>rated peak withstand current</td>
<td>kA</td>
</tr>
<tr>
<td>$U_{p, U_{\text{w}}}$</td>
<td>rated lightning impulse withstand voltage (peak value)</td>
<td>kV&lt;sub&gt;peak&lt;/sub&gt;</td>
</tr>
<tr>
<td>$U_d$</td>
<td>rated short-duration power-frequency withstand voltage (1 minute)</td>
<td>kV r.m.s.</td>
</tr>
<tr>
<td>$U_a$</td>
<td>rated supply voltage of auxiliary circuits</td>
<td>V</td>
</tr>
<tr>
<td>$I_{\text{ma}}$</td>
<td>rated short-circuit making current</td>
<td>kA</td>
</tr>
<tr>
<td>$I_{\text{ic}}$</td>
<td>rated short-circuit breaking current</td>
<td>kA</td>
</tr>
<tr>
<td>$I_s$</td>
<td>rated cable-charging breaking current</td>
<td>A</td>
</tr>
<tr>
<td>$I_d$</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>$n$</td>
<td>number of operations for mainly active load breaking</td>
<td>-</td>
</tr>
</tbody>
</table>

**Table 1: Explanation of information on the type plate in accordance with IEC**
1.4.2 Radiation and noise emission

Radiation
For the vacuum interrupters installed in the Innovac SVS/08 system, a type approval is available. They satisfy the requirements up to the level of the rated short time AC voltage as specified in the technical data (test voltage in accordance with IEC and VDE).

Noise
During normal use, the noise level does not exceed 70 dB(A). Therefore there is no legal requirement to wear ear protection. Nevertheless, personnel who carry out switching operations are strongly advised to wear ear protection such as earplugs or ear defenders.

1.4.3 Heating element
The Innovac SVS/08, as normally supplied, is suitable for use in power systems up to and including 12 kV under the conditions described in EN 62271-1.
In practice it appears that installations are not always set up in accordance with the applicable regulation EN 62271-1. Sometimes it is difficult to determine the environmental conditions and to ascertain which factors will have a positive influence. For that reason, a heating element is fitted on all 17.5 and 24 kV installations as standard. In some cases, a power supply may not be available for the heating element. In such cases the client must lay on a power supply for the heating element, or take steps to ensure that the environmental requirements described in EN 62271-1 are satisfied. If these environmental requirements are met, there is no need to connect the heating element.
The user manual contains clear guidelines for improving the environmental conditions (see Chapter 3.1).

1.4.4 Referral to the documentation package
See the electrical section of the documentation package supplied with the order.
2. SYSTEM DESCRIPTION

2.1 The system

2.1.1 Panel types

Switch panel | Circuit-breaker panel | Switch-fuse combination panel | Bus-section panel | Bus-section panel

Switch | Circuit-breaker | Switch-fuse combination | Bus-section | Bus-section

Panel

| * A switch and switch-fuse combination panel can also be fitted with voltage transformers.
1. Installation comprising various panel types

1. Operation panel of a switch panel and circuit-breaker panel (standard version)
2. Operation panel of a switch panel and circuit-breaker panel (with various options)
3. Operation panel of a bus-section panel
4. Operation panel of a switch-fuse combination panel
5. Protection cover for cables and/or fuses
6. Type plate per panel (inside door)
7. Main type plate for installation (outer side)
8. Instrument compartment (400 mm high)
9. Instrument compartment (200 mm high)
10. Lifting eyes (lifting eyes are positioned between the fields). Position depends on the panel composition. The lifting eyes are indicated by a label.
11. Foundation frame

Note:
For a description of the operation panels see Chapter 4 System operation.
2.2 Description of the panels

2.2.1 Circuit-breaker panel
A circuit-breaker panel includes the following principal components as standard:
- a busbar system
- a disconnector
- a circuit-breaker
- one of the three connection possibilities:
  - three connection cones for T-connector (24 kV) (figure 1) or
  - a terminal block with locked cable entry ports for Eaton Magnefix cable boxes (12 kV) (figure 2)
  - three terminal blocks with locked cable entry ports for cable lug connection 12 kV (figure 3)
- an operating mechanism
- an operation panel

Options
The following options are available as standard:
- auxiliary contacts for switch and disconnector
- electrical opening and closing of the switch
- cable side voltage transformers
- cable side overvoltage arrestors
- secondary instrument compartment
- current transformers, secondary equipment

Applications of standard version
- Incoming and outgoing feeder panels
- Generator panels
- Motor panels
- Transformer panels

Special version
- Circuit-breaker with integrated protection. No separate auxiliary voltage is needed, since the current transformers supply the power for opening.

Applications of special version
- Protected transformer panel or cable panel in stations without auxiliary voltage

CONNECTION OF SECONDARY WIRING
For the position of the terminals for the secondary wiring see Chapter 2.2.2, figure 4.
2.2.2 Switch panel

A switch panel includes the following principal components as standard:
- a busbar system
- a disconnector
- a switch
- one of the three connection possibilities:
  - three connection cones for T-connector (24 kV) (figure 1) or
  - a terminal block with locked cable entry ports for Eaton Magnefix cable boxes (12 kV) (figure 2)
  - three terminal blocks with locked cable entry ports for cable lug connection 12 kV (figure 3)
- an operating mechanism
- an operation panel

Options

The following options are available as standard:
- self-resetting overcurrent indicator
- auxiliary contacts for switch and disconnector
- electrical opening and closing of the circuit-breaker
- cable side voltage transformers
- cable side overvoltage arrestors
- secondary instrument compartment
- current transformers, secondary equipment

Application

- Ring cable panels, spur cable panels
- Incoming feeder panels

Connection of secondary wiring

See figure 4.

1. Location of the terminals

This shows a cable panel
2.2.3 Switch-fuse combination panel

A switch-fuse combination panel includes the following principal components as standard:

- a busbar system
- a disconnector
- a switch
- three fuse holders:
  - for fuses on 12 kV version (figure 1) or
  - for fuses on 24 kV version (figure 2) or
- one of the two connection possibilities:
  - for 12 kV version (figure 1); cable connections for paper-insulated lead-covered cables and plastic-insulated cables via Eaton Magnefix cable boxes
  - for 24 kV version (figure 2); cable connections for plastic-insulated cables directly under the fuse holder
- an operating mechanism
- an operation panel

Options

The following options are available as standard:

12 kV version:
- auxiliary contacts for switch and disconnector
- auxiliary contacts for fuses
- electrical opening and closing of the circuit-breaker

24 kV version:
- auxiliary contacts for switch and disconnector
- auxiliary contacts for fuses
- electrical opening and closing of the circuit-breaker
- fuses with 10/12 kV dimensions can be used with an adapter
- plug connector for plastic-insulated cable can be used with an adapter
- cable side voltage indication

Application

- Outgoing panels to transformers, protected with fuses.

The switch disconnects in three poles after one or more fuses blow.

Connection of secondary wiring

- The secondary wiring can be connected to the terminals in the compartment at the top of the installation. See figure 3.
2.2.4 **Bus-section panel with switch or circuit-breaker**

A bus-section panel (figure 1) includes the following principal components as standard:
- a busbar system
- a disconnector
- a switch or a circuit-breaker
- an operating mechanism
- an operation panel

**Options**
The following options are available as standard:
- auxiliary contacts for switch and disconnector
- electrical opening and closing of the circuit-breaker
- secondary instrument compartment
- current transformers, secondary equipment

**Application**
- Interruption between the supply section of the electricity company and the user
- Sectioning of an installation with different feeder panels

**Special version for a bus-section panel with circuit-breaker**
- Circuit-breaker with integrated protection. No separate auxiliary voltage is needed, since the current transformers supply the power for opening.

**Applications of special version**
- Protected bus-section panel in stations where no auxiliary voltage is available.

**Connection of secondary wiring**
- For connecting secondary wiring see Chapter 2.2.2, figure 4.
2.2.5 Metering panel

A metering panel (figure 1) fitted with current and voltage transformers can be included in the busbar system. A metering panel is equipped as standard with:

- epoxy resin insulated voltage transformers. The voltage transformers are connected - on the primary side - directly to the main busbar, in such a way as to ensure that no spark voltages can develop at the connections (this makes primary fuses unnecessary).
- earthed or insulated primary star point
- fuses or installation circuit-breakers on the secondary side if necessary
- epoxy-resin-insulated current transformers, equipped with ring core with secondary windings
- Secondary instrument compartment

Options

- Secondary equipment (protection relays, voltmeters and ammeters)

Application

- Current measurement
- Voltage measurement
- kWh measurement for billing and monitoring

**NOTE**

The short-circuit capacity of the metering panel depends on the transformation ratio. See the one-line diagram or the panel type plate on the installation for the actual value.
2.2.6 Busbar connection panel

A busbar connection panel (figure 1) consists of a busbar system to which a cable can be directly connected. For this the panel is equipped with one of the standard connection possibilities:

- three connection cones for applying T-connectors (24 kV)
- a cable terminal block for applying Eaton Magnefix cable boxes (17.5 kV)
- three terminal blocks for cable lug connection (17.5 kV)

Options

- Cable side voltage transformers
- Cable side overvoltage arrestors
- Secondary instrument compartment
- Current transformers, secondary equipment

Application

- Direct connection with another installation or an adjoining section via a cable connection linked directly to the main busbars

Connection of secondary wiring

- See Chapter 2.2.2, figure 4.

2.2.7 Wall duct

The wall duct (figure 2) consisting of an epoxy resin insulated busbar system with an earthed metal enclosure. It is used as a connection between two parts of an installation, with protection in-between, for example in the form of a separating wall.
2.3 Safety (system-specific)

2.3.1 Interlocks

Definitions
- Service position: In the service position the cable is connected to the main busbar of the unit. This means:
  - The switch or circuit-breaker is open and the disconnector is in the busbar position.
- Earthing position: the cable is earthed in the earthing position. This means:
  - The switch or circuit-breaker is open and the disconnector is in the earthing position.
- Disconnected position. This means:
  - The switch or circuit-breaker is closed and the disconnector is in the disconnected position.
- Tripped position. This means:
  - The switch or circuit-breaker is closed and the disconnector is in the busbar position.

Disconnector
- The disconnector can only be operated when the switch or circuit-breaker is open.

Switch panel or circuit-breaker panel
- The switch or circuit-breaker can only be closed if the disconnector is fully in the busbar position or fully in the earthing position.
- A panel has a padlock to prevent closing of:
  - the switch in the service position and in the earthing position;
  - the circuit-breaker only in the earthing position.
- As an option, an interlock can be provided on the access door of the cable compartment. This means that the door can only be opened in the earthing position. In this case, the switch can no longer be locked to prevent switching off in the service position.
- The cable entry port of the 17.5 kV cable terminal block can only be opened if the cable is earthed, that is to say, if the panel is in the earthing position.
- A scissor-type interlock with padlock is available as an option. This scissor-type interlock can be used to lock the switch or circuit-breaker in an intermediate position.

Bus-section panel
- On a bus-section panel, the switch or circuit-breaker cannot be closed if the disconnector is in the earthing position.
- The switch can be locked against opening with a padlock.
- The circuit-breaker cannot be locked with a padlock.

Metering panel
- A padlock can be provided on the access door of a metering panel.

2.3.2 Safety
System-specific safety instructions appear in this manual as instructions (such as warnings, hazards, etc.) before or within the relevant operation in the step-by-step procedures. The procedures describe what the user may do:
- The user must follow the procedures precisely and should only use the accessories supplied.
- The user must observe the safety instructions indicated before the relevant procedures or operations.
- No other activities whatsoever are permitted.
- When panels are open, the user is responsible for safety during work on the installation.

2.3.3 Noise and radiation

Noise
In general it can be stated that the switchgear does not generate any noise under operating conditions apart from switching operations. The noise during switching operations is less than 70 dB(A), meaning that noise protection measures are not required.

Radiation
Radiation is far below the safety standard level.
2.4 Technical data

2.4.1 Technical data

<table>
<thead>
<tr>
<th>type SVS/08</th>
<th>12</th>
<th>17.5</th>
<th>24</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated voltage (kV)</td>
<td>12</td>
<td>17.5</td>
<td>24</td>
</tr>
<tr>
<td>Impulse withstand voltage (kV)</td>
<td>75</td>
<td>95</td>
<td>125</td>
</tr>
<tr>
<td>Power frequency withstand voltage (kV)</td>
<td>28</td>
<td>38</td>
<td>50</td>
</tr>
<tr>
<td>Rated frequency (Hz)</td>
<td>50-60</td>
<td>50-60</td>
<td>50-60</td>
</tr>
<tr>
<td><strong>Busbar system</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated normal current (A)</td>
<td>800</td>
<td>800</td>
<td>800</td>
</tr>
<tr>
<td>Rated short-time current 1 s/3 s(^1) (kA)</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Rated peak withstand current (kA)</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td><strong>Switch</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated normal current (A)</td>
<td>630</td>
<td>630</td>
<td>630</td>
</tr>
<tr>
<td>Rated breaking current at cos (\phi) = 0.7 (A)</td>
<td>630</td>
<td>630</td>
<td>630</td>
</tr>
<tr>
<td>Rated short-circuit making current (kA)</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Rated short-time current 1 s/3 s(^1) (kA)</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td><strong>Switch-fuse combinations</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated normal current (A)</td>
<td>61/57</td>
<td>61</td>
<td>36</td>
</tr>
<tr>
<td>Rated breaking current (A)</td>
<td>630</td>
<td>630</td>
<td>630</td>
</tr>
<tr>
<td>Rated short-circuit making current (kA)</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Fuses in accordance with DIN 43625 (kV)</td>
<td>12</td>
<td>12/24</td>
<td>24</td>
</tr>
<tr>
<td><strong>Circuit-breaker</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated normal current (A)</td>
<td>630</td>
<td>630</td>
<td>630</td>
</tr>
<tr>
<td>Rated breaking current 1(^1) (kA)</td>
<td>16/20</td>
<td>16/20</td>
<td>16/20</td>
</tr>
<tr>
<td>Direct current component (%)</td>
<td>35</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>Rated short-circuit making current 1(^1) (kA)</td>
<td>40/50</td>
<td>40/50</td>
<td>40/50</td>
</tr>
<tr>
<td>Rated short-time current 1 s/3 s(^1) (kA)</td>
<td>16/20</td>
<td>16/20</td>
<td>16/20</td>
</tr>
<tr>
<td><strong>Metering panel</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated peak withstand current(^2) (kA)</td>
<td>40/50</td>
<td>40/50</td>
<td>40</td>
</tr>
<tr>
<td>Rated short-time current 1 s/2.5 s(^2) (kA)</td>
<td>16/20</td>
<td>16/20</td>
<td>16</td>
</tr>
<tr>
<td>Rated normal current (A)</td>
<td>630</td>
<td>630</td>
<td>630</td>
</tr>
</tbody>
</table>

\(^1\) Depending on version; refer to type plate on panel for the actual value.
\(^2\) Ratio-dependent.
2.4.2 Dimensions and weights

<table>
<thead>
<tr>
<th></th>
<th>without instrument compartment</th>
<th>with instrument compartment (200 mm high)</th>
<th>with instrument compartment (400 mm high)</th>
<th>centre-to-centre distance for lifting eyes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel width (mm)</td>
<td>420</td>
<td>420</td>
<td>420</td>
<td>1 panel: 420 mm</td>
</tr>
<tr>
<td>Panel depth (mm)</td>
<td>700</td>
<td>700</td>
<td>700</td>
<td>2 panels: 840 mm</td>
</tr>
<tr>
<td>Panel height (mm)</td>
<td>1350</td>
<td>1550</td>
<td>1750</td>
<td>3 panels: 420 mm</td>
</tr>
<tr>
<td>Weight per panel (kg)</td>
<td>approx. 150</td>
<td>approx. 170</td>
<td>approx. 180</td>
<td>4 panels: 840 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5 panels: 1260 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6 panels: 840 mm</td>
</tr>
</tbody>
</table>

Example dimensions:
Number of panels = N;
total width B = N x 420 + 80 mm.
3. SETTING UP THE SYSTEM

3.1 Guidelines for switchrooms

3.1.1 General

Space considerations
The dimensions of the installation are indicated on the floor plan. This forms part of the total documentation package. The dimensions of the electrical switchroom can be determined on the basis of the floor plan. The requirements are set out below.

Clear space
In front of switchgear installations or between two facing switchgear installations there must be a clear space along the whole length. This clear space must be at least 1 m wide and 2 m high. There must be no projecting parts within the clear space. The width of clear spaces is measured from the front of projecting parts and not from the front of the switchgear. The height must be measured from the floor or from the platform in front of the switchgear. The space needed for extension (to the left or right side) must be as follows: \[ N \times 420 \text{ mm} + 330 \text{ mm} \], where \( N \) = number of panels.

Escape routes
In front of switchgear installations or between two facing switchgear installations there must be an escape route at least 0.5 m wide and 2 m high along the whole length. Escape routes must be as straight as possible. There must be no projecting parts within these escape routes. The width of escape routes must be measured from the outer extremity of projecting parts. It is important to take into account the turning direction of doors; doors that are designed to be closed must not be capable of blocking each other. The height must be measured from the floor or from the platform in front of the switchgear.

Entrances
Entrances must be provided at suitable places to rooms in which switchgear installations are set up. These entrances must be at least 0.75 m wide and 2 m high. Finally, they must be accessible from the escape routes via connecting routes that are at least 0.5 m wide and 2 m high. Doors must:
- open outwards
- be able to be opened from the inside without tools.
With regard to the dimensions of doors, it is necessary to take into account the dimensions of the installation.

The climate
The climate in the switchroom must comply with the requirements of IEC 62271-1. This defines the standard conditions for indoor switchrooms:
- ambient temperature: maximum 40°C and minimum -5°C for "class minus 5 indoor"
- altitude < 1000 m
- The environment must not be polluted by dust, smoke, corrosive or inflammable vapours or salts. Only occasional condensation is permitted.
- The relative humidity must be not greater than 95% (measured over a 24-hour period).

Special operating conditions
In this case, account must be taken of the requirements laid down in IEC 62271-1. This means that special agreements must be made with the user of the installation.

For stations installed in areas with high relative humidity or a high groundwater level, particular attention must be paid to the prevention of condensation. The same applies to installations in areas abounding in water. See also section 3.1.3 (floor), page 26.
3.1.2 Ceiling
If the ceiling is prone to condensation, it is advisable to fit an additional ceiling made of, for example, hardboard (Masonite). Fit this board with the rough side facing downwards and ensure a certain amount of ventilation between the board and the roof.

3.1.3 Floor
The floor on which the installation is placed must be flat and have a smooth finish, so that the sheet steel foundation frame of the switching equipment has good contact with the floor. The installation must be fixed to the floor at least at the four corners.

The fixing holes in the floor must be made in accordance with the floor plan drawing supplied with the installation.

All openings between the space where the installation is set up and the space below ground level from where the medium and low-voltage cables are introduced must be thoroughly sealed. This is necessary for rooms both with and without a transformer.

Cable trench
Fill the cable trench with gritty sand and then cover it with a material such as polyurethane foam.

Cable cellar
Thoroughly seal the opening between the switchroom and the cable cellar using, for example, polyurethane foam, after proper support has been provided. The polyurethane foam must have a closed cellular structure.

3.1.4 Ventilation
Avoid unwanted air circulation; make sure that doors close properly. If the installation is set up near to heavy vehicular traffic, try as far as possible to prevent air displaced and polluted by the traffic from entering directly through the ventilation slots.

Rooms without a transformer
Avoid air circulation inside the room; the switchgear does not need any cooling. One single ventilation slot can be provided, but this must be low down in the room.

3.1.5 Heating
The measures described in 3.1.1 to 3.1.4 will usually be sufficient to satisfy the set-up conditions of IEC 62271-1. If, in special cases, these measures appear to be insufficient, each panel containing a heating element (see Chapter 1.4.3) must be connected to an auxiliary voltage of 110 - 220 V AC or DC.

3.1.6 Storage conditions
- The installation must be packed for storage.
- The climatological conditions must at least correspond to those of the switchroom (see Chapter 3.1.1).
- Appropriate steps must be taken to avoid contamination by dust and moisture (rain, snow, condensation) or mechanical damage.
3.2 Transport and assembly

3.2.1 Transport

An SVS/08 system can be transported in sections of maximum 6 panels. Each section is packed in Styrofoam and foil and placed on 15 cm high pallets (figure 1). The pallets are attached to the installation by means of retaining straps.

Each installation also has four lifting points so that it can be moved by crane.

A packed SVS/08 installation can also be moved with the aid of a pallet truck or fork lift truck.

**NOTE**
The installation must be transported in the "service position" or "earthing position", see Chapter 2.3.1.

3.2.2 Transport instructions

The user must follow the supplier's instructions.

**Lifting.**
- Follow the instructions on the supplied label.
- Ensure there are safe working conditions: observe local statutory regulations.
- Never stand under the load.
- The angle of the hoisting cable relative to the hoisting point is preferably 90° but never smaller than 85°.
- Use an equalizer so that the hoisting angle (see previous point) is guaranteed. On request a special equalizer can be ordered from Eaton.
- Lifting at extreme temperatures:
  - at temperatures from -5°C to -19°C and when using lifting gear made from steel equal to or less than grade B of Euronorm 25-67, the work load must be reduced by 25%.
- Lifting under the influence of wind:
  - Lifting operations must be stopped if the wind reaches wind force 7 (wind speeds greater than 13.9 - 17 m/s).
  - If lifting is taking place at a great height, lifting must be stopped earlier.

**Shipment**
- The installation must be transported in a vertical position.
- During transportation, appropriate steps must be taken to prevent penetration of dust and moisture (rain, snow) and to avoid mechanical damage.
Transport into the switchroom
SVS/08 installations can be placed in the switchroom by means of steel rollers. Trolleys from Eaton can also be used to move the installation on wheels.

3.2.3 Installing the unit
1. Make holes in the floor
   Carry this out in accordance with the floor plan as supplied with the system

2. Remove the protective panels with the key supplied, except for the protective panels for the fuses.

3. Remove the base plates from the outermost panels.

4. Set the installation up in the intended place and make the fastenings finger-tight.

   **NOTE**
   The installation must be level. If necessary, spacers may be used to fill space between the foundation frame and the floor.

5. Fasten the foundation frame with fixing bolts (M10). Tighten the bolts with a torque of 15 Nm.

6. Connect the earth bar to the earthing system. Fit the earthing point between the SVS/08 and the earthing system. Fit the adapter ring with the smallest diameter facing towards the station and tighten the hexagonal bolt (M12) with a torque of 30 Nm. (See figure 1):

   ![Diagram](image)

   1. Location of the earthing point
   2. Adapter ring
   3. Plain washer
   4. Spring washer
   5. Hexagonal bolt

**Setting up installations having greater than 6 panels**
Installations supplied in sections must be put in place and coupled by the supplier.
### 3.3 Cable connection options

The safety regulations must be observed when connecting cables (see chapter 1.3). Different cable connections are available for SVS/08 switchgear. An overview of the connections is given below.

#### SWITCH PANELS and CIRCUIT-BREAKER PANELS

<table>
<thead>
<tr>
<th>Voltage Range</th>
<th>Panel Fitted With:</th>
<th>Panel Fitted With:</th>
<th>Panel Fitted With:</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 kV</td>
<td>terminal block with locked cable entry ports for Magnefix cable boxes</td>
<td>cones in accordance with EN50181: type C and D</td>
<td>terminal block with locked cable entry ports for cable lug connections</td>
</tr>
<tr>
<td>12 - 17.5 - 24 kV</td>
<td>Grease-filled cable boxes for paper-insulated, lead-covered cable maximum 70 mm² Cu see Chapter 3.3.4</td>
<td>Plug connection with T-plugs with screw connections for plastic cables Type C: maximum 240 mm² Cu or Al Type D: maximum 630 mm² Cu or Al see Chapter 3.3.1</td>
<td>1 cable per phase</td>
</tr>
<tr>
<td>12 kV</td>
<td>maximum 150 mm² Cu maximum 120 mm² Al see Chapter 3.3.4 and 3.3.5</td>
<td>2 cables per phase</td>
<td>Dry cable box for plastic-insulated cables max 630 mm² Cu or Al see Chapter 3.3.11</td>
</tr>
<tr>
<td></td>
<td>maximum 240 mm² Cu or Al with soldering pressure plate see Chapter 3.3.6</td>
<td>Plug connection with “elbow” plugs with plug connection for plastic-insulated cables Type B: maximum 240 mm² Cu or Al see Chapter 3.3.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>maximum 240 mm² Cu or Al with plastic entry bushing see Chapter 3.3.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dry cable boxes for plastic-insulated cable maximum 240 mm² Cu or Al see Chapter 3.3.10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**For more detailed information, refer to Chapters 3.3.4, 3.3.5, 3.3.6, 3.3.7, 3.3.10, 3.3.11.**
### switch-fuse combination panels

<table>
<thead>
<tr>
<th></th>
<th>12 kV</th>
<th>12 - 17.5 - 24 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Panel fitted with:</strong></td>
<td>12 kV connection points below the fuse holders</td>
<td>24 kV direct connection below the fuse holders, with rubber sleeves and cable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>core bushes (Cu or Al)</td>
</tr>
<tr>
<td><strong>Grease-filled cable boxes for paper-insulated, lead covered</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>maximum 70 mm² Cu</td>
<td>Direct connection of single-core</td>
</tr>
<tr>
<td></td>
<td>see Chapter 3.3.4</td>
<td>plastic-insulated cables</td>
</tr>
<tr>
<td></td>
<td>maximum 150 mm² Cu</td>
<td>Maximum 50 mm² Cu or Al</td>
</tr>
<tr>
<td></td>
<td>maximum 120 mm² Al</td>
<td>see Chapter 3.3.2</td>
</tr>
<tr>
<td></td>
<td>see Chapters 3.3.4 and 3.3.5</td>
<td></td>
</tr>
<tr>
<td><strong>Dry cable boxes for plastic-insulated cable</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maximum</td>
<td>Connection of single-core</td>
</tr>
<tr>
<td></td>
<td>240 mm² Cu or Al</td>
<td>plastic-insulated cables</td>
</tr>
<tr>
<td></td>
<td>see Chapter 3.3.9 and 3.3.10</td>
<td>with plug connectors</td>
</tr>
<tr>
<td></td>
<td></td>
<td>on cones in accordance with</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EN50181</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Type A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maximum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>120 mm² Cu or Al</td>
</tr>
<tr>
<td></td>
<td></td>
<td>see Chapter 3.3.3</td>
</tr>
</tbody>
</table>
General
It is possible to remove the front (2) of the foundation frame and the plinth (1) so that the cables are easy to reach (see figure 2). To do this, the doors of the panels must first of all be removed.

If no cables are connected to a panel, the cable connection must be earthed (switch closed and disconnector in earthing position). The cable earthing cores can be connected to the copper earth bar. For extra safety, so-called “dead ends” can be fitted on the connection cones. It is also possible to fit earthing interlocks on the panels (see Chapter 4.2.7).

**NOTE**
If the cable supports in the panel do not fit the cables being connected, suitable supports must be ordered from Eaton.
This is important so as to guarantee that cables are securely fastened to the panel, also in case of a short-circuit current.

3.3.1 Connection of plastic-insulated cables with plugs to a 12 - 24 kV switch panel or circuit-breaker panel

**General**
For connection via plugs, the panels are provided with connection cones (figure 1). There are three versions:
- in accordance with EN50181: type B, suitable for "elbow" plugs (up to 400 A) with plug connection
- in accordance with EN50181: type C, suitable for T plugs (up to 630 A) with screw connection
- in accordance with EN50181: type D, suitable for T plugs (up to 630 A) with screw connection

The termination of the cable cores and the connection of the cables must satisfy the requirements of the manufacturer concerned.
Examples of plugs of different manufacturers:
- Raychem RICS (630 A)
- Raychem RSTI (630 A)
- Kabel & Draht SEHDT (630 A)
- Asea Kabeldon Kap 300/400 (630 A)
- Euromold K400 TB (630 A)
- Euromold K400 LR (400 A)
- Pirelli (630 A)
Procedure

**NOTE**
Check that the plug type matches the type of connection cone.

1. Open the panel door,
   - remove the plinth.
2. Remove the foam (polyethylene) floor plate.
3. Clean the connection cone and the plug and grease them lightly with silicone grease.
4. Fit the plug on the connection cone in accordance with the instructions of the manufacturer concerned. Use the specified tightening torques.
5. Fix the cable with the cable blocks.
   For wood:
   - drill a hole (depending on the cable diameter) in the cable block
   - ensure that a 4 mm gap remains between the two clamp halves to allow fixing of the cable
   For plastic:
   - select the appropriate plastic cable clamp for the cable diameter.
   - The cable clamp blocks are mounted on an adjustable frame in the cable connection compartment.
     The bolts through the plastic cable clamps must be tightened to a torque of minimum 20 Nm and maximum 40 Nm.
6. Earth the cable sheath to the earth bar.
7. Mark off the cable diameter on the foam. Cut the hole/holes in the foam. Cut the foam sheet through the middle and place the sheet back around the cable(s).
8. Reattach the plinth and the terminal box, if any.

**NOTE**
If plugs are used without an earthed outer layer, Eaton recommends fitting an extra interlock on the protection cover, so that the cables can only be accessed if the panel has been safely switched into the earthing position (disconnector in the earthing position, switch or circuit-breaker closed).
3.3.2 Direct connection of plastic-insulated cables up to 50 mm$^2$ Cu or Al to a 12 - 24 kV switch-fuse combination panel

General
The panel is equipped with moulded-resin-insulated 24 kV connections under the fuse holders. Virtually any type of single-core plastic-insulated cable up to 50 mm$^2$ Cu or Al may be connected to these. The cables must be terminated in accordance with the instructions of the cable manufacturer and the connection that is used.

For these panels Eaton can also supply fully terminated plastic-insulated cables for operating voltages up to 24 kV. These cables are designed with a core cross-section of 16 mm$^2$ and are obtainable in any desired length.

Required components (figure 1)
- 3 rubber sealing sleeves (a) for the cables
- 3 cable core bushes (b) with M8 internal thread
- 3 rubber sealing sleeves (c) with 3 sealing caps for the non cable side
- 3 hexagon socket head screws M8 x 25 with conical spring washers and plain washers

The sealing sleeves (see table 1) and the cable core bushes (see table 2) are correctly sized for the cable to be connected. The following cable data are important in this respect:
- the diameter across the primary core insulation after removal of the semi-conductive layer of the cable core
- the diameter of the cable core
- the material of the cable core (copper or aluminium)
- the type and manufacturer of the cable

Based on this information about the cables, the following sealing sleeves and cable core bushes can be supplied:

<table>
<thead>
<tr>
<th>Diameter across primary core insulation (mm)</th>
<th>Sealing sleeves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal diameter (mm)</td>
<td>Code</td>
</tr>
<tr>
<td>13.8 - 15.3</td>
<td>12.3</td>
</tr>
<tr>
<td>15.3 - 17.3</td>
<td>13.8</td>
</tr>
<tr>
<td>17.3 - 18.75</td>
<td>15.8</td>
</tr>
<tr>
<td>18.75 - 20.5</td>
<td>17.5</td>
</tr>
<tr>
<td>20.5 - 22.0</td>
<td>19.5</td>
</tr>
<tr>
<td>22.0 - 23.5</td>
<td>21.0</td>
</tr>
</tbody>
</table>

Note:
To seal the non-cable side, sleeve no. 1 (part number 612.424) must be used in combination with the supplied plastic pin (part number 106.081).

Table 1  Sealing sleeves (grey E.P.R.)

<table>
<thead>
<tr>
<th>Diameter Cable core (mm)</th>
<th>Article no. cable core bushes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>Tool* number</td>
</tr>
<tr>
<td>4.7 - 5.8</td>
<td>106.117 8</td>
</tr>
<tr>
<td>5.8 - 6.6</td>
<td>612.410 10</td>
</tr>
<tr>
<td>6.6 - 7.75</td>
<td>612.428 12</td>
</tr>
<tr>
<td>8.0 - 9.75</td>
<td>612.340 14</td>
</tr>
<tr>
<td>Aluminium</td>
<td></td>
</tr>
<tr>
<td>6.1 - 7.4</td>
<td>612.430 14</td>
</tr>
<tr>
<td>7.2 - 9.1</td>
<td>612.429 16</td>
</tr>
</tbody>
</table>

* in accordance with DIN 48083

Table 2  Cable core bushes
Procedure

**Terminating cables (for non Eaton cables)**

1. Check on the basis of tables 1 and 2 that you have the correct parts to hand.

2. Terminate the cable cores to the correct length, as shown in figure 2.
   - The cable core insulation must be perfectly smooth on the outside. The presence of grooves and ridges can lead to insulation that is "not completely electrically sealed".

3. Using a suitable pressing tool (see table 2), fix the cable core bushes on the cable cores. The position and number of clamping rings are marked with a groove on the cable core bushes.

**Connecting cables (for Eaton and non Eaton cables)**

4. Lead the three cables into the installation via the underside (from the cellar).

5. Make a hole suitable for the cable diameter in the grummet. Slide the grummet over the cable.

6. Grease the cable at the location of the primary cable insulation and place the 3 cable sleeves over the cable core bushes.

**NOTE**

- Use the correct type of grease:
  - for red (older) rubber sleeves: Vaseline
  - for grey rubber sleeves: silicone grease

7. Insert the cable with the sleeve carefully from underneath into the cable connection. Make sure the sleeves are not pushed back.

8. Push the cable inside from underneath, until the cable core bush meets the contact face inside the connection.
9. Then fasten the cable from above (torque 15 Nm) with the hexagon socket screw M8 x 25 (with conical spring washer and plain washer).

**NOTE**
If the connection is not pressed fully against the contact face, the cable core may be damaged when the hexagon socket screw is tightened. This situation must be avoided.

10. Seal the non-cable side as follows:
- Place the sleeve with the sealing cap in the opening of the cable connection.
- During this operation, hold a nylon vent thread between the sleeve and the epoxy resin, and afterwards pull this thread out.

**NOTE**
These sleeves are always coded as sleeve no. 1. The other sleeves for the cable connection have a different code, depending on the cable to be connected.

11. Fasten the cable to the frame with a wooden terminal block or with a cable clamp.
- Ensure that the bending radius of the cable is at least that specified by the supplier.
- For Eaton transformer cables, the bending radius is 15 times the external diameter of the cable.

12. Earth the screening of the cables to the earth bar via the flexible earth connection.

13. Place the grummet in the floor plate of the panel.
3.3.3 Connection of plastic-insulated cables of up to 120 mm² Cu or Al with straight plug connectors to a 12 - 24 kV switch-fuse combination panel

General
The panel is equipped with moulded-resin-insulated 24 kV connections under the fuse holders. Single-core plastic-insulated cables up to 120 mm² Cu or Al can be connected to these connections using straight plug connectors. The connection points on the cable side must however be provided with an adapter. The adapter has a connection cone in accordance with DIN 47636250 and Cenelec EN50181: 1994, type A. If the installation is delivered without an adapter, one must be retro-fitted.

Required components
- Three rubber sealing sleeves for the cable-side
- Three adapters
- Three rubber sealing sleeves with three sealing caps for the non-cable side
- Three hexagon socket head screws (M8 x 25) with conical spring washers and plain washers

Fitting the adapter
1. Thoroughly clean the connection point on the cable side and the inside and the outside of the adapter.
2. Apply some Vaseline to the outside of the connection point on the cable side.
3. Fit the sleeves on the cable side of the connection point and apply some Vaseline to the outside of the sleeves.
4. Push the adapter over the sleeve in such a way that the lugs of the adapter are horizontal. Make sure the sleeve is not pushed back.
5. Fasten the adapter from above the connection point (15 Nm) by means of the hexagon socket head screw with conical spring washer and plain washer.
6. Seal the non-cable side as follows:
   - Place the sleeve with the sealing cap in the opening of the cable connection.
   - During this operation, hold a nylon vent thread between the sleeve and the epoxy resin, and afterwards pull this thread out.
Fitting the straight plug connector
1. Clean the adapter and the plug and apply some silicone grease.
2. Fit the plug on the special adapter in accordance with the instructions of the manufacturer concerned.
3. Fasten the cable to the frame with a wooden terminal block or with a cable clamp.
   - Ensure that the bending radius of the cable is at least that specified by the supplier.
   - For Eaton transformer cables, the bending radius is 15 times the external diameter of the cable.
4. Earth the cable sheath.
5. Place the grummet in the floor plate of the panel.

3.3.4 Connection of paper-insulated lead-covered cables up to 95 mm² Cu by means of grease-filled cable boxes

General
Paper-insulated lead-covered cables can be connected to switch panels and circuit-breaker panels and to switch-fuse combination panels up to 12 kV. Switch panels and circuit-breaker panels are equipped with a terminal block with locked cable entry ports. The terminal block has three connection pins moulded into the epoxy resin insulation. On switch-fuse combination panels, the 12 kV connection pins are directly below the fuse holders.

Required components
- A small cable box (a) for core cross-sectional areas up to 95 mm² or
- A large cable box (b) for core cross-sectional areas up to 150 mm²
- two protection covers (c)
- three cable core clamps (d)
- a cable clamp (e) (D = cable diameter)
- one hose clip (f)
- polyethylene tape
Procedure
1. Remove the foam (polyethylene) floor plate.
2. Cut the cable to the correct length, as shown in figure 2.
   - L1 = 515 mm for a small cable box
   - L1 = 700 mm for a large cable box

Tip
To simplify insertion of the cable cores in the right tubes of the cable box, it is recommended to cut the cable cores to different lengths.

3. Finish the cable as shown in figure 2.
   - L2 = 170 mm for a small cable box
   - L2 = 200 mm for a large cable box
   - d = diameter across the lead sheath
   Remove the lead sheath over distance (d). Remove the sharp edges of the lead sheath.

NOTE
Dimensions L1 and L2 allow for a length of 50 mm for earthing the lead sheath.

4. Saw off the cable box in accordance with the diameter (d) measured across the lead sheath. Take into account that several layers of polyethylene tape are to be applied over the lead sheath.
   - Deburr sharp edges.
5. Degrease the upper side of the lead sheath and sand it lightly, for example, with a Scotch Brite scouring pad.
   - Apply a couple of layers of polyethylene tape to the lead sheath, so that the diameter measured across the tape equals the inside diameter of the cable box.
   - Make sure that the upper side of the tape is flush with that of the lead sheath (indicated by arrow).
   - Smooth out any wrinkles.
6. Slide the cable box on to the cable terminal block of the panel.
   - Pull the cable next to the cable box until the polyethylene tape protrudes about 10 mm beneath the cable box.
   - Mark the cable just above the cable clamp.
7. Remove the cable box from the cable terminal block.
8. Insert the cable into the cable box from below and lower the cable box on to the cable as far as possible.

**NOTE**
*Make sure the paper insulation of the cores does not get damaged.*

9. Fix the cable in the marked position in the cable clamp. The cable clamp blocks are mounted on an adjustable frame in the cable connection compartment. The bolts through the plastic cable clamps must be tightened to a torque of minimum 20 Nm and maximum 40 Nm.
10. Seal the openings of the cable box to prevent intrusion of dirt.

11. • Cut the cable cores 2 to 3 mm below the epoxy resin insulation.
    • Remove the insulation from the cable cores over a distance of 30 mm.

12. • Check that the O-rings are fitted over the epoxy resin insulation.
    • Apply cable grease lightly to the epoxy resin insulation.

13. • Connect the cable cores to the connection points using the cable core clamps.
    • Make sure that the cable cores are correctly positioned in the clamps. This is where the associated cross-sectional area is stated (see detailed insert).
    • Tighten the hexagon socket head screws (torque 15 Nm). Make sure that the screws are positioned well forward in all three phases.
    • Re-tighten the screws after some time.
14. • Hang a double folded nylon thread over the edge of each opening in the cable box, with the ends hanging inside.
• Now slide the cable box completely on to the epoxy resin insulation.

15. Fit the protection cover on the right side and secure it. Make sure that the clamping edge of the cable box adequately rests on the bearing face of the protection cover.

16. Fit the hose clips on the end of the cable box and tighten (torque 5 Nm).

17. Mark off the cable diameter on the foam. Cut the hole/holes in the foam. Cut the foam sheet through the middle and place the sheet back around the cable(s).

18. Fill the cable box with grease (see Chapter 3.3.8).
3.3.5 Connection of paper-insulated lead-covered cables up to 150 mm$^2$ Cu or 120 mm$^2$ Al by means of grease-filled cable boxes

General
Paper-insulated lead-covered cables can be connected to switch panels and circuit-breaker panels and to switch-fuse combination panels up to 12 kV. Switch panels and circuit-breaker panels are equipped with a terminal block with locked cable entry ports. The terminal block has three connection pins moulded into the epoxy resin insulation. On switch-fuse combination panels, the 12 kV connection pins are directly below the fuse holders.

Required components
For cables with a copper core (figures 1a and 1b):
- a large cable box (b)
- two protection covers (c)
- three cable core clamps (d), each consisting of:
  - one connecting piece
  - one pressure plate
  - two washers with hexagon socket head screws
- a cable clamp (e) (D = cable diameter)
- one hose clip (f)
- polyethylene tape

NOTE
For cables with an aluminium core (figure 1c):
Eaton cable core clamps are only suitable for connecting cables with a copper core.

There is a maximum free space measuring Ø 40 x 85 mm for connecting cables with an aluminium core by means of crimp cable sockets, for instance.

Basically, any type of cable core clamp can be used, provided it is within the permitted dimensions when crimped.
**Procedure**

1. Attach the cable box to the cable, following the procedure described in Chapter 3.3.4, steps 1 to 12.

2. Fit the connecting pieces to the connection pins using one of the washers.
   - Tighten the hexagon socket head screws (torque 15 Nm). Make sure that the screws are positioned well forward in all three phases.

3. Slide the other washers as far as possible on to the connecting pieces and provisionally tighten the hexagon socket head screws.

4. Seal the openings of the cable box to prevent intrusion of dirt.

5. Shorten the cable cores so that all three of them fit into the recesses in the connecting pieces.

6. Position the cable cores in the recesses in the connecting pieces. Fit the pressure plates onto the core ends in the recesses in the connecting pieces and slide the lowermost washers along the pressure plates.
   - Tighten the hexagon socket head screws (torque 15 Nm). Make sure that the screws are positioned straight forward in all three phases.
   - Re-tighten the cable core clamp hexagon socket head screws after a time.
7. • Hang a double folded nylon thread over the edge of each opening in the cable box, with the ends hanging inside.
• Now slide the cable box completely on to the epoxy resin insulation.

8. Fit the protection cover on the right side and secure it. Make sure that the clamping edge of the cable box adequately rests on the bearing face of the protection cover.

9. Fit the hose clips on the end of the cable box and tighten it (torque 5 Nm).

10. Mark off the cable diameter on the foam. Cut the hole/holes in the foam. Cut the foam sheet through the middle and place the sheet back around the cable(s).

11. Fill the cable box with grease (see Chapter 3.3.8).
3.3.6 Connection of paper-insulated lead-covered cables up to 240 mm² Cu or Al by means of grease-filled cable boxes with soldering pressure plate

General
Paper-insulated lead-covered cables can be connected to switch panels and circuit-breaker panels and to switch-fuse combination panels up to 12 kV. Switch panels and circuit-breaker panels are equipped with a terminal block with locked cable entry ports. The terminal block has three connection pins moulded into the epoxy resin insulation.

On switch-fuse combination panels, the 12 kV connection pins are directly below the fuse holders.

Required components
For cables with a copper core (figure 1a):
- one cable box (a) (depending on the core diameter)
- two protection covers (c)
- three cable core clamps:
  - d1: for core diameters ≤ 75 mm²
  - d2: for core diameters > 75 mm², comprising one connecting piece, one pressure plate and two washers with hexagon socket head screws
- a cable clamp (e) (D = cable diameter)
- one hose clip (f)
- one pressure plate bush (g) with O-ring
- polyethylene tape

NOTE
For cables with an aluminium core (figure 1c):
Eaton cable core clamps are only suitable for connecting cables with a copper core.
There is a maximum free space measuring Ø 40 x 110 mm for connecting cables with an aluminium core by means of crimp cable sockets, for instance Ø

Basically, any type of cable core clamp can be used, provided it is within the permitted dimensions when crimped.
Procedure

1. Remove the foam (polyethylene) floor plate.

2. Cut the cable as shown in figure 2.
   - \( L_1 = 650 \text{ mm} \)

**Tip**
To simplify insertion of the cable cores in the right tubes of the cable box, it is recommended to cut the cable cores to different lengths.

3. Finish the cable as shown in figure 2.
   - \( L_2 = 175 \text{ mm} \)
   - \( d = \text{ diameter across the lead sheath} \)
   Remove the lead sheath over distance \((d)\). Remove the sharp edges of the lead sheath.

4. Remove the O-ring from the pressure plate bush.
   - Saw off the underside of the pressure plate bush, creating a hole whose inside diameter equals the diameter \((d)\) measured across the lead sheath.

5. Slide the pressure plate bush along the lead sheath.

6. Solder the pressure plate bush straight on to the lead sheath.
   - Preferably use soldering tin containing 35% tin and 65% lead to keep the soldering temperature as low as possible.
   - Make sure that the top of the pressure plate bush and the end of the lead sheath are aligned.

7. Grease the O-ring with silicone grease or acid-free Vaseline and slide it onto the pressure plate bush.

8. Slide the cable box onto the cable terminal block of the panel and pull the cable next to the cable box so that the bottom of the O-ring is about 15 mm higher than the bottom of the cable box.
   - Mark the cable just above the cable clamp.
9. Remove the cable box from the cable terminal block.

10. Slide the cable box as far as possible on to the cable. Make sure the paper insulation of the cable cores does not get damaged.

11. Fix the cable in the marked position in the cable clamp. The cable clamp blocks are mounted on an adjustable frame in the cable connection compartment. The bolts through the plastic cable clamps must be tightened to a torque of minimum 20 Nm and maximum 40 Nm.

12. For cables with an aluminium core:
   - If the crimp cable clamps have been fitted, fix them in accordance with the instructions.
   - In this case, skip step 13.

13. Depending on the core diameter, follow the procedure described in:
   - Chapter 3.3.4, steps 10 to 15
   - Chapter 3.3.5, steps 2 to 7

14. Fit the hose clip to the pressure plate bush, at the level of the O ring.

15. Mark off the cable diameter on the foam. Cut the hole/holes in the foam. Cut the foam sheet through the middle and place the sheet back around the cable(s).

16. Fill the cable box with grease (see Chapter 3.3.8).
3.3.7 Connection of paper-insulated lead-covered cables up to 240 mm\(^2\) Cu or Al by means of grease-filled cable boxes with plastic entry bushing

General

Paper-insulated lead-covered cables can be connected to switch panels and circuit-breaker panels and to switch-fuse combination panels up to 12 kV. Switch panels and circuit-breaker panels are equipped with a terminal block with locked cable entry ports. The terminal block has three connection pins moulded into the epoxy resin insulation.

On switch-fuse combination panels, the 12 kV connection pins are directly below the fuse holders.

Required components

For cables with a copper core (figures 1a and 1b):
- one cable box (a) (depending on the core diameter)
- two protection covers (c)
- three cable core clamps:
  - d1: for core diameters < 75 mm\(^2\)
  - d2: core diameters > 75 mm, s\(^2\), comprising one connecting piece, one pressure plate and two washers with hexagon socket head screws
- a cable clamp (e) (D = cable diameter)
- two hose clips (f)
- one plastic entry bushing (g) with two fixing shells (h) and an O-ring (i)
- polyethylene tape

**NOTE**

For cables with an aluminium core (figure 1c):
Eaton cable core clamps are only suitable for connecting cables with a copper core.

There is a maximum free space measuring Ø 40 x 110 mm for connecting cables with an aluminium core by means of crimp cable sockets, for instance.

Basically, any type of cable core clamp can be used, provided it is within the permitted dimensions when crimped.
Procedure
1. Remove the foam (polyethylene) floor plate.

2. Cut the cable as shown in figure 2.
   - $L_1 = 650$ mm

   **Tip**
   To simplify insertion of the cable cores in the right tubes of the cable box, it is recommended to cut the cable cores to different lengths.

3. Finish the cable as shown in figure 3.
   - $L_2 = 175$ mm
   - $d$ = diameter across the lead sheath
   Remove the lead sheath over a distance $d$. Then remove the sharp edges of the lead sheath.

4. Saw off the plastic entry bushing in accordance with the diameter ($d$) measured across the lead sheath. Take into account that several layers of polyethylene tape are to be applied over the lead sheath.
   - Deburr sharp edges.

5. Grease the O-ring using silicone grease or acid-free Vaseline.
   - Place the O-ring in the upper recess of the plastic entry bushing (g).

6. Press the plastic entry bushing into the cable box and fit the two fixing shells (h) in the lower recess of the entry bushing. Clamp it using the hose clip (f).
7. Degrease the upper side of the lead sheath and sand it lightly, for example, with a Scotch Brite scouring pad.
   - Apply a couple of layers of polyethylene tape to the lead sheath, so that the diameter measured across the tape equals the inside diameter of the entry bushing.
   - Ensure that the upper side of the tape is flush with that of the lead sheath (see arrow).
   - Smooth out any wrinkles.

8. Slide the cable box onto the cable terminal block of the panel.
   - Pull the cable next to the cable box until the polyethylene tape protrudes about 15 mm beneath the plastic entry bushing.
   - Mark the cable just above the cable clamp.

9. Remove the cable box from the cable terminal block.

10. Remove the plastic entry bushing from the cable box and slide it over the cable.
    - Then, if applicable, fix the crimp cable sockets on the aluminium cable.
      In this case, skip step 13.

11. Slide the cable box over the cable and then over the entry bushing.
12. Fix the cable in the marked position in the cable clamp. The cable clamp blocks are mounted on an adjustable frame in the cable connection compartment. The bolts through the plastic cable clamps must be tightened to a torque of minimum 20 Nm and maximum 40 Nm.

13. Depending on the core diameter, follow the procedure described in:
- Chapter 3.3.4, steps 10 to 15
- Chapter 3.3.5, steps 2 to 7

14. Firmly clamp the plastic entry bushing onto the cable box using the hose clip (torque 5 Nm).

15. Mark off the cable diameter on the foam. Cut the hole/holes in the foam. Cut the foam sheet through the middle and place the sheet back around the cable(s).

16. Fill the cable box with grease (see Chapter 3.3.8).
3.3.8 Filling the cable boxes

Materials required (figure 1)

a. Can of grease for the cable box:
   - for small cable box:
     - contents = 1.5 l
     - \( h = 135 \text{ mm} \)
   - for large cable box:
     - contents = 2.25 l
     - \( h = 205 \text{ mm} \)
   - for cable box with pressure plate:
     - contents = 3.5 l
     - \( h = 282 \text{ mm} \)

b. Hand pump

c. Filling device with filling tube and valve

d. Filling hose with hose clip, shut-off ring and connector nipple

Procedure

1. Heat the can whilst stirring to a temperature not exceeding 100°C. At this temperature the grease will be perfectly fluid. When heating with a naked flame, keep it away from joints and the filling opening of the can.
   - Then allow the grease to cool to a temperature of approximately 80°C.

2. Place the filling device on the can and push the filling tube down to the bottom.
3. • Secure the filling device by firmly tightening the screw in the top plate.
   • Using the hose clip, firmly attach the hose to the filling tube of the filling device.

4. Remove the nylon locking pin and the rubber sealing from the cable box.

5. Connect the filling hose to the cable box:
   • insert the nipple as far as possible into the filling hole and give it a quarter turn. Check that the nipple snaps into the filling hole interlock.

6. Place the hand-operated pump on the valve and fill the cable box by pumping steadily (to prevent air bubbles from developing).
   The cable box has to be completely filled.

7. • When the grease in the cable box touches the epoxy resin insulation, continue pumping steadily until the cable box has expanded by approximately 2 cm.
   • Wait for the grease to come out of one of the spouts and then pull away the nylon thread. Repeat this for the other spouts.

8. Fit the protection cover on the left side and secure it.
   Make sure that the clamping edge of the cable box adequately rests on the bearing face of the protection cover.

9. • Remove the pump from the valve.
   • Now depressurise the cable box, using the valve, until the box remains about 1 cm thicker.
   The excess filling is necessary to compensate for shrinkage and any grease absorption by the cable.
   • Close the filling hose using the shut-off ring.

10. Reduce the pressure on the can by completely opening the valve.
    Undo the hose clip and remove the can from the filling hose.
    Hold the can in such a way that the grease from the filling hose cannot get into contact with the valve.
11. Remove the filling hose from the cable box once the grease in the cable box has cooled down and immediately put your thumb on the opening. This is necessary as the grease in the cable box is under pressure.

12. Fit the rubber sealing and push it into the opening of the cable box, while rotating it. Make sure that the edge snaps behind the wall of the cable box.

13. Fit the nylon locking pin. There must not be any grease in the cavity in the rubber sealing.
   - The lead sheath can now be earthed. Earthing should be done right above the outer cable sheath so that the cable box can be lowered, if necessary. This earth connector has to be attached to the horizontal earth bar.
3.3.9 Connection of plastic-insulated cables up to 70 mm² Cu by means of dry cable boxes

General
Paper-insulated lead-covered cables can be connected to switch panels and circuit-breaker panels and to switch-fuse combination panels up to 12 kV.
Switch panels and circuit-breaker panels are equipped with a terminal block with locked cable entry ports. The terminal block has three connection pins moulded into the epoxy resin insulation.

On switch-fuse combination panels, the 12 kV connection pins are directly below the fuse holders.

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DANGER WARNING
The termination of the cable cores and the splitting point must comply with the cable manufacturer’s instructions.
For terminating the earth screen, the cable cores must be fitted with stress cones.

If the diameter of the stress cones in the fitted condition is less than or equal to Ø46 mm, they fit in the cable box as shown in figure 1A.

If the diameter of the stress cones in the fitted condition is greater than Ø46 mm, they do not fit in the cable box and must be fitted underneath it as shown in figure 1B. In that case, the protection cover must be fitted to ensure that the part above the stress cones is also insulated.

Figure 1C shows a situation in which a cable termination is used without a stress cone. This situation occurs, for example, for cables supplied by Eaton.
Required materials
- Three insulating tubes (a)
- One bag containing three greased rubber sleeves (b)
- Three sealing plugs (c)
- Two protection covers (d)
- Three stress cones (e) (Ø ≤ 46 mm or Ø > 46 mm) (figure 1)
- One protecting cover (f) (only for stress cones with Ø > 46 mm)
- Three cable core clamps (g)
- Cable clamps (h)
- Cable block (j)

Procedure
1. Remove the foam (polyethylene) floor plate.
2. Pull the cable up and fasten it. There are two ways of doing this, depending on the type of cable, namely:
   - “3-core cable”
   - “3x1-core cable” on cable panel

2.1 “3-core cable”
- fix the cable in the desired position in the cable clamp.
  The cable clamp blocks are mounted on an adjustable frame in the cable connection compartment.
  The bolts through the plastic cable clamps must be tightened to a torque of minimum 20 Nm and maximum 40 Nm.
2.2 “3x1-core cable” on cable panel

- fix the cable in the desired position in the cable clamp.

The cable clamp blocks are mounted on an adjustable frame in the cable connection compartment. The bolts through the plastic cable clamps must be tightened to a torque of minimum 20 Nm and maximum 40 Nm.
3. • Cut the cable cores 2 to 3 mm below the epoxy resin insulation.
   • Remove the insulation of the cable cores over a distance of approximately 30 mm.

4. • Turn the sealing plugs (c) inside out.
   • Carefully cut a hole in the conical part of the sealing plugs without making any notches. The diameter of this hole must be half the diameter of the core insulation.
   • Turn the sealing plugs back to their normal position.

5. Fit the stress cones (e) and sealing plugs (c) on the cable.
   The assembly sequence depends on whether the stress cone is situated in (figure 1A) or below (figure 1B) the insulating tube.

6. • Insert the rubber sleeves (b) previously greased with silicone grease upwards into the feed opening of the insulating tubes (a) and slide the tubes over the cores.
   • Slide any protection caps to be fitted onto the insulating tubes.

7. • Fix the cable cores to the connection pins. Make sure that the cable cores are correctly positioned in the connection clamps, i.e. at the position indicating the relevant cross-sectional area.
   • Tighten the hexagon socket head screws (approx. 15 Nm). Make sure that the hexagon socket head screws are positioned straight forward in all three phases.
   • Re-tighten the screws after some time.

8. Slide the insulating tubes and the rubber sleeves on to the epoxy resin insulated members. Check that the flattened sides of the washers around the insulating tubes abut.
9. Fit both protection covers (d) and secure them. Make sure that the tubes adequately rest on the bearing faces of the protection covers.

10. Fit the sealing plugs and lower the protecting cover (f) into its final position, if applicable.

11. Mark off the cable diameter on the foam. Cut the hole/holes in the foam. Cut the foam sheet through the middle and place the sheet back around the cable(s).
3.3.10 Connection of plastic-insulated cables from 95 mm² to 240 mm² Cu by means of dry cable boxes

**General**
Plastic-insulated cables can be connected to switch panels and circuit-breaker panels and to switch-fuse combination panels up to 12 kV.
Switch panels and circuit-breaker panels are equipped with a terminal block with locked cable entry ports. The terminal block has three connection pins moulded into the epoxy resin insulation.

On switch-fuse combination panels, the 12 kV connection pins are directly below the fuse holders.

**DANGER WARNING**
The termination of the cable cores and the splitting point must comply with the cable manufacturer’s instructions.
For terminating the earth screen, the cable cores must be fitted with stress cones.

If the diameter of the stress cones (e) in the fitted condition is less than or equal to 46 mm, they fit in the cable box as shown in figure 1A.

If the diameter of the stress cones (e) in the fitted condition is greater than 46 mm, they do not fit in the cable box and must be fitted underneath it as shown in figure 1B.
In that case, the protecting cover (f) must be fitted to ensure that the part above the stress cones is also insulated.

Figure 1C shows a situation in which a cable termination is used without a stress cone. This situation occurs, for example, for cables supplied by Eaton.
Required materials (figures 1, 2a and 2b)
- Three insulating tubes (a)
- One bag containing three greased rubber sleeves (b)
- Three sealing plugs (c)
- Two protection covers (d)
- Three stress cones (e) (figure 1)
  \( \varnothing \leq 46 \text{ mm} \) or \( \varnothing > 46 \text{ mm} \)
- One protecting cover (f) (only for stress cones with \( \varnothing > 46 \text{ mm} \))
- Three cable core clamps (g) (figure 2b) consisting of:
  - one connecting piece
  - one pressure plate
  - two washers with hexagon socket head screws
- Cable clamps (h)
- Cable block (j)

Procedure
1. Remove the foam (polyethylene) floor plate.
2. Pull the cable up and fasten it. There are two ways of doing this, depending on the type of cable, namely:
   - “3-core cable”
   - “3x1-core cable” on cable panel

2.1 “3-core cable”
- fix the cable in the desired position in the cable clamp.
The cable clamp blocks are mounted on an adjustable frame in the cable connection compartment.
The bolts through the plastic cable clamps must be tightened to a torque ranging from a minimum of 20 Nm to a maximum of 40 Nm.
2.2 “3x1-core cable” on cable panel
- fix the cable in the desired position in the cable clamp.

The cable clamp blocks are mounted on an adjustable frame in the cable connection compartment. The bolts through the plastic cable clamps must be tightened to a torque of minimum 20 Nm and maximum 40 Nm.
3. • Cut the cable cores 2 to 3 mm below the epoxy resin insulation.  
   • Remove the insulation of the cable cores over a distance of approximately 30 mm.

4. • Turn the sealing plugs (c) inside out.  
   • Carefully cut a hole in the conical part of the sealing plugs without making any notches. The diameter of this hole must be half the diameter of the core insulation.  
   • Turn the sealing plugs back to their normal position.

5. Fit the stress cones (e) and sealing plugs (c) on the cable.  
   The assembly sequence depends on whether the stress cone is situated in the insulating tube (figure 1A) or below the insulating tube (figure 1B).

6. Lightly grease the epoxy resin insulation using silicone grease or acid-free Vaseline.

7. Fit the connecting pieces to the connection pins using one of the washers.  
   • Tighten the hexagon socket head screws (torque 15 Nm). Make sure that the screws are positioned well forward in all three phases.

8. Slide the other washers as far as possible onto the connecting pieces and provisionally tighten the hexagon socket head screws.
9. Seal the openings of the cable box to prevent intrusion of dirt.

10. Shorten the cable cores so that all three of them fit into the recesses in the connecting pieces.

11. • Insert the rubber sleeves (b) previously greased with silicone grease upwards into the feed opening of the insulating tubes (a) and slide the tubes over the cores.
• Slide any protecting covers to be fitted onto the insulating tubes.

12. • Position the cable cores in the recesses in the connecting pieces. Fit the pressure plates onto the core ends in the recesses in the connecting pieces and slide the lowermost washers along the pressure plates.
• Tighten the hexagon socket head screws (approx. 15 Nm). Make sure that the hexagon socket head screws are positioned straight forward in all three phases.
• Re-tighten the cable core clamp hexagon socket head screws after a time.
13. Slide the insulating tubes and the rubber sleeves onto the epoxy resin insulated members. Check that the flattened sides of the washers around the insulating tubes abut.

14. Fit both protection covers (d) and secure them. Make sure that the tubes adequately rest on the bearing faces of the protection covers.

15. Fit the sealing plugs and lower the protecting cover (f) into its final position, if applicable.

16. Mark off the cable diameter on the foam. Cut the hole/holes in the foam. Cut the foam sheet through the middle and place the sheet back around the cable(s).
3.3.11 Connection of plastic-insulated cables up to 630 mm² Cu or Al via cable lug connections

General
Plastic-insulated cables can be connected to panels up to 12 kV.
The panels are fitted with terminal blocks with locked cable entry ports. The terminal block has three connection pins moulded into the epoxy resin insulation.

NOTE
The termination of the cable cores and the splitting point must comply with the cable manufacturer's instructions.

(Crimp) cable sockets are used to connect the cable.

The maximum space for cable termination and the cable socket is Ø 70 x 430 mm. The maximum space available for the cable socket is Ø 70 x 255 mm.
Required materials (figure 1b)
- Three insulating tubes (a) consisting of a long part (a2) and a short part (a1)
- Two bags containing three greased rubber sleeves (b)
- Three sealing plugs (c)
- Three cable blocks (d)

Procedure
1. Remove the insulating tubes (a1,a2) and the tube support.

2. Drill a hole (depending on the cable diameter) in the cable block.
   - Ensure that a 4 mm gap remains between the two clamp halves to allow fixing of the cable.

3. Terminate the cable according to the manufacturer’s instructions. For the available space, see figure 1.

4. Turn the sealing plugs (c) inside out.
   - Carefully cut a hole in the conical part of the sealing plugs without making any notches. The diameter of this hole must be half the diameter of the core insulation.
   - Turn the sealing plugs back to their normal position and grease them with acid-free Vaseline.

5. Slide the sealing plugs (c) over the cable.
   - Slide a greased sleeve (b) over the long tube (a2) on the side of □ 87 and then slide the short tube (a1) over this.
   - Slide the assembled tube over the cable with the short tube at the bottom.

6. Fit the cable socket according to the manufacturer’s instructions.
8. Lightly grease the epoxy resin insulation of the terminal blocks with acid-free Vaseline.

9. Fit three greased sleeves (b) on the terminal blocks.

10. Fix the cable sockets on the terminal blocks.

11. Slide the assembled insulating tubes over the epoxy resin insulation of the terminal blocks.

12. Fit the detached tube support over the tubes.

13. Fix the cables in the cable blocks.
3.3.12 Mounting the capacitive sensor

Required accessories
A voltage indicator on a 12 - 24 kV switch-fuse combination panel is available as an option. This requires a capacitive sensor to be fitted on the non-cable side connection of the fuse box.

Procedure
Fit the capacitive sensor as follows:

1. Fit the primary cables as described in manual no. 991.127 Cable connections, but do not close the non-cable side connection of the fuse box.

2. Clean the outside of the non-cable side connection of the fuse box and lightly grease it using the Vaseline supplied.

3. Fit the three sleeves and lightly grease the outside of the sleeves.

4. Clean the inside of the capacitive sensor and lightly grease it.

5. Lay the nylon thread over the sleeve and push the capacitive sensor into place with a linear movement. Make sure that:
   - distance \( a = 15 \) mm
   - the sleeve is not pushed back

6. Fit the secondary connections on the plug connectors.
   - Pay attention here to the correct coding: L1, L2 and L3.

7. Check the voltage indicator with the voltage tester (see Chapter 4.2.4).

3.3.13 Connection of secondary wiring
Electrical information regarding the secondary wiring is indicated on the diagrams in the supplied document package (see also the descriptions of the panels).
4. SYSTEM OPERATION

4.1 Who may operate the system?

4.1.1 Level of training
Operational activities may only be carried out by or on the
inguishment of a responsible specialist or control expert.

4.1.2 Service conditions
The operating conditions must not differ from the conditions
described in Chapter 3.1.1.

4.1.3 Personal protection equipment
No personal protection equipment is necessary under
normal operating conditions.

4.1.4 Potential dangers for bystanders
Since no switchgear is without danger, you must do
everything possible to ensure that people do not go near
the system unnecessarily. Only personnel
(see Chapter 4.1.1) who need to work on the system may
enter the room.
4.2 Operation

4.2.1 Operation panel

1. Operation panel of switch panel or circuit-breaker panel

2. Operation panel of switch-fuse combination panel

1. Position indicator of switch or circuit-breaker.
2. Operating shaft of switch or circuit-breaker
3. Operating shaft of disconnector.
4. Position indicator of disconnector.
5. Padlock interlock strip.
6. Closing button with key for switch or circuit-breaker (optional).
7. Opening button for switch or circuit-breaker.
8. Selector
10. Voltage indicator.
4.2.2 Switching the circuit-breaker and load-breakswitch on and off

A distinction is made between the following operating modes of circuit-breakers and switches:
- Manual operation
- Motor operation
- Motor operation with “quick-acting” switch

A. Manual operation: switching on
1. Check by the position indicator (4) that the disconnector is fully in the busbar position or fully in the earthing position.
2. The selector slide (8) must be to the left.
3. Place the operating handle on the operating shaft (2) of the switch or circuit-breaker.
4. Turn the operating handle clockwise, until the switch closes.
5. The position indicator (1) must be horizontal.
6. Remove the operating handle.

B. Motor operation: closing
1. With auxiliary voltage connected, the spring-tensioning motor tensions the closing springs.
2. Check by the position indicator (4) that the disconnector is fully in the busbar position or fully in the earthing position.
3. The selector slide (8) must be to the left.
4. Press the closing button on the panel (6) or the remote-positioned closing button to electrically switch on.
5. The position indicator (1) must be horizontal.

C. Motor operation with “quick-closing” switch: closing
1. With auxiliary voltage connected, the spring-tensioning motor tension the closing springs.
2. Check by the position indicator (4) that the disconnector is fully in the busbar position or fully in the earthing position.
3. The selector slide (8) must be to the left.
4. Closing is only possible using the closing button on the panel (6) or the remote-positioned closing button. The closing button on the panel is locked with a key. Switch the panel on by turning this key clockwise and then pressing the button.
5. The position indicator must be horizontal.

Note:
If the panel is fitted with “motor operation with quick-acting switch”, manual closing using the operating handle is not possible. Closing is only possible using the closing button (6) on the panel.

Auxiliary voltage not connected for motor operation with “quick-acting switch”
If no auxiliary voltage is connected, switch on as follows:
1. Check by the position indicator (4) that the disconnector is fully in the busbar position or fully in the earthing position.
2. The selector slide (8) must be to the left.
3. Place the operating handle on the operating shaft (2) of the switch or circuit-breaker.
4. Turn the handle clockwise until the spring is tensioned (turn the handle to the stop).
5. Remove the operating handle.
6. Switch on mechanically by pressing the push-button with key (6).

Note:
A switch with motor operation has no closing coil. Closing is carried out by allowing the motor to turn after tensioning the spring.
A switch with motor operation with a “quick-acting switch” does have a closing coil. Closing is achieved by giving the closing coil a command after the motor has tensioned the spring.

Auxiliary voltage not connected for motor operation
If no auxiliary voltage is connected, then manual mechanical closing (using the operating handle) is possible (see 4.2.2 paragraph 1). In order to manually close motor-operated switches, it may be necessary to use extra force when fitting the handle.

Note: Without auxiliary voltage connected it is not possible to close using the closing button. (even not if the springs are tensioned).
Opening:
The actions below apply to all operating modes described in Chapter 4.3.

1. The selector slide (8) must be to the left.

2. Firmly press the opening button (7) or the remotely positioned opening button.
   - The position indicator (1) must now be vertical.

No-voltage coil
The installation can optionally be equipped with a no-voltage coil.
The no-voltage coil meets the requirements of IEC 62271-1.
The no-voltage coil works in the following way:
- If the secondary voltage drops below 35% of the rated value (U_n), the no-voltage coil trips and opens the switch. With the no-voltage coil tripped, the switch can no longer be opened.
- If the secondary voltage becomes higher than 85% of the rated value (U_n), the no-voltage coil engages and the switch can be closed again.
- The operation of the no-voltage coil can be tested by varying the secondary voltage and checking whether the coil trips and reengages at the thresholds mentioned above.

The switch must be off for these tests.

Shunt Trip
The tripping coil opens the switch electrically. The tripping coil is operated by means of a local or remote opening button.

Note:
The opening button (7) on the switch is always mechanical.
In addition to the tripping coil, it is possible to fit a second tripping coil or a no-voltage coil.

NOTE
If an installation has a no-voltage coil without a locking coil, then the installation may not be operated when the auxiliary voltage is not connected.

NOTE
If an installation has a switch with no-voltage coil, earthing the cable is not possible without auxiliary voltage.
4.2.3 Operating the disconnector

Description of the disconnector
The disconnector has two positions, namely the busbar position and the earthing position.

**NOTE**
Switching from one position to the other is only possible if the switch or circuit-breaker is open.

Busbar position
In the *busbar position* the disconnector is connected to the busbar system, so that if the switch or circuit-breaker is closed, the cable is also connected to the busbar system. See figure 1.

Earthing position
In the *earthing position* the disconnector is connected to the earth busbar. See arrow in figure 2.

When the switch or circuit-breaker is closed, the cable is also connected to the earth busbar.

When the switch or circuit-breaker is open, the disconnector forms an *earthed barrier* between the busbar system and the cable.

In the earthing position, there is also a safe separating distance between the cable and the busbar system.
Operating the disconnector

1. Operation panel of switch panel or circuit-breaker panel

Interlocks
The disconnector can only be operated when the switch or circuit-breaker is open.

Switching over from the busbar position to the earthing position
1. Open the switch or circuit-breaker (see Chapter 4.2.2).
2. Slide the selector (8) to the right and put the operating handle on the operating shaft (3) of the disconnector.
3. Turn the operating handle clockwise until resistance is felt and change-over has been effected.
   - The position indicator (4) of the disconnector should now be in the horizontal position.

**NOTE**
An earthed barrier now separates the cable and the busbar system.

4. Remove the operating handle.

Changing over from the earthing position to the busbar position
1. Open the switch or circuit-breaker (see Chapter 4.2.2).
2. Slide the selector (9) to the right and put the operating handle on the operating shaft (3) of the disconnector.
3. Turn the operating handle anti-clockwise until resistance is felt and change-over has been effected.
   - The position indicator (4) of the disconnector should now be in the horizontal position.

**NOTE**
This removes the earthed barrier between the cable and the busbar system.

4. Remove the operating handle.

For a description of the various ways of earthing the cable, see Chapters 4.2.8 – 4.2.10.
4.2.4 Voltage indication and phase sequence testing

A switch, circuit-breaker and bus-section panel are equipped as standard with a voltage indicator. A voltage indicator can also be optionally fitted on a switch-fuse combination panel. For the operation and specifications of a voltage indicator used in a standard way, see appendix 9.2.

4.2.5 Padlocks

DESCRIPTION

Definitions

Service position  
Disconnected in the busbar position and switch or circuit-breaker closed.

Earthing position  
Disconnected in the earthing position and switch or circuit-breaker closed.

Disconnected position  
Disconnected in the earthing position and switch or circuit-breaker opened.

On the operation panel of a switch panel, circuit-breaker panel and bus-section panel is an interlock strip (5), which can be pulled out (see figure 1, page 77). A padlock can be attached to this. The interlock works in the following way:

Switch

Fitting a padlock prevents the closed switch from being opened in the service position and in the earthing position.

Circuit-breaker

Fitting a padlock prevents the closed circuit-breaker from being opened in the earthing position. Opening CANNOT be prevented in the operating position.

Locking in the intermediate position using a scissor-type interlock

As an option, a scissor-type interlock with padlock can be supplied (figure 1). This scissor-type interlock can be used to lock the switch or circuit-breaker in the disconnected position, for example with the disconnector in the earthing position and the switch or circuit-breaker in the OPEN position.

Bus-section panel with switch

On a bus-section panel, the switch CANNOT be closed if the disconnector is in the earthing position. Fitting a padlock only locks the closed switch from being opened in the operating position.

Bus-section panel with circuit-breaker and switch-fuse combination panel

These panels CANNOT be locked with a padlock interlock.

NOTE

If an electrical tripping coil is present, this is also locked to prevent opening electrically.
FITTING THE PADLOCK INTERLOCKS

Locking in the earthing position
If the cable is earthed via the switch or circuit-breaker, an interlock can be fitted to prevent opening (figure 1). The procedure is as follows:

1. Pull the interlock strip (5) out and attach the padlock and warning sign:
   - The switch or circuit-breaker cannot be switched mechanically or electrically.
   - Remove the padlock to overcome the interlock. The switch or circuit-breaker can then be opened (see Chapter 4.2.2).

2. **NOTE**
   Remove the warning sign as well.

Locking in intermediate position (with scissor-type interlock)
Fit the scissor interlock as follows:
1. Check that the panel is in the intermediate position.
2. Slide the selector to the right.
3. Insert the half-opened scissor interlock into the operating cavity of the disconnector (figure 2).
4. Press the two halves of the scissor interlock together so that one hole is directly above the other.
5. Fit the padlock on the scissor interlock (figure 3).
**OPTION**

As an option, it is possible to have an arrangement whereby the protection cover can only be removed if the cable is earthed and the interlock strip is pulled out. In this case, the switch can no longer be locked to prevent opening in the service position.

**Procedure:**

- **Fundamental principle:**
  The cable is earthed (disconnector in earthing position, switch closed).

- **To open the door:**
  Pull the interlock strip (5) out and open the door with the key.

- **To close the door:**
  Pull the interlock strip (5) out and close the door with the key.
4.2.6 Self-resetting indicators

As an option, cable panels can be provided with a self-resetting overcurrent indicator or short-circuit current indicator.

**Overcurrent indicator**
The overcurrent indicator (9) signals an overcurrent between 200 and 1000 A per phase, adjustable in steps of 200 A.

The indicator consists of a module with (see figure 1):
- three signal-emitters (L1, L2 and L3), one for each phase; these signal red when the preset response value is reached.
- a test and reset button (10a)
- a built-in battery (lithium) for testing and resetting

Upon delivery the response value of the short-circuit current is set to 200, 400, 600, 800 or 1000 A.
The automatic reset time can be set to 2 or 4 hours. This means that the indicator automatically resets itself 2 or 4 hours after responding. Press the test and reset button to reset it sooner.

**Testing the self-resetting overcurrent indicator**
The signal-emitters should be red when the test and reset button is pressed. The signal-emitters should turn black when the test and reset button is pressed again.
If the indicator is not working properly, the user should contact Eaton Service.

**Short-circuit current indicator**
The short-circuit current indicator (9) signals a sudden change of current (not overcurrent). Slow changes of current, such as load fluctuations during the course of a day, are not signalled.

Two conditions must be met in order for the indicator to respond:
1. There must be a rapid change in the current that is characteristic of a short-circuit current, $150 \text{ A} \leq \Delta i \leq 300 \text{ A}$.
2. The short-circuit current must be switched off after at least 1 second and the current must be $< 3 \text{ A}$.
The indicator will only signal a short-circuit current if both conditions are met.

The indicator consists of a module with (see figure 1):
- three signal-emitters (L1, L2 and L3), one for each phase; these signal red in the event of a short-circuit current
- a test and reset button (9a)
- a built-in battery (lithium) for testing and resetting

The automatic reset time is set to 3 hours. This means that the indicator automatically resets itself after 3 hours.
4.2.7 Cable-side voltage transformers

General
As an option, 3 cable-side voltage transformers can be fitted in a switch, circuit-breaker or bus-section panel. The 3 cable-side voltage transformers (see figure 1) are mounted under the cable connection in the cable panel. The primary side of the voltage transformers is connected to the cable connection by means of a detachable epoxy resin insulated connector. Connection information regarding the secondary side is given in the diagram package supplied with the installation.

**DANGER WARNING**
The cable-side of the panel on which work is being carried out must be earthed; for instructions, see Chapter 4.2.8.
The cable must not be live; check this by means of the voltage indicator (see chapter 4.2.4).
On the secondary side of the transformer, the fuses must be removed or the automatic cut-outs turned off, so that feedback is impossible.

**Disconnection**
1. Make sure the cables are earthed and the transformers isolated on the secondary side (see under General).
2. Remove the protection cover.
3. Remove the 3 end caps and the 3 sleeves from the epoxy resin insulated connection. An extraction tool is available for removing the end caps (see chapter 7).
4. Loosen the 3 contact pins with a socket wrench (size 13) and remove them.
The cable can now be tested or metered, for example (see Chapter 4.2.15).

**Connecting**
1. Make sure the primary cables are earthed and the transformers isolated on the secondary side (see General).
2. Fit the 3 contact pins and tighten them with a socket wrench (size 13); the tightening torque is 9 Nm.

3. Clean the holes for the sleeves.
   - Fit new sleeves greased with silicone grease and then the end caps. Use a polyamide thread for venting.
   - The sleeves, end caps and polyamide thread are obtainable from Eaton.
   - Remove the polyamide thread.
4. Fit the protection cover.
5. Fit the fuses or switch the automatic fuses on the secondary side back on.

The panel can now be brought into service again (see Chapter 4.2.2).
4.2.8 Earthing the cable via the switch or circuit-breaker

1. Open the switch or circuit-breaker (see Chapter 4.2.2).

2. Put the disconnector in the earthing position (see Chapter 4.2.3).

3. Check the operation of the voltage indicator with the tester (see appendix 9.2).

4. Using the voltage indicator, check that the earthing cable is not live (see appendix 9.2).

5. Turn the switch or circuit-breaker on (see Chapter 4.2.2).
   - The cable is now earthed via the switch or circuit-breaker.

6. Lock the installation where applicable with a padlock (see Chapter 4.2.5)
4.2.9 Earthing the cable of a 12 - 24 kV switch-fuse combination panel

Required accessories
Bag containing earthing equipment, consisting of (see figure 1):
- three earthing pins (a) with earth contact and earthing cable (25 mm²) with connecting clamp
- an operating rod

For technical data, see Chapter 7.

Interlocks
- The cables can only be earthed if the high-voltage fuses are removed and the earthing equipment is fitted.
- It is only possible to gain access to the high-voltage fuses if the switch is open and the disconnector is in the earthing position.

INSTALLATION OF EARTHING
1. Remove the high-voltage fuses (see Chapter 4.2.13).
   - In this situation the disconnector is in earthing position and the switch cannot be closed.

2. Remove the lower protection cover using the key.

3. Switch off the low-voltage side of the transformer to be earthed and check that the cables to be earthed are not live before attaching the earthing equipment.

4. Connect the earthing cable clamps to the earth bar of the panel using the wing nuts.

5. Fit the earthing pins one by one using the operating rod. Note:

   **DANGER!**
   When fitting the earthing pins, never place your hand between the red ring on the operating rod and the earthing pins or the stop.

   - Connect the operating rod to the earthing pins and push the earth contacts into the socket contacts of the cable to be earthed.
Removal of earthing

**DANGER!**
When fitting the earthing pins, never place your hand between the red ring on the operating rod and the earthing pins or the stop.

1. Using the operating rod, remove the earthing pins one by one from the socket contacts.

2. Remove the earthing cable clamps from the earth busbar.

3. Secure the lower protection cover again using the key.

*Note:*
If the panel is put back into service after the earth has been removed, it is first necessary to replace the high-voltage fuses (Chapter 4.2.13), after which the panel can be in service again (Chapter 4.2.2).
4.2.10 Earthing the cable of a 12 kV switch-fuse combination panel

Required accessories
Bag containing earthing equipment, consisting of (see figure 1):
- three earthing pins (a) with earth contact and earthing cable (25 mm$^2$) with connecting clamp
- an operating rod
For technical data, see chapter 7.

Interlocks
- The cables can only be earthed if the high-voltage fuses are removed and the earthing equipment is fitted.
- It is only possible to gain access to the high-voltage fuses if the switch is open and the disconnector is in the earthing position.

INSTALLATION OF EARTHING
1. Remove the high-voltage fuses (see Chapter 4.2.13).
   - In this situation the disconnector is in earthing position and the switch cannot be closed.
2. Remove the lower protection cover using the key.
3. Switch off the low-voltage side of the transformer to be earthed and check that the cables to be earthed are not live before attaching the earthing equipment.
4. Connect the earthing cable clamps to the earth bar of the panel using the wing nuts.
5. Fit the earthing pins one by one using the operating rod. Note:

DANGER!
When fitting the earthing pins, never place your hand between the red ring on the operating rod and the earthing pins or the stop.

- Connect the operating rod to the earthing pins and push the earth contacts into the socket contacts of the cable to be earthed.
Removal of earthing

DANGER!
When fitting the earthing pins, never place your hand between the red ring on the operating rod and the earthing pins or the stop.

1. Using the operating rod, remove the earthing pins one by one from the socket contacts.

2. Remove the earthing cable clamps from the earth busbar.

3. Secure the lower protection cover again using the key.

Note:
If the panel is put back into service after the earth has been removed, it is first necessary to replace the high-voltage fuses (Chapter 4.2.13), after which the switch can be in service again (Chapter 4.2.2).
4.2.11 Three-pole short-circuit-proof take-over earth

**Required accessories**

For fitting a three-pole take-over earth on the (Magnefix adapter) cable entry port, a bag of earthing equipment can be supplied (figure 1), consisting of:
- one unit with three earth contacts and two built-in interlocks with keys
- one earthing cable (70 mm²) with connecting clamp

For technical data, see Chapter 7.

**Interlocks**

Access to the cable entry port is only possible if the cable is earthed by means of the integrated earthing of the switch panel or circuit-breaker panel. However, this is not possible on a panel with a direct busbar connection.

**Installation of the three-pole take-over earth**

**DANGER!**

When earthing the cable via the (Magnefix cable) terminal block in combination with a direct busbar connection, the shutter is secured in front of the cable entry ports. The contacts behind this shutter are directly connected to the main busbar system of the installation. This requires extra safety measures.

1. Earth the cable via the integrated earthing of the switch or circuit-breaker (see Chapter 4.2.8).
2. Open the relevant protection cover by turning the key a quarter turn **anti-clockwise** and remove the panel.

**NOTE**

The shutter can only be opened if the disconnector is in the earthing position and the circuit-breaker or switch is closed.

3. Connect the earthing cable to the earth bar using the connecting clamp.
4. Move the shutter of the cable entry port up.

5. Insert the earthing unit in the cable entry port as far as the plastic rings.

6. Then lock the unit by turning the two interlocks **behind** the posts of the cabinet and remove the key.
   - **The cable is now also earthed via the external take-over earth.**

**Remove the three-pole take-over earth**

*Fundamental principle*

The cable is earthed via the integrated earthing of the switch or circuit-breaker.

1. Unlock the take-over earthing unit by means of the two interlocks and remove the unit from the cable entry port.

2. Disconnect the earthing cable from the earth bar.

3. Close the installation by fitting the relevant protection cover and lock it by turning the key a **quarter turn** clockwise.
   - **The outgoing cable is now only earthed via the integrated earthing of the switch panel or circuit-breaker panel.**
4.2.12 Single-pole short-circuit-proof take-over earth

Using the single-pole short-circuit-proof take-over earth it is possible to earth 1, 2 or 3 phases as necessary, whilst carrying out metering or voltage testing on the unearthed phase.

**Required accessories**

For fitting a single-pole take-over earth on the (Magnefix adapter) cable entry port, a bag of earthing equipment can be supplied (figure 1), consisting of:

- three earthing pins
- an insulated locking plate with:
  - two hooked latches and
  - two guide pins
- two padlocks
- one cable clamp bar

The single-pole take-over earth should be connected using commercial earthing cables with ball-head bolt connector and a mounting rod (20 mm ball) (see figures 2 and 3 for an example).

The earth plate of the relevant SVS/08 panel has to have a 20 mm ball-head bolt connection (see figure 4).

These earthing cables with ball-head bolt connections are also obtainable from Eaton.

For technical data of the accessories obtainable from Eaton, see Chapter 7.

**Note:**

The technical data of earthing cables and ball-head bolt connections not supplied by Eaton depend on the used make and type. These cables and connections must comply with the recommendations described in IEC publication 60298, Chapter 5.3.2.

**Interlocks**

Access to the cable entry port is only possible if the cable is earthed by means of the integrated earthing of the switch panel or circuit-breaker panel. However, this is not possible on a panel with a direct busbar connection.
Installation of the single-pole take-over earth

**DANGER!**
When earthing the cable via the cable terminal block in combination with a direct busbar connection, the shutter is secured in front of the cable entry ports. The contacts behind this shutter are directly connected to the main busbar system of the installation. This requires extra safety measures.

1. Earth the cable via the integrated earthing of the switch or circuit-breaker (see Chapter 4.2.8).

2. Open the relevant protection cover by turning the key a quarter turn **anti-clockwise** and remove the panel.

**NOTE**
The shutter can only be opened if the disconnector is in the earthing position and the circuit-breaker or switch is closed.

3. Connect the earthing cable to the earth bar using the connecting clamp.

4. Fit the 3 earthing pins to the connection points on the earthing cables. Note:
   - Move the shutter of the cable entry port up and insert the pins in the cable entry port using the mounting rod.
5. Fit the insulated locking plate and slide it onto the earthing pins as far as the plastic rings. Make sure that the guide pins of the locking plate are situated on top, next to the shutter.

6. Then turn the 2 hooked latches behind the posts of the cabinet and attach the padlocks.

7. Place the cable clamp bar as close as possible to the clamps on the ball contacts and secure the clamp bar using the two wing nuts.

The cable is now also earthed via the external take-over earth. This enables the metering and voltage testing of the phase that has not been earthed by an earthing cable. To do so, the switch or circuit-breaker has to be opened.

**DANGER!**

Before changing phases for metering and voltage testing, the cable must first be earthed (see Chapter 4.2.8) via the switch or circuit-breaker.

---

**Remove the single-pole take-over earth**

1. Remove the padlocks.

2. Unlock and remove the insulated locking plate.

3. Disconnect the earthing cable from the earth plate.

4. Close the installation by fitting the relevant protection cover and lock it by turning the key a quarter turn clockwise.

   - The outgoing cable is now only earthed via the integrated earthing of the switch panel or circuit-breaker panel.
4.2.13 Replacing high-voltage fuses

**NOTE**
The fuses (in conformance with DIN 43625) should have a striker pin, to ensure correct automatic opening of the switch. Always place the striker pin output in the handle.

1. **Open** the switch (see Chapter 4.2.2).

2. Put the disconnector in the **earthing position** (see Chapter 4.2.3).

3. Check that the selector (7) is in the **right-hand** position.

4. Insert the key in the lock of the protection cover for the fuses and push the selector (7) **up**.

5. Give the key a quarter turn **anti-clockwise** and open the protection cover.

6. Remove the fuses with handles.

---

**6.1 Removing the 12 kV fuse with handle**

**6.2 Removing the 12 - 24 kV fuse with handle**
7. Replace the fuse in the handle.

7.1 Inserting the fuse in the 12 kV handle.

**WARNING**
When fitting the fuse, do not rest the handle against the wall or the ground, to avoid damaging the fuse internals. Fit the fuse with the striker pin output in the handle.

8. Slide the handle with the fuse into the installation.

8.1 Inserting the 12 kV fuse with handle

**NOTE**
On a 12 - 24 kV version, when removing the fuse from the handle, the ring of the handle must first be pushed backwards.

8.2. Inserting the 12 - 24 kV fuse with handle

9. Close the protection cover by pushing the selector (7) up and turning the key a quarter turn clockwise.

10. Set the disconnector to the busbar position. Chapter 4.2.3).

11. Close the switch-fuse combination panel (see Chapter 4.2.2).
4.2.14 Operating the instrument compartment

**DANGER WARNING**
If some components are still live while the instrument compartment is open, the general low-voltage safety regulations must be observed.

A. Instrument compartment 200 mm and 400 mm in height.

**Opening**
Turn the key a quarter turn **anti-clockwise** and using the key pull the drawer outwards to the stop.

**Closing**
The instrument compartment is closed in the reverse sequence to that described above.

B. Complete removal of the drawer (for servicing purposes).

- Open the panel door
- Press the interlock strip (1) of the drawer downwards (figure 1)
- Carefully pull out the drawer further whilst supporting it from below.
- Place the drawer at a height of circa 135 cm.

**DANGER WARNING**
Do **not** remove the connectors of the drawer whilst the installation is in operation.

When the installation is not in operation the connectors can be removed.

Only restart the installation after the connectors have been replaced.

C. Removing the protecting cover

200 mm compartment
The protecting cover has two pressed-in threaded ends. These threaded ends are on the front left and right of the cover. Remove the nuts from these threaded ends to remove the cover.

400 mm compartment
The protecting cover has three pressed-in threaded ends. There are two threaded ends on the right of the cover and one threaded end on the left. Remove the nuts from these threaded ends to remove the cover.
4.2.15 Metering and voltage testing

Required accessories

- Metering and testing pins for the 12 kV cable entry port.
- Metering and testing pins for right-angle plugs are available from the plug supplier.

Testing the cable via the cable terminal block

**DANGER!**
When testing the cable via the cable terminal block in combination with a direct busbar connection, the shutter is secured in front of the cable entry ports. The contacts behind this shutter are directly connected to the main busbar system of the installation. Extra safety measures must be taken when any testing is undertaken.

1. Earth the cable via the integrated earthing of the switch or circuit-breaker (see Chapter 4.2.8).
   Disconnect any voltage transformer mounted on the cable-side (see Chapter 4.2.7).
2. Open the relevant protection cover by turning the key a quarter turn anti-clockwise and remove the panel.
3. Move the shutter of the cable entry port up.
4. Insert the pins in the cable entry port and connect the metering or voltage testing equipment.
5. Turn the switch or circuit-breaker off (see Chapter 4.2.2).
   - Metering or voltage testing can now be carried out.
6. Remove the pins.
7. Move the shutter of the cable entry port down.
8. Close the protection cover and lock it by turning the key a quarter turn clockwise.

*Note:*
For further information about using metering or voltage testing equipment, refer to the supplier documentation.
Testing the cable using right-angle plugs

1. Earth the cable via the integrated earthing of the switch or circuit-breaker (see Chapter 4.2.8).

2. Open the relevant protection cover by turning the key a quarter turn anti-clockwise and remove the panel.

3. Remove the protecting covers from the right-angle plugs.

4. Remove the insulation cones.

5. Place the metering and voltage testing equipment in the right-angle plugs.

6. Turn the switch or circuit-breaker off (see Chapter 4.2.2).
   - Metering or voltage testing can now be carried out.

7. Directly after the metering or voltage testing, close the switch or circuit-breaker on (see Chapter 4.2.2).

8. Remove the metering or voltage testing equipment.

9. Fit the insulation cones.

10. Fit the protecting covers.

11. Close the protection cover and lock it by turning the key a quarter turn clockwise.

Note:
For further information about using metering or voltage testing equipment, refer to the supplier documentation.
5. SYSTEM COMMISSIONING AND DECOMMISSIONING

5.1 Commissioning

5.1.1 Preparatory work and checks

1. Carry out a visual inspection.

Before commissioning the SVS/08 installation, check that:

- the area in which the installation is set up complies with the guidelines described in Chapter 3.1.
- the installation is placed in a sufficiently firm and level position.
- the cables are located directly beneath the connections.
- the cable connection and the support are properly tightened.
- the phase sequence of the connected cables is correct.
- the earth busbar is earthed.
- the lead sheath and the earth screens of the cables are earthed.
- the cable boxes for PILC cables (if used) are completely filled.
- the hose clips (if used) are tightened.
- the rated currents of the high-voltage fuses are correct.
- the high-voltage fuses are fitted correctly with the striker pin in the handle.
- the inside of the installation is free of dust.

2. Replace all protective covers after the checks are completed.

**DANGER!**

If an SVS/08 panel is commissioned without a primary cable connected, the panel in question must be put in the earthing position to prevent contact with live connection points, that is to say, the disconnector must be in the earthing position and the switch or circuit-breaker must be closed.

**DANGER!**

When commissioning a metering panel in the special version (supplied up to 2006) with non-insulated copper connections, all guards against direct or indirect contact must be in place. Therefore do not remove any covers from this panel when the system is live.

3. Then carry out a function test:

- Test the closing and opening functions.
- Test the interlocks
- Test the door interlock.
5.2 Decommissioning

5.2.1 Dismantling

**DANGER!**
The installation must be completely dead before dismantling.

**Personal protection equipment**
- Safety goggles
- Protective clothing and footwear

**Removing the main spring**

**DANGER!**
The installation must be disconnected from the network.

**Note:**
The description refers to figure 1 in Chapter 6.1.2.

1. Switch the installation off (see Chapter 4.2.2).

2. Place the operating handle on the operating shaft of the switch.
   - Turn the operating shaft a quarter turn clockwise and keep it in this position.

3. Insert an L profile in the slot which comes free under strip G of the main spring.

4. Turn the operating shaft back.

5. Remove the pin (X) and remove the main spring completely from the mechanism.

**DANGER WARNING**
The main spring is still tensioned. It must first be clamped. After that, the interlocks can be removed and the spring carefully released.

The user is himself responsible for the safe execution of this procedure.

5.2.2 Disposal

Switchgear should be disposed of in an environmentally responsible manner.

Substances and materials arising from dismantling should be destroyed, re-used or disposed of in accordance with the regulations and requirements currently in force.

A list of the materials used is available from Eaton.

- In consultation with Eaton, the installation can be returned to Eaton.
6. SYSTEM INSPECTION, MAINTENANCE AND REPAIR

6.1 Inspection and maintenance

6.1.1 Maintenance frequency

Under normal conditions, medium voltage switchgear, type SVS/08, is maintenance free for 10 years. Thereafter, depending on the operating conditions, maintenance is only required once every 5 years.

This maintenance can be carried out by qualified personnel, in accordance with the 6.1.2 guidelines described below. The safety instructions must be adhered to. Eaton can undertake this work for you or, if desired, can train your own personnel to carry out inspection and maintenance work.

Switches that are motor-controlled and have a quick-on mechanism—so-called generator switches—are subject to an additional maintenance requirement. For these switches, the mechanism must be inspected after being switched 2000 times and must be replaced after being switched 5000 times. This inspection and replacement must be carried out by Eaton.

6.1.2 Checking and maintaining the mechanism

Checking the mechanism

- Turn switches which are seldom or never switched on and off ten times.

Maintenance of the mechanism

WARNING

During the following activities, access is gained to the mechanism.

Avoid injuries that may be caused by uncontrolled movements of the mechanism or injuries caused by sharp edges of sheeting.

Access is also gained to the secondary wiring and components; if any parts are live, the general low-voltage safety requirements must be observed.

1. Ensure there are safe working conditions:
   - open the appropriate switch and put the disconnector in the earthing position (see Chapter 4 System operation).

2. Removing the top cover:
   - Slightly loosen the 2 bolts on the back of the installation with a spanner (size 8).
   - Lift the cover at the back and slide it forwards.

3. If there is an instrument compartment:
   See also paragraph 4.2.14

3.1 Opening the drawer
   - Press the interlock strip (1) of the drawer downwards (figure 1)
   - Carefully pull out the drawer further whilst supporting it from below.
   - Place the drawer at a height of circa 135 cm.

Or if the installation is dead
   - Remove the connectors and then remove the drawer.

3.2 Removing the protecting cover

200 mm compartment

The protecting cover has two pressed-in threaded ends. These threaded ends are on the front left and right of the cover. Remove the nuts from these threaded ends to remove the cover.

400 mm compartment

The protecting cover has three pressed-in threaded ends.

There are two threaded ends on the right of the cover and one threaded end on the left. Remove the nuts from these threaded ends to remove the cover.

3.3 Removing the cover plate.

This plate is secured with 3 bolts.

Two on the front and one in the centre of the rear of the cover plate.

4. Lubricate the turning and sliding points of the parts concerned with Molykote paste BR2 lightly. These are indicated in figure 1 on page 99.

NOTE

It is advisable to use a long-handled brush to grease the various parts. This facilitates greasing and prevents injuries.

Tip

Use as little as possible grease.
Front of the installation

A. The shaft for driving the disconnector.
B. The shaft for driving the switch or circuit-breaker.
C. The bevel gear.
D. The catch in the three levers.
E. The shaft for driving the position indicator for the disconnector.
F. The shaft for driving the position indicator for the switch or circuit-breaker.
G. The main spring strip.
H. The opening strip.
K. The 2 interlock plates.
X. Pin for main spring.
6.1.3 Topping up grease-filled cable boxes

Supplied accessories
• Filling device

**DANGER!**
When performing work on the cable box, the relevant cable(s) must always be earthed.

1. Check the cable grease level, using a lamp if necessary.
   • The cable box will require to be topped up once its grease level has dropped to a point below the cable core clamps, due to the grease being absorbed by the cable.
   • Should this be the case, the hose of the filling device - prior to being inserted into the cable box – must be filled completely with grease so as to prevent the ingress of air.
   • For filling the cable box, see Chapter 3.3.8.

2. Undo the hose clip and slide the cable box so far down that the nylon vent threads can be fitted (see figure 1).
   • If the sliding action is difficult due to the grease having become too viscous, you can apply a little heat to the cable box, using a hot air gun for instance.

**DANGER WARNING**
Never heat the cable box with a naked flame.

6.1.4 Cleaning the installation

If the installation has been set up in accordance with the guidelines described in chapter 3.1, cleaning is not necessary.

For installations that are dirty, the following measures are required:

**DANGER!**
The installation must be made completely dead.

• Clean dirty parts with a damp cloth.
• Dry the installation and lightly grease epoxy resin parts with silicone grease, type DC-4 or MAC 05. Polish the film of grease until a polished, non-sticky finish is obtained.

*Note:*
MAC 05 is a cleaning and conditioning agent developed by Eaton which gets rid of surface dirt and creates a moisture-repellent film of silicone on the epoxy resin.
6.1.5 Replacing the bottom contacts in the 24 kV fuse holder of a switch-fuse combination panel

General
The 24 kV fuse holders of a switch-fuse combination panel are suitable for use with 20/24 kV fuses (figure 1) in conformance with DIN 43625.

If an installation is supplied for an operating voltage of 10/12 kV, these fuse holders can be equipped with 10/12 kV bottom contacts with spacer (figure 2).

If an installation is initially commissioned with a certain operating voltage and is later changed to a different operating voltage, the bottom contacts must be changed.

Required accessories
- one bottom contact 20/24 kV (figure 1) or
- one bottom contact 10/12 kV with spacer (figure 2)
- a spanner (figure 3)

Note:
17.5 kV fuses are available in short (10/12 kV) and long (20/24 kV) versions.

1. Bottom contact 20/24 kV (DIN 43652)

2. Bottom contact 10/12 kV with spacer (DIN 43625)

3. Spanner, to be used in combination with a torque wrench set at 20 Nm
Replacing a 10/12 kV bottom contact with spacer with a 20/24 kV bottom contact

1. Remove the high-voltage fuses according to the procedure described in Chapter 4.2.13.

In this situation the disconnector is in earthing position and the switch cannot be closed.

2. Switch the low-voltage side of the transformer off and check - before removing the bottom contact with spacer - that the outgoing cables are not live.

3. Remove the 10/12 kV bottom contacts and the spacers using the special spanner.

4. Clean the contact surfaces of the 20/24 kV bottom contacts with, for example, Scotch Brite scouring pads.

5. Fit the preassembled 20/24 kV bottom contact using the special spanner set to a tightening torque of 20 Nm, as follows:
   - Fit the preassembled 20/24 kV bottom contact on the spanner.
   - Rest the contact against the side of the fuse holder and slowly lower the whole assembly.

6. Fit the 20/24 kV fuses and close the switch (see Chapter 4.2.10).
Changing a 20/24 kV bottom contact for a 10/12 kV bottom contact with spacer

1. Remove the high-voltage fuses according to the procedure described in Chapter 4.2.13. In this situation the disconnector is in earthing position and the switch cannot be closed.

2. Switch the low-voltage side of the transformer off and check - before removing the bottom contact - that the outgoing cables are not live.

3. Remove the 20/24 kV bottom contacts with the special spanner.

4. Clean the contact surfaces of the 10/12 kV bottom contacts with spacer using, for example, Scotch-Brite scouring pads.

5. Fit the preassembled 10/12 kV contact with the spacer using the special spanner with a tightening torque of 20 Nm, as follows:
   - Fit the preassembled 10/12 kV bottom contact with the spacer on the spanner.
   - Rest the contact against the side of the fuse holder and slowly lower the whole assembly.

6. Fit the 10/12 kV fuses and close the switch (see Chapter 4.2.10).
6.2 Repairs

Eaton-Electrical Services & Systems (E_ESS) should be contacted for troubleshooting and repairs. E_ESS is available for advice and repair work 24 hours a day, 7 days a week.

Address:

Eaton Electrical Services & Systems (E_ESS)
7550 AA HENGELO, P.O. Box 23
7559 SC HENGELO, Europalaan 202

Telephone:  +31 (0) 74 246 9111 /
             +31 (0) 74 246 6888 (24 hours)
Fax:         +31 (0) 74 246 4444
E-mail:      Holec-info@Eaton.com
             secretariaatservice@Eaton.com
Internet:    www.eatonelectrical.nl
7. ACCESSORIES

7.1 Overview of accessories which can be supplied

1. Operating handle
   (106.311)

2. Key for protection cover
   A. (106.363) up to release 1.3, February 2007
   B. (324 555) from release 2.0, March 2007

4. Key for cable core clamps (681.963)
5. Filling device with:
   - hand pump (a)
   - filling hose with hose clip, shut-off ring and connector nipple (b)
   - filling device with filling tube (c)
     (complete set : 684.016)

6. Single-core Eaton plastic-insulated transformer cable; please state length and type when ordering

   A. SVS side
   B. Transformer side
7. Earthing equipment for earthing the cable of a 12 – 24 kV switch-fuse combination panel (long fuse cassette):
   - three earthing pins (a) with earth contact and earthing cable with clamps
   - an operating rod (b)
     (12 kV: 106.107) (for a long fuse cassette with 12 kV adapter)
     (24 kV: 106.132)

Technical data

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8. Earthing equipment for earthing the cable of a 12 kV switch-fuse combination panel (short fuse cassette):
   - three earthing pins (a) with earth contact and earthing cable with clamps
   - an operating rod (b)
     (612.891)

Technical data

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<td>Earthing cable cross-section</td>
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9. Three-pole, short-circuit-proof take-over earth to be installed on the 12 - 17.5 kV cable entry port of a switch panel or circuit-breaker panel, consisting of:

- a three-phase star point with:
  - three earth contacts (a)
  - one earthing cable (b)
  - two built-in interlocks (c) with keys (612,191)

Technical data

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<td>withstand current</td>
<td>(kA)</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Rated peak</td>
<td>(kA)</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>withstand current</td>
<td>(mm²)</td>
<td>70</td>
<td>70</td>
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</table>

10. One-pole, short-circuit-proof take-over earth to be installed on the 12 - 17.5 kV cable entry port of a switch panel or circuit-breaker panel, consisting of:

- three earthing pins (a)
- an insulated locking plate (b) with:
  - two hooked latches (c)
  - two guide pins (d)
- two padlocks (e)
- one cable clamp bar (f) (107.924)

Technical data

<table>
<thead>
<tr>
<th></th>
<th>(kV)</th>
<th>12</th>
<th>17.5</th>
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<td>17.5</td>
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<td>Rated short-time</td>
<td>(kA)</td>
<td>20</td>
<td>20</td>
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<tr>
<td>withstand current</td>
<td>(kA)</td>
<td>50</td>
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11 Accessories for short-circuit-proof take-over earth
11.1 Earthing cable with ball-head bolt connection
   (107.197)

11.2 Mounting rod for earthing cables
   (684.420)

Technical data

<p>| | | |</p>
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<td>Rated short-time withstand current for 1 sec</td>
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<td>Rated peak withstand current</td>
<td>(kA)</td>
<td>50</td>
</tr>
<tr>
<td>Earthing cable cross-section</td>
<td>(mm²)</td>
<td>50</td>
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</table>

12. Padlock with warning sign; used to lock to prevent opening if a panel is earthed via the switch or circuit-breaker
   (569.463 lock)
   (107.079 sign)

13. Scissor-type interlock for locking a switch or circuit-breaker in the intermediate position
   (106.348)
14. Metering and testing pins for 12 - 17.5 kV cable terminal block. (106.340)
15. Single-pole voltage tester type UNL: (12 kV 685.083)
   • Measurement probe (a)
   • Handle (b)

The single-pole voltage tester consists of two parts:
   • the measurement probe (antenna) with interchangeable test point (a);
   • the handle (b)

The probe is screwed onto the grip before use. During transport of the tester the probe can also be fixed to the grip in inverted position.

The probe has a clearly visible red ring.

An indicator lamp (c) and push button (d) are fitted to the wide end of the probe (which is screwed to the grip). The indicator lamp will light up when the test point of the measurement probe is under voltage. The pushbutton is used to test the probe.

The rated voltage of the probe must match the operating voltage of the switchgear being tested. The rated voltage is indicated on the wide part of the probe.

**CAUTION**
- Clean and dry the voltage tester thoroughly before using it.
- Do not insert the voltage tester past the red ring into live switchgear components.
- Hold the voltage tester firmly behind the ring on the grip.

**NOTE**
Read the instructions for use included with the voltage tester.

16. Extraction tool for removing end caps of voltage transformers. (625.540)

17. Sealing set for cable-side voltage transformers. (107.070)
8. GLOSSARY

8.1 Safety and qualification of personnel

European standard applicable
Applicable standard: EN 50110-1, chapter 4 ‘Basic principles’. This paragraph sets out the main requirements for safe operation as regards personnel.

- Supplier:
  Eaton Electric B.V. or its representative.

- User:
  The person or body responsible for operation and maintenance of the switchgear.

- Competence of personnel
  Operating personnel are subject to the following requirements:
  1. They must be ‘competent’. A competent person has relevant training and experience so that he or she is capable of preventing dangers which may be caused by electricity, for instance, during switching operations.
  2. Operating personnel must hold a written certificate of authorisation to perform switching operations signed by the management of the (power) company involved.

- Responsibility
  It must be clear who is responsible for operations.
  - All operations come within the area of responsibility of the works operations manager (this person must be designated in accordance with EN 50110-1 as the person directly in charge of the operations).
  - An installation manager must be appointed (in accordance with EN 50110-1) the installation manager is directly responsible for operation of the installation). If two or more installations are in close proximity to each other, it is essential that appropriate arrangements are made between the installation managers.

  - The responsibility which persons have for the safety of those involved in the operations, and of those who (may) have to deal with the consequences of the operations, must conform to national legislation.
  - Before operations are begun, while they are being carried out and prior to commissioning of the installation, the works operations manager must ensure that all requirements, rules and instructions are complied with.

- Communication
  Before starting operations, the installation manager must be informed of the intended operations. See EN 50110-1 § 4.4 for additional requirements.

- Instruction
  All personnel involved in operations carried out on, with or near electrical installations require to have been instructed (using these operating instructions) on the safety requirements, safety rules and operating instructions applicable to operating the installation.

- Clothing
  Personnel must wear suitable close-fitting clothing.

- Local regulations
  Naturally, local rules and regulations (including operating instructions) must be followed.
8.2 Abnormal Service conditions

- **Rated voltage, current, power**
  The voltage, current and power upon which the design of the switchgear is based.

- **Short-circuit**
  An unintentional connection between two or more electrical conductors, or between a conductor and earth, in which extreme heat may be generated which may damage the installation and its surroundings.

- **Short-circuit current**
  An electrical current which is higher, as a result of a short-circuit, than the nominal current.

- **Arc**
  An electrical discharge, through the insulation, which produces a short-circuit. In general, and in particular in air-insulated installations, arcing may occur unexpectedly and be of an explosive nature.

8.2.1 Equipment and the area surrounding it

- **Electrical installation**
  An assembly of electrical leads and the appliances to which the leads are connected.

- **Switching and distribution unit, switchgear**
  A unit to protect or switch on or off, in one place, two or more parts of an electrical installation.

- **Switchroom**
  The location in which the switchgear is set up.

- **Working area**
  A clearly designated part of the switchroom in which work on the installation can be carried out safely.

- **Switch**
  A device for the purpose of switching electrical currents on and off.

- **Fuse**
  An electrical appliance that is connected in series with a circuit, and can interrupt the circuit safely by the melting of an internal conductor immediately the current in the circuit exceeds a specified value for a specified time.

- **Cartridge fuse**
  The replaceable part of a fuse which contains the (fusible) conductor.
9. APPENDIX

9.1 General

This user manual is part of the information package compiled whenever equipment is supplied and consists of the following parts:

Information on the folder(s):
- Project title
- Name of the installation
- Type of installation (key data such as voltage, current, etc.)
- Client order number
- Eaton name and order number
- Eaton contact address; name and telephone/fax number (for reporting faults)
- Date of issue
- Table of contents

Diagram package, including:
- Single line diagram
- Equipment diagrams
- Key to codes
- Panel diagrams
- Space allocation
- Floor plan drawing with dimensions, measurements and weights

Test reports:
- Routine test reports of:
  - Switchgear
  - Current and voltage transformers which are supplied
  - Other equipment which is supplied, for example:
    - Contactors
    - switches
    - Earthing switches
    - Battery sets

Spare parts list:
- All relevant parts which may be replaced during the lifetime of the equipment, for example spring tensioning motors, tripping coils, meters, push-buttons, terminal strips, etc.
- Information such as the type, rating, price, stock number and other ordering information

User manuals:
- User manual for the Eaton equipment in the relevant version(s)
9.2 Voltage detecting system Wega 1.2

Instructions for Use
Integrated voltage detecting system
Typ WEGA 1.2

1. General
The integrated voltage detecting system WEGA 1.2 is in compliance with the requirements for voltage detecting systems of the valid VDE 0682 part 415 (IEC 61243-5), which are capacitively connected to single pole with live parts.
The WEGA 1.2 is designed for fitting into switch-gears. It serves for determination and indication of the operating status of medium voltage systems according to VDE 0105 part 1 and 100 and includes a LRM interface for all three phases.
The display can be verified by using the integrated display test function in installed state or if the voltage is not present.

2. Specification for application
WEGA 1.2 may only be used for determination of operating status and for taking a phase comparison of high voltage systems in accordance with VDE 0105 part 1 and 100.
Special care should be taken in observing the following:
- Integrated voltage detecting systems WEGA 1.2 may only be implemented by an electrician or by electrically trained persons.
- Integrated voltage detecting systems WEGA 1.2 may only be used in accordance with the permitted rated voltage (rated voltage of the medium voltage system) and rated frequency. Adaptation to the prevailing operating voltage can be made with capacitors by manufacturer.
- The equipment has to be handled exactly as specified in the operating instruction (5).
- The positive display “Voltage present” according to VDE 0682 part 415 is granted, if WEGA 1.2 is operated according to its rated voltage and rated frequency and the adaption with capacitors was done accordingly.
- Indication appears in three-phase networks in the range from 45% to 120% of the rated voltage, but not less than 10% of the rated voltage.
- Integrated voltage detecting systems WEGA 1.2 may only be used indoor.
- It has to be ensured that voltage is not present (all-pole) before entering a medium voltage area.
- At unfavourable lighting conditions it may be useful to shadow the LCD-display or to illuminate it additional.
- Integrated voltage detecting systems WEGA 1.2 is designed for continuous operation.
- Phase comparison is possible by using a phase comparator in accordance to VDE 0682 part 415 (LRM Systems) which has to be plugged into the earth point and one of the three test points.
3. Design

The integrated voltage detecting system WEGA 1.2 is located in a panel-mounted housing containing the PCB with the electronic circuits and the rated brake points for over voltage. The display is designed as an LCD in the front (symbols shown in red). Arranged on the front panel are also an earth point and three test points for connecting a phase comparator for LRM-interfaces. On the back the rectangular connectors for the four unshielded cables are located.

![Diagram of WEGA 1.2](image)

Figure 1: Integrated voltage detecting system WEGA 1.2 (front)

4. Technical data

4.1 Electrical details:
- Rated voltage: 3kV...36kV (rated voltage of the switch gear)
- Rated frequency: 50Hz
- Operating temperature: -25°C...+55°C (according to the operating temperature of switchgear)
- Power supply: generated by the voltage to be tested
- Interface: LRM-System for every phase
- Indication:
  - Arrow: Means „Voltage present“. The display appears in the range of 0.1...0.45°UN.
  - Dot: Means that the current flowing through the detecting system fulfills the requirements for integrated voltage detecting systems (VDS) of VDE 0682 part 415. This constant monitoring makes a maintenance test not necessary.
  - No indication: All the symbols are turned off in the switchgear condition with all-poles switched off/ disconnected.

4.2 Mechanical details:
- Dimensions: 96mm x 48mm x 26 mm,
- Panel mounting housing for panel cut-out A 96 x 48 according to DIN 43700
- Panel opening: 92°6.8 x 45°6.6 mm
- Protection class: IP 54
- Housing: polycarbonate
- Weight: 130 g
- Earth-test point: LRM-System - distance of sockets 14 mm, diameter of pole 4 mm

4.3 Matching capacitors:
For an adaption to couple capacity, cables and rated voltages it is possible to insert matching capacitors by the manufacturer.
4.4 Connection diagram

In figure 2 the back view is shown.

![Connection diagram](image)

Figure 2: Connection diagram and contact configuration

5. Operating instructions

Functional control:
The function test can be done in installed and active state (arrow or arrow and dot are displayed) or in the non-installed condition as well.

Testing in the active state:
This is carried out by short-circuiting the earth and one of the three test points on the front. The display of the corresponding phase must disappear.

Testing in the inactive state:
There are two different test methods available:
1. By pushing the key "Display Test" all symbols of the display will be activated for a short time to verify the function. This key can be pushed also in an active state (i.e. at least at one phase the voltage is present). All symbols will be activated in that case.

2. Using the functional tester for WEGA:
   - Connect both lines of the function tester with one of the three test points of WEGA 1.2 and the earth terminal.
   - Switch on the function tester.
   - On the display of the WEGA 1.2 the related symbols (arrow and dot) will appear.

![Functional tester, Horstmann](image)

Order-No: 52-0211-010

Voltage testing:
Integrated voltage detecting system WEGA 1.2 can be use for continuous operation. Voltage detection is permanently done. The condition "voltage present" is displayed by arrows and respectively arrows and dots. For detailed meaning of symbols during voltage testing see point 4 Technical Data.
Attention:
If the WEGA displays voltage not present on all three phases the device must be tested! During this test it must display in the way specified above, otherwise it may be damaged and mustn’t be used any longer for voltage detection.

Phase comparison:
Phase comparison is possible by using an external phase comparator in accordance to VDE 0682 part 415, for example the ORION 3.0 (product Horstmann) which has to be plugged in the earth and test point (LRM system). These test points are accessible after removing the protective cap. While using an external phase comparator the display of WEGA 1.2 may lapse. Display returns immediately after unplugging the external phase comparator. After finalisation of the phase comparison protective caps have to be closed again.

6. Storage, care and transport
Integrated voltage detecting systems WEGA 1.2 must be stored and transported under dry and dust-free conditions. Any damage must be avoided. Damaged units, i.e. those, of which the functional capacity and reliability is no longer ensured, or whose lettering is illegible, mustn’t be used.
The user must always check that the unit is in perfect operating conditions.

Attention:
In case of claims which result in disregarding the operation instructions the warranty will expire and we are not liable for consequential damages.

7. Maintenance
Please check to ensure that the integrated voltage detecting system WEGA 1.2 is in a clean and dry condition; otherwise the unit is maintenance-free. After using the test points the protective cap has to be closed again. Integrated voltage detecting systems WEGA 1.2 don’t contain any batteries or other parts, changeable or replaceable by customer.

8. Maintenance test
Appearance of the dot means that the current flowing through the detecting system fulfills the requirements for integrated voltage detecting systems (VDS) of VDE 0682 part 415. This constant monitoring makes a maintenance test not necessary.

Order-No: 51-1200-001

Equipment:

Functional tester WEGA
Orion 3.0
Measuring module NO-M
(for measuring the current of the measuring socket)

Order-No: 52-0211-010
Order-No: 51-0206-006
Order-No: 51-0207-010
9.3 Phase monitor Orion 3.0

The phase monitor/voltage tester/interface monitor, Type ORION 3.0, is a microcontrolled display unit for capacitive test points with LRM interface according to the standards stated above. It is a combined display unit with which the following tests can be carried out:
- voltage of two phases
- phase position of these voltages relative to each other
- repeat tests on coupling parts (interface monitoring).

Mechanical and electrical adaptation to HR interfaces can be made with HR- LRM adapter attachment (2 pieces Order No. 52-0206-001).

Technical data:

Design:
Response voltage LRM:
Response voltage HR:
Response value with repeat tests on coupling parts:
Display phase balance:
Display phase unbalance:
Temperature range:
Rated frequency:
Direct impedance:
Degree of protection:
Power supply:
Battery service life:
Battery check:
Unit's self-testing:
Sound level of audible indicator:
Total weight:
Dimensions:
Length of measuring lines:

LRM system
(4 to 5) V
(70 to 90) V with adapter
3.2 μA with rated voltage
For phase angle <15° according to VDE 0582, Section 415
For phase angle >60° according to VDE 0582, Section 415
-25 °C to +55 °C
50 Hz
2 MOhm
IP 40
2 BR 2/3A lithium batteries, each 1.2 Ah, 2 x 3 V
6 years, at 8 to 10 operating cycles/day and 230 days/year
constantly effective in operating mode
activated every time unit is turned on >57 dB
approx. 340 g
157 x 84 x 30 mm
1.5 m each

Operating modes:

Off mode:
all 6 LEDs are off

Ready mode:
2 green LEDs on the voltage display light up (constant display), all the others are off. The duration of the ready mode is about 80 s.

Voltage display:
The voltage display’s red LED allocated to the measuring line comes on (constant display), the allocated green LED is off.

Phase display:
Both measuring lines are plugged in, both voltage displays are red, the display „phase balance“ (constant green display) or „phase unbalance“ (flashing red display) must be shown. As long as none or only one voltage display is red e.g. only one measuring line is plugged in, no phase display will be shown.

Display during interface monitoring:
- The voltage display’s red LED allocated to the measuring line comes on (constant display), the allocated green LED is off;
  Interface conditions fulfilled (I > 3.2 μA)
- The red flashes and at the same intervals an audible signal is emitted, the green LED is off. Interface conditions not fulfilled (2.5 μA < I < 3.2 μA)
Operating instructions:

1. Turning on the unit and checking its functions:
   Unit in off mode, no measuring lines plugged in
   ● Depress the button until all 6 LEDs come on (max. 15 s)
   ● Release the button; the unit carries out its self-test – subsequent to the correct conclusion of the test, the unit goes into ready mode

2. Voltage monitoring:
   Unit in ready mode, one measuring line plugged in
   ● allocated green LED still displayed:
   No voltage at test point
   ● allocated red LED displayed:
   Voltage available at test point

3. Phase monitoring:
   ● Unit in ready mode, both measuring lines plugged in
   both or one test point display "no voltage" – no phase display
   ● both test points display "voltage available":
   phase display's green LED on – both phases balanced
   phase display's red LED flashing – both phases unbalanced

   Please note: The phase display is switched normally with a phase difference between 15° and 60°.

4. Interface monitoring:
   Monitoring is executed automatically (within 2 s) when a measuring line is plugged in. Unit in ready mode, one measuring line plugged in:
   ● allocated green LED still on:
   No voltage at test point, interface monitoring will not be carried out
   ● allocated red LED on (constant display):
   Voltage available at test point and interface conditions fulfilled – repeated test passed
   ● allocated red LED flashing and audible signal emitted:
   Voltage available at test point but interface conditions not fulfilled – repeated test failed

5. Extending the switched-on period in the ready mode:
   The duration of the ready mode can be re-started by briefly depressing the button (approx. 0.5 s). The self-test will not be repeated.

6. Turning off the unit:
   ● automatically 60 s after leaving the ready mode or
   ● by prolonged depression of the button (approx. 2 s) after leaving the ready mode or
   ● 15 s after the button has been depressed when the unit is switched on or
   ● when the battery is dead

   Please note: As soon as at least one voltage display is red, the unit will not be switched off automatically.

Ordering information:

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<th>ORION incl. HR-LRM adapter and case</th>
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Special adapters

- LR-LRM adapter (for jack connectors)
  Order No. 52-0206-002

- ALSTOM (AEG)-IVIS adapter
  Order No. 52-0206-003

- WEFA adapter, 10kV
  Order No. 52-0206-004

- WEFA adapter, 20kV
  Order No. 52-0206-005

- Special adapter HR1-LRM (U₀<Ur)
  Order No. 52-0206-006