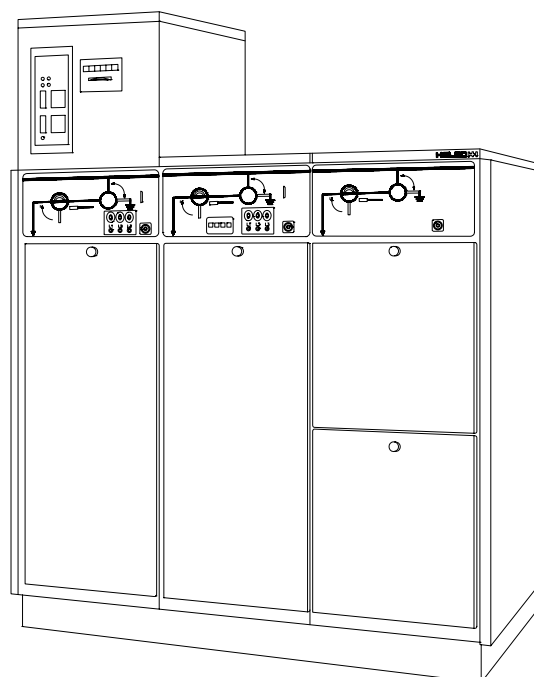




Electric

Medium-voltage switchgear - type Innovac SVS/08



USER MANUAL

Medium-voltage switchgear type Innovac SVS/08

HVDOC.025/2

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

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1. INTRODUCTION

1.1 GENERAL SYSTEM DESCRIPTION

The Innovac SVS/08 system is a metal enclosed, epoxy resin insulated switching system with fixed built-in vacuum circuit breakers. The system is not only suitable for electricity companies, but also for industry and utilities.

The system is suitable for the medium-voltage range, that is for rated voltages of up to 24 kV, with the panels capable of carrying a rated current of 630 A.

1.1.1 MODULAR CONSTRUCTION

The Innovac SVS/08 system is of a modular construction. This enables any combination and sequence of panels. An installation consisting of more than 7 panels is supplied in sections of up to 6 panels. The sections are completely mounted, assembled, wired and tested. Thanks to this modular construction it is also possible to add one or more panels to existing installations.

1.1.2 DESIGN

The Innovac SVS/08 system is in accordance with the applicable regulations as to safety, reliability in operation and environment.

The aspects incorporated in the design are summarised below.

Insulation

The live primary components are insulated by means of epoxy resin, which will prevent failures due to an open arc. All connections between the primary components have rubber sleeves. Thus a constant safe insulation level is maintained throughout the switchgear and the Innovac SVS/08 system can be categorised as 'compartmented switchgear and controlgear' (IEC-60298).

The earthed metal enclosure guarantees physical safety during normal operation (IEC 60298).

Mechanical interlocks

Thanks to the built-in mechanical interlocks specific jobs like the earthing of cables and the replacement of fuses can only be done in a safe way. The mechanical interlocks also prevent any unauthorised switching operations.

Connections

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

- By means of cables with plugs;
For this purpose, the Innovac SVS/08 is fitted with connection cones (DIN 47636 and CENELEC pr EN 50181/1994).
- By means of Eaton Magnefix cable boxes; max 12 kV. In this case the Innovac SVS/08 is fitted with interlocked shutters. These will remain closed until the cable is safely earthed.
- By means of terminal strips with locked entry ports for cable socket connection, 12 kV max.

Materials

All the materials used in the Innovac SVS/08 system are - by today's standards - environment-friendly; not just during use, but also at the end of their technical lifetime.

Transport

An Innovac SVS/08 installation consisting of more than 7 panels can be transported in sections of up to 6 panels. Each section can be provided with four lifting eyes or a lifting frame. If there is no lifting equipment available, transport by means of a fork lift truck, braces with transport wheels or steel rollers is possible as well.

Arrangement

The panels must be placed on a flat floor and be fixed with wedge bolts. All installation jobs are carried out from the front of the installation.

1.1.3 OPERATION

Each panel has a control panel. This panel contains the mimic diagram and the necessary controls and indicators. The mimic diagram enables easy recognition of the panel type.

1.1.4 SEPARATE COMPARTMENT FOR SECONDARY EQUIPMENT

Secondary equipment, like protective 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 at the bottom of the panel.

1.2 USING THE MANUAL

1.2.1 TARGET GROUP

The Innovac SVS/08 system is developed for use by personnel suitably qualified or trained in electrical operations. Persons considered belonging to this group: any authorised persons, team leaders, operators and responsible experts. See chapter 8 - Glossary for a description of these concepts.

The user's manual is meant for this target group.

1.2.2 STRUCTURE OF THIS MANUAL

This manual consists of 9 chapters.

Chapters 1 and 2 contain general information on the system (design and construction), the manual and general safety aspects. The information is presented in text form, supported by illustrations as necessary. The illustrations are numbered consecutively and subtitled, if necessary, for each chapter.

Chapters 3 to 7 inclusive mainly consist of step-by-step procedures. These procedures describe the individual operations in the exact sequence in which they are to be performed. Illustrations are on the same page as the relevant step and have the same number.

Warning

Never take any action without knowing what the consequences will be.

Remark

It is important to read through all actions first, using the relevant figures. Please contact Eaton if you do not understand what you are expected to do.

Chapters 3 to 7 inclusive are now explained in more detail.

- Chapter 3 - System assembly
This chapter only contains instructions for transport and assembly. It also contains a description of the requirements made on the operating area as well as a summary of the connection possibilities.

- Chapter 4 - System operation
This chapter is specifically meant for the operator. He is to carry out operational and control work independently, which is why this work is described in detail.
- Chapter 5 - System commissioning and decommissioning
In chapter 5.1 it is explained which operations are to be performed prior to system commissioning. These operations are to be performed in conjunction with Eaton.
Chapter 5.2 deals with system decommissioning. It also contains recommendations for safe discharge of the system.
- Chapter 6 - System inspection, maintenance and repair
This chapter describes just the operations which the user is allowed to carry out.

Note

Operations that are not discussed in the manual are to be carried out by or under the supervision of Eaton.

- Chapter 7 - Accessories
This chapter contains a summary of available accessories.

The other chapters, viz. chapters 8 and 9, are explanatory chapters of a general nature.

- Chapter 8 - Glossary
This chapter contains clarifications on specific concepts used, but not explained further, in the manual.
- Chapter 9 - Appendix
This chapter shows the structure of the complete documentation system supplied with the system.

1.3 SAFETY INSTRUCTIONS

1.3.1 APPLICABLE REGULATIONS

The Innovac SVS/08 switchgear is developed in compliance with EC safety directives.

The Innovac SVS/08 switchgear meets:

IEC 60694	Common specifications for high voltage switchgear and controlgear standards (prHD448), for general regulations.
IEC 60265-1	High voltage switches for rated voltages above 1 kV and less than 52 kV (HD355.1), as a load-break switch combination for general use.
IEC 60420	High voltage alternating current switch fuse combinations (prEN60420), as a load-break switch with fuses.
IEC 622271-100	High voltage alternating current circuit breakers, as a power circuit breaker.
IEC 60298	Alternating current metal enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV (EN 60298-A1), in compartmented execution, according to the insulated connections method.
IEC 60129	Alternating current disconnectors and earthing switches.

1.3.2 SAFETY MEASURES

Safety measures are a combination of safety principles, which have been incorporated in the system design, and measures that are to be taken prior to and during use.

A Design

A number of aspects are listed below. These aspects are described in chapters 1.1 and 4.1.

A.1 Safe

- Safe to touch because of earthed metal enclosure and complete primary insulation
- Unauthorised switching operations are impossible because of mechanical interlocks
- Continuous voltage indication
- Mechanical interlocks safeguard access to the cable connections for replacement of fuses and base contacts
- Environment-friendly materials

A.2 User-friendly

- Uniform and easily understandable control panels
- Good access to the cable connection
- Ample space for cable termination
- Easily transportable
- Easy installation in the operating area

B Use

This includes aspects with respect to:

- Operating area
- Personnel
- Execution of work
- Fire fighting

B.1 Operating area

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

Eaton also gives the following advice with regards to clean spaces, escape routes and entrances.

Clear space

In front of the 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

To the 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 in a straight line as far 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 Innovac SVS/08 system, see chapter 2.3.2.

Access

Access to areas in which switchgear is installed should be available at suitable places and should be at least 0.75 m wide and 2 m high.

It should be accessible from the escape routes, via connecting routes at least 0.5 m wide and 2 m high.

Doors:

- have to open outwardly;
- must allow opening from the inside without the use of aids.

B.2 Personnel

Operations consisting of the installation, connection, operation, inspection, commissioning and decommissioning, and maintenance of medium-voltage, type Innovac SVS/08, switchgear, should only be carried out by persons authorised to do so.

B.3 Execution of work

- Operations that may be carried out by the user either independently or under the supervision of Eaton are described in this manual.

Note

The user must only carry out those operations and must strictly follow the procedures described.

- In case of operations that require installations or parts of them to be de-energised, the operating area must be clearly marked.
- All parts that are not de-energised must remain closed and must have warning signs on their front panels.
- Before starting with the operations one will have to make sure that the installation is indeed dead.
- After completion of the operations it is not allowed to energise the installation again until after it has been ascertained that this can be done without danger.
- Before the safety measures taken in connection with the operations are undone, there must be certainty about the fact that the operations in all appropriate places have been completed and terminated, and that all guards have been refitted.

B.4 Fire fighting

The civil engineering and related facilities should be in accordance with local regulations.

- Recommendations to the user:
 - Before starting with the constructional work and/or adaptation thereof, you should contact the local fire brigade to have your design inspected.
 - The system manager, in conjunction with such bodies as the fire brigade, will have to draw up a safety plan and keep it up to date; this plan should mention any measures that are to be taken in the event of a calamity.
- Access to electrical operating areas must be kept clear. In addition, free areas and escape routes should be kept clear of obstacles.
- Material storage in electrical operating areas is only allowed insofar the material is associated with the installation in that area.
- Lightly flammable substances and propane or butane gas cylinders must not be stored in electrical operating areas.
- It is not allowed to start fire fighting until after the complete system has been de-energised. Any incoming cables, low-voltage cables, return power supply via the low-voltage side etc. should be taken into account as well.
- Extinguishing materials may conduct the electrical current; when, contrary to regulations, a system which is not dead is being extinguished, personnel and bystanders may be electrocuted.
- Fire in or in the vicinity of the electrical operating areas must not be extinguished with water.

1.3.3 NOTATION GUIDE

LIFE HAZARD

The life of the user and bystanders is at risk.

WARNING

The user and bystanders may get seriously injured or the product may be seriously damaged. A warning warns against physical injury of the user and/or bystanders or against damage to the product, if the user does not carefully follow the procedures.

CAUTION

The product is at risk. Caution warns against damage to the product, if the user does not carefully follow the procedures.

NOTE

A remark containing additional information for the user. It will make the user aware of possible problems.

REMARK

The user is given suggestions and advice to facilitate or simplify the performance of specific operations.

1.3.4 SAFETY INSTRUCTIONS AND WARNINGS

A Safety instructions

A.1 Organisational instructions

The user is responsible for the organisational instructions, which may, for instance, be:

- Allocation of authorities
- Procedures for access to the electrical operating areas
- Reporting procedures upon start and termination of operations
- Regulations with respect to the performance of operations
- Drawing up a safety plan
- Warning against risks by displaying signs on the system

All these aspects depend on the nature and the policy of the company.

Advice to the user: the user may compile a book of all these aspects. He will have to make sure that all authorised persons are informed about the existence and the contents of this book.

A.2 Operational instructions

Operational instructions are "system-related instructions" and they are described in this manual. This is done by means of instructions (like warnings, life hazard etc.), which are given before or with the relevant action in the step-by-step procedures. See chapter 2.2 - Safety (system-related), for more details.

B Warnings

B.1 Warning signs

- Inscriptions, warning and information signs should be clearly legible, they should be displayed at easily visible places and be kept in a good condition.
- If such signs are no longer necessary, they are to be removed.
- Warnings have to be brief and clear. The use of standardised expressions is to be considered.
- Warnings signs must never be attached to live components.

B.2 Alerting to danger

What to do in case of a relative humidity of 99% and higher?

Do not use the system at a relative humidity of 99% and higher.

What to do in case of flooding?

In the event that the system should be completely surrounded by water you should leave the building immediately and turn off the power supply to the system as soon as possible. There is a risk of electrocution due to a high pace voltage.

What to do in the event of a fire?

Any fire will produce noxious gases and harmful substances; exposure should naturally be avoided. Fire is to be fought with the appropriate means (see also chapter 1.3.2, B.4 - Fire-fighting).

The manager responsible for the installation must have a complete safety plan which specifies the appropriate measures.

1.4 PRODUCT INFORMATION

1.4.1 TECHNICAL SPECIFICATIONS

A complete type plate is made up of a main type plate with supplementary type plates if required. The main type plate is headed with the Eaton logo and address:

Eaton Electric B.V. Medium Voltage P.O. Box 23, 7550 AA Hengelo The Netherlands		EAT•N	Holec
M. V. SWITCHGEAR		IEC 60466 / 60265	
system:	SVS/08 [rel.1.3]	serial no.	110000
year of constr.	2004	w.o. no.	0000000
U _r	12 kV	U _p	75 kV
f _r	50	Hz	
BUSBAR SYSTEM		IEC 60298	
I _r	800 A	I _k	20 kA
t _k	2,5	s	
		I _p	50 kA

Main type plate

Eaton Electric B.V. Medium Voltage P.O. Box 23, 7550 AA Hengelo The Netherlands		EAT•N	Holec
GENERAL PURPOSE SWITCH		IEC 60265	
type:	SVS 14BA-1206 [rel. 1.3]	serial no.	004571
year of constr.	2004	w.o. no.	0000000
U _r	12 kV	U _p	75 kV
I _r	630 A	I _k	20 kA
t _k	1	s	
	I _{ma}	50 kA	I _p 50 kA

Supplementary type plate for load-break switch (example)

Eaton Electric B.V. Medium Voltage P.O. Box 23, 7550 AA Hengelo The Netherlands		EAT•N	Holec
CIRCUIT - BREAKER		IEC 60056	
type:	NVS 20BA-1206 [rel 1.3]	serial no.	004571
year of constr.	2004	w.o. no.	0000000
U _r	12 kV	U _p	75 kV
I _r	630 A	I _k	20 kA
t _k	2,5	s	
I _{sc}	20 kA	I _{ma}	50 kA

Supplementary type plate for circuit breaker (example)

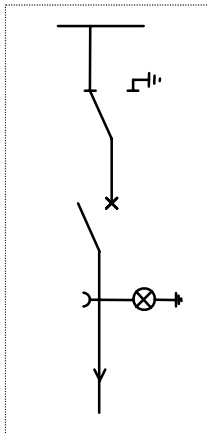
Variable	Description	Unit
system	-	-
rel.	release	-
IEC	-	-
serial. no.	Serial number	-
year of constr.	year of construction	-
w.o.no.	work order number	-
U_r	rated voltage	kV
f_r	rated frequency	Hz
I_r	rated normal current	A
$I_{r \text{ T-off}}$	rated normal current switch/circuit breaker	A
I_k	rated short time withstand voltage	kA
t_k	rated duration of short-circuit	s
I_p	rated peak withstand current	kA
U_p	rated lightning impulse withstand voltage (peak value)	kV_{peak}
I_{ma}	rated short-circuit making current	kA
I_{sc}	rated short-circuit breaking current	kA

1.4.2 REFERENCE TO DIAGRAM PACKAGE

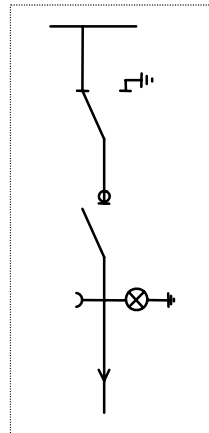
Refer to the electrical section, which is included in the documentation package supplied with the system.

2. SYSTEM DESCRIPTION

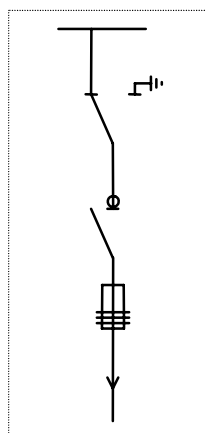
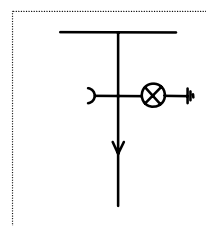
2.1 THE SYSTEM



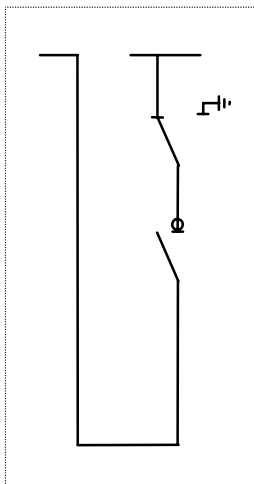
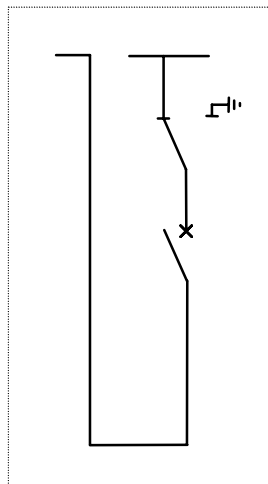
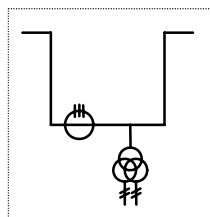
Circuit breaker panel



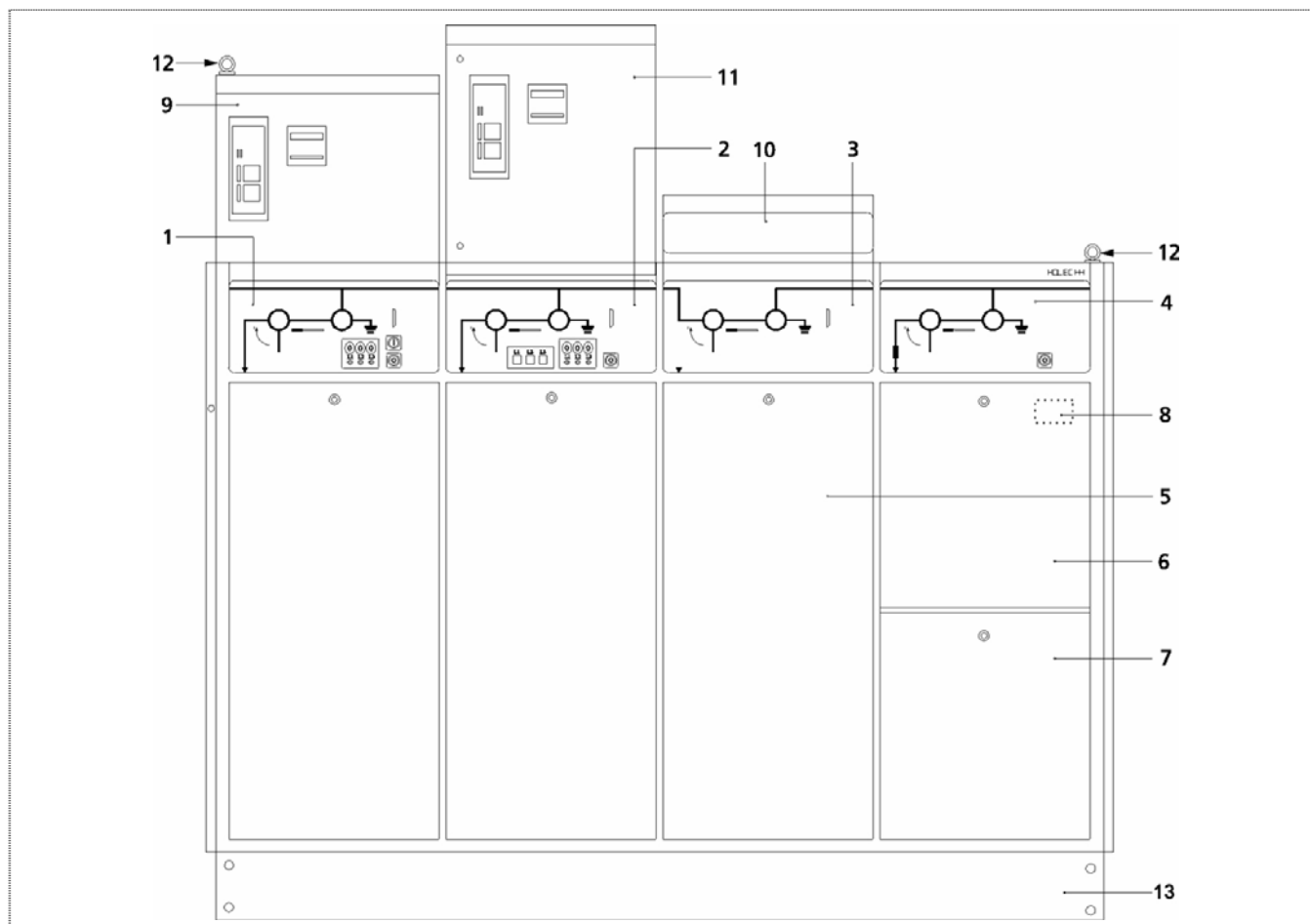
Load-break switch panel


Load-break switch/
fuse panel
24 kV max.


Bushbar connection panel


Bushbar section panel
with load-break switch

Bushbar section panel
with circuit breaker


Metering panel



1. Installation composed of various panel types

1. Control panel of load-break switch or circuit breaker (standard version)
2. Control panel of load-break switch or circuit breaker panel (with various options)
3. Control panel of a busbar section panel
4. Control panel of a load-break switch/fuse panel
5. Cable protection cover
6. Protection cover for fuse links
7. Protection cover for transformer cables
8. Type plate per panel (on inside of door)
9. Instrument compartment (400 mm high)
10. Instrument compartment (150 mm high)
11. Instrument compartment (600 mm high)
12. Lifting eyes
13. Foundation frame

Remark:

For a description of the control panels see chapter 4 - Operation.

2.2 DESCRIPTION OF THE PANELS

2.2.1 CIRCUIT BREAKER PANEL

A standard circuit breaker panel consists of the following main components:

- One busbar system;
- One disconnecter;
- One circuit breaker;
- One of three connection possibilities:
 - Three connection cones for T-connectors (24 kV) (figure 1) or
 - One terminal block with interlocked cable access ports for Eaton Magnefix cable boxes (12 kV) (figure 2) or
 - Three terminal blocks with interlocked cable entry ports for cable socket connection (12 kV) (figure 3).
- One operating mechanism;
- One control panel.

Options

The following options are available as standard:

- Auxiliary contacts for circuit breaker and disconnecter;
- Electrical switching-on and switching-off of the circuit breaker;
- Voltage transformers on cable side;
- Overvoltage detectors on cable side;
- Secondary instrument compartment;
- Current transformers, secondary equipment.

Application of standard version:

- Incoming and outgoing supply panels;
- Generator panels;
- Motor panels;
- Transformer panels.

SPECIAL VERSION

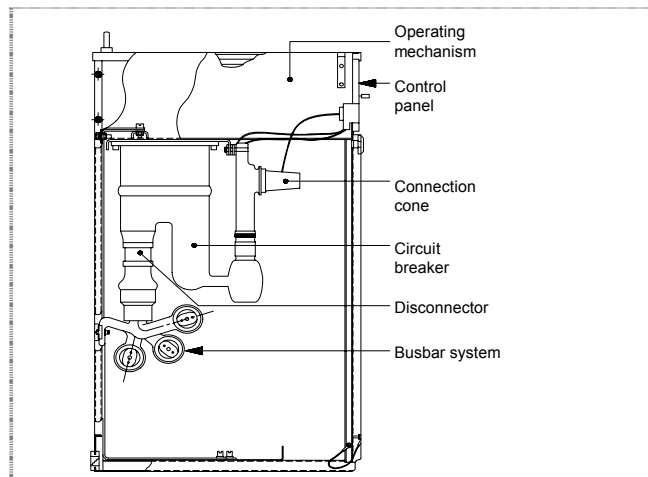
- Circuit breaker with integrated safety feature. A separate secondary voltage is not necessary here, as the current transformers supply the energy required for switching-off.

Application of special version:

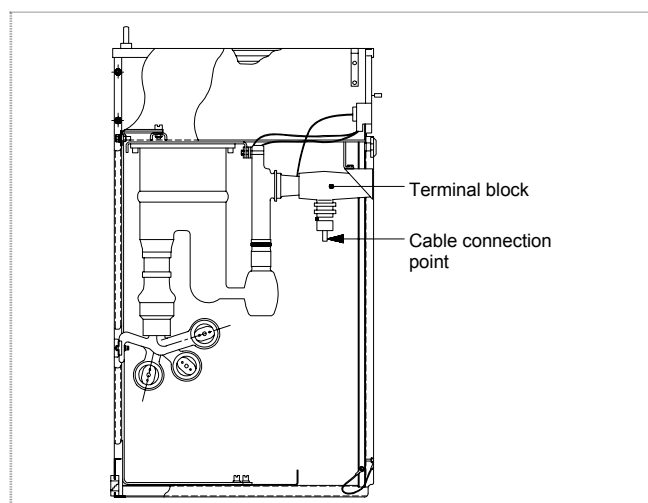
- Protected transformer or cable panel in stations without secondary voltage.

CONNECTION OF SECONDARY WIRING

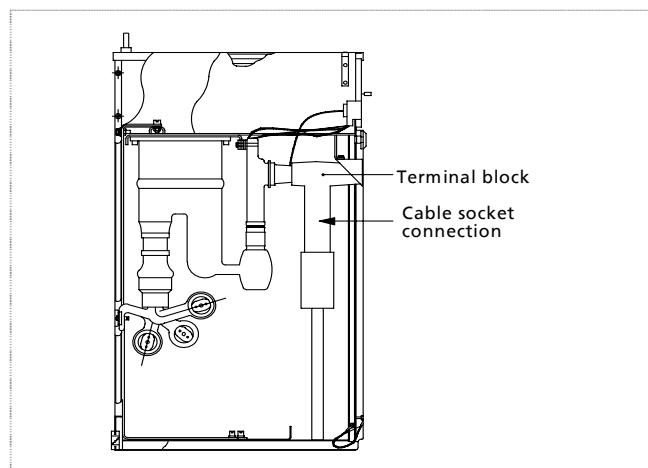
See chapter 2.2.2, figure 4, for connection terminals of the secondary wiring.



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2.2.2 LOAD-BREAK SWITCH PANEL

A standard load-break switch panel consists of the following main components:

- One busbar system;
- One disconnecter;
- One load-break switch;
- One of three connection possibilities:
 - Three connection cones for T-connectors (24 kV) (figure 1) or
 - One terminal block with interlocked cable access ports for Eaton Magnefix cable boxes (12 kV) (figure 2) or
 - Three terminal blocks with interlocked cable entry ports for cable socket connection (12 kV) (figure 3);
- One operating mechanism;
- One control panel.

Options

The following options are available as standard:

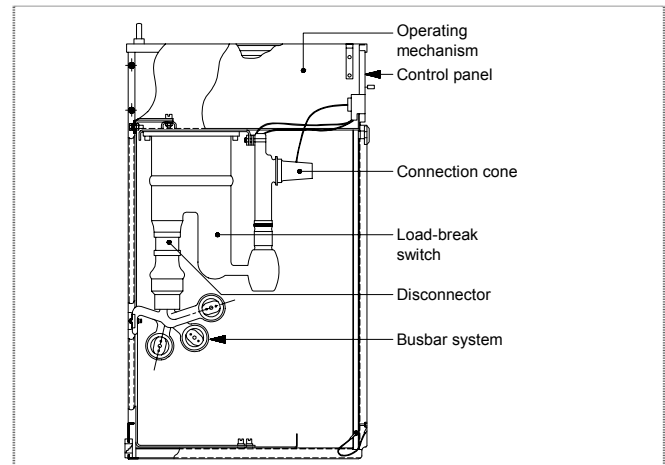
- Automatic resetting overcurrent indicator;
- Auxiliary contacts for load-break switch and disconnecter;
- Electrical switching-on and switching-off of the load-break switch;
- Voltage transformers on cable side;
- Overvoltage detectors on cable side;
- Secondary instrument compartment;
- Current transformers, secondary equipment.

Application:

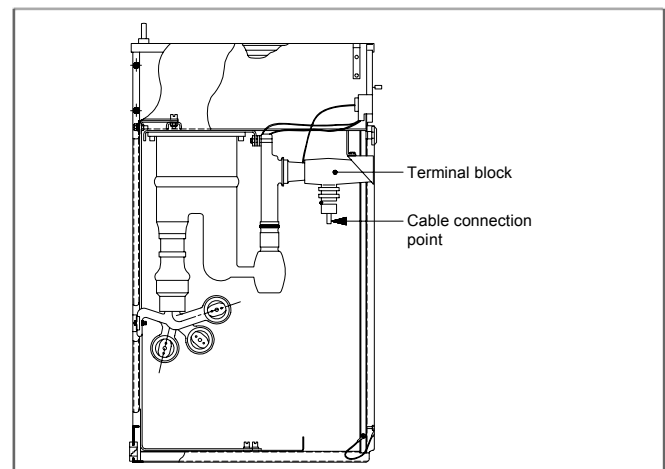
- Ring cable panels, straight cable panels;
- Incoming supply panels.

CONNECTION OF SECONDARY WIRING

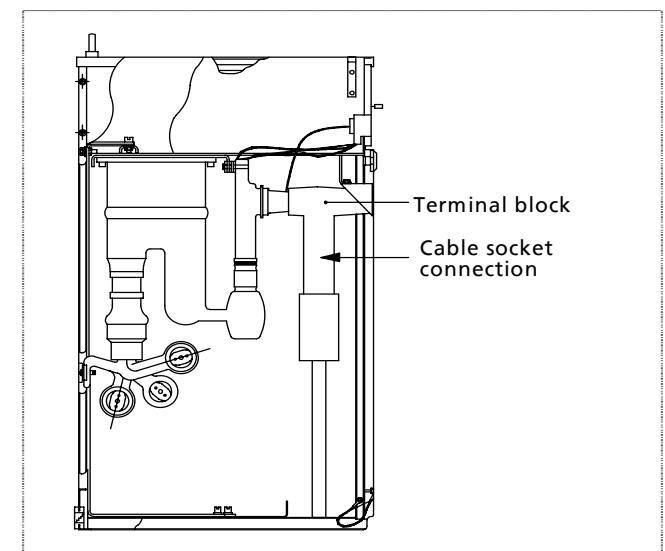
See figure 4.



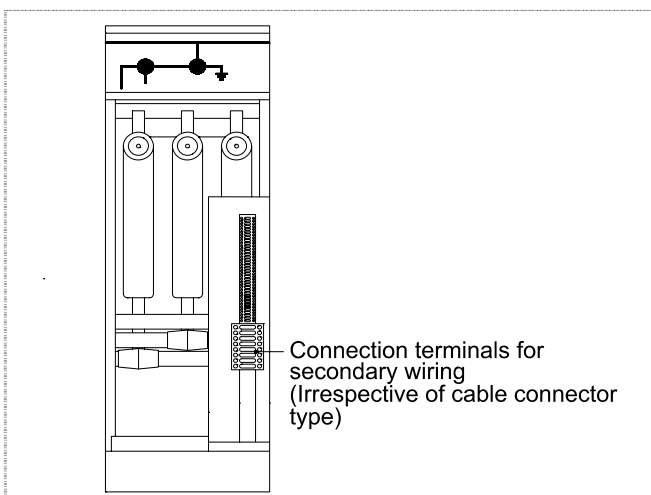
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2.2.3 LOAD-BREAK SWITCH/FUSE PANEL

A standard load-break switch/fuse panel consists of the following main components:

- One busbar system;
- One disconnecter;
- One load-break switch
- Three fuse holders:
 - for 12-kV fuses (figure 1) or
 - for 24-kV fuses (figure 2);
- One of two connection possibilities:
 - for the 12-kV version (figure 1): cable connections for paper-insulated lead-covered cables and plastic-insulated cables via Eaton Magnefix cable boxes;
 - for the 24-kV version (figure 2): cable connections for plastic-insulated cables directly underneath the fuse holders;
- One operating mechanism;
- One control panel.

Options

The following options are available as standard:

12-kV version:

- Auxiliary contacts for load-break switch and disconnecter;
- Auxiliary contacts for fuses;
- Electrical switching-on and switching-off of the load-break switch.

24-kV version:

- Auxiliary contacts for load-break switch and disconnecter;
- Auxiliary contacts for fuses;
- Electrical switching-on and switching-off of the load-break switch;
- Application of 10/12-kV fuses using an adapter;
- Application of a plug for plastic-insulated cable using an adapter;
- Voltage indication on cable side.

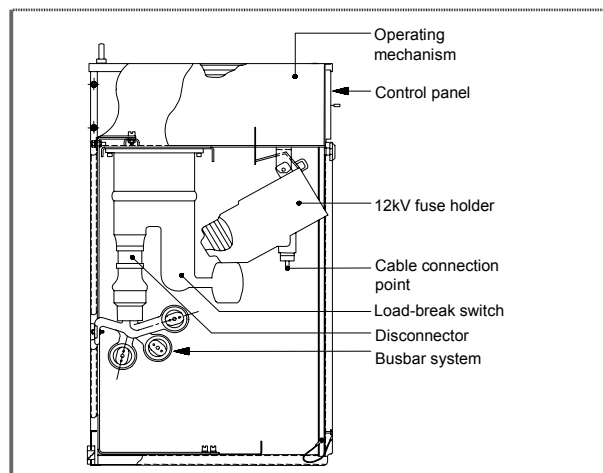
Application

- Outgoing panels to the transformers, fuse-protected.

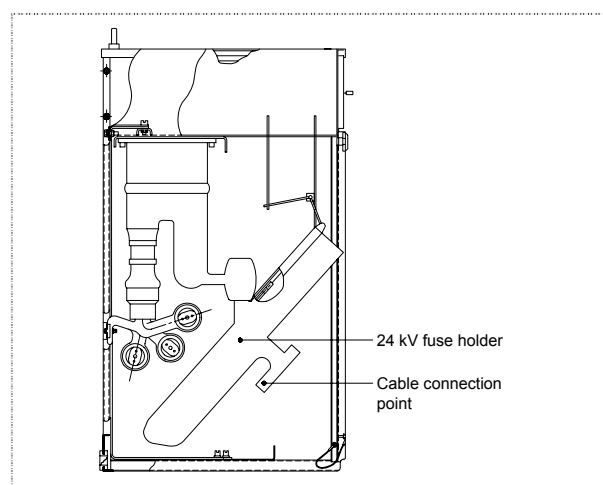
The load-break switch cuts off three poles upon actuation of one or more fuses.

CONNECTION OF SECONDARY WIRING

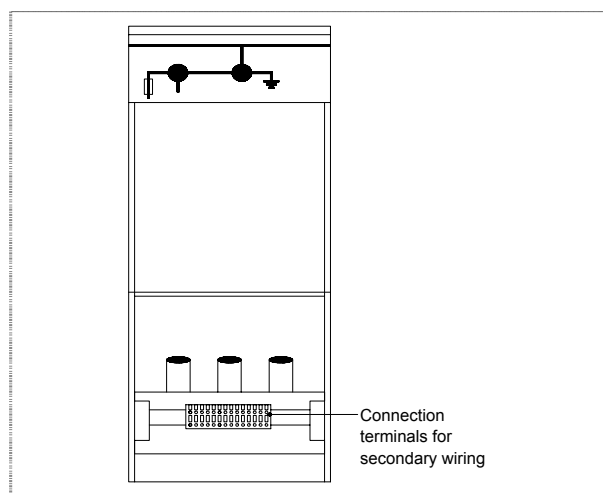
- For a 12-kV version, see connection of secondary wiring for a load-break switch, chapter 2.2.2, figure 4.
- For a 24-kV version, see figure 3.



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2.2.4 BUSBAR SECTION PANEL WITH LOAD-BREAK SWITCH OR CIRCUIT BREAKER

A standard busbar section panel (figure 1) consists of the following main components:

- One busbar system;
- One disconnecter;
- One load-break switch or circuit breaker;
- One operating mechanism;
- One control panel.

Options

The following options are available as standard:

- Auxiliary contacts for load-break switch and disconnecter;
- Electrical switching-on and switching-off of the load-break switch;
- Secondary instrument compartment;
- Current transformers, secondary equipment.

Application

- Interruption between the supply section of the electricity company and that of the user.
- Sectionalising an installation with different supply panels.

SPECIAL VERSION FOR A BUSBAR SECTION PANEL WITH CIRCUIT BREAKER

- Circuit breaker with integrated safety feature.
A separate secondary voltage is not necessary, as the current transformers supply the energy required for switching-off.

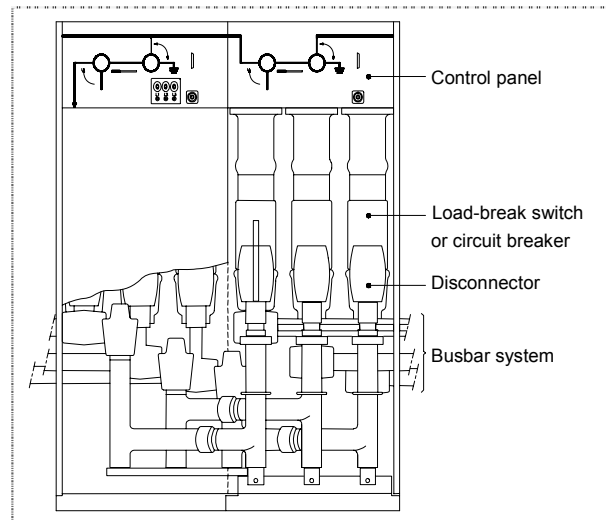
Application of special version

- Protected busbar section panel in stations without secondary voltage.

CONNECTION OF SECONDARY WIRING

Depends on the type of panel coupled.

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2.2.5 METERING PANEL

A metering panel (figure 1), equipped with current and voltage transformers, may be incorporated in the busbar system. A standard metering panel contains:

- Epoxy resin insulated voltage transformers. On the primary side, the voltage transformers are connected directly to the main bar, connections being protected against spark-over voltages (which makes primary fuses superfluous).
- Earthed or insulated primary neutral point;
- Fuses or automatic circuit breakers on the secondary side as needed;
- Epoxy resin-insulated current transformers, which have a toroid core with secondary windings.

Options

- Secondary instrument compartment
- Secondary equipment (protective relays, voltmeters and ammeters)

Application

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

SPECIAL VERSION (figure 2):

- With universal connection for current and voltage transformers, installed with non-insulated copper connections;
- Two panels wide;
- Covers protecting against accidental contact;
- Padlock protecting against opening;
- Earthed metal enclosure, executed without provisions for accommodating internal arcs.

Application of special version

Application of customised current and voltage transformers for:

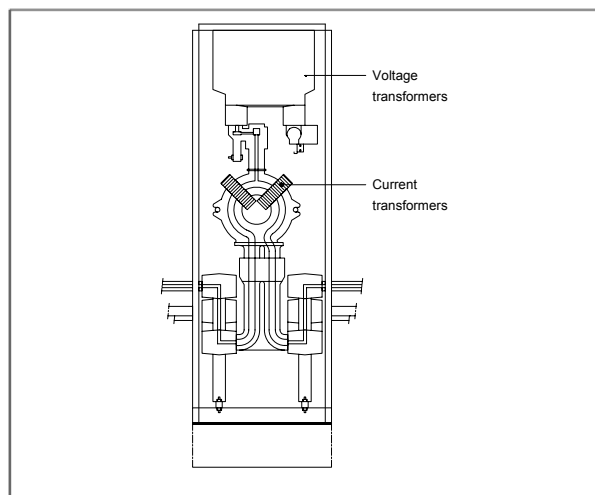
- Current measurement
- Voltage measurement
- kWh-measurement for billing and checking

LIFE HAZARD

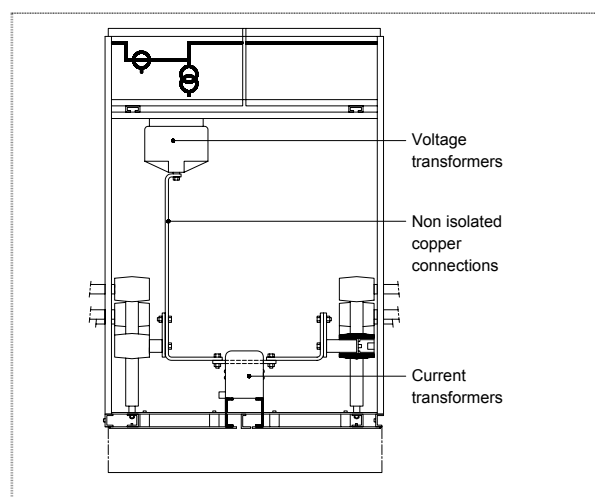
This panel is **NOT** arc resistant, because uninsulated copper connections are used.

CONNECTION OF SECONDARY WIRING

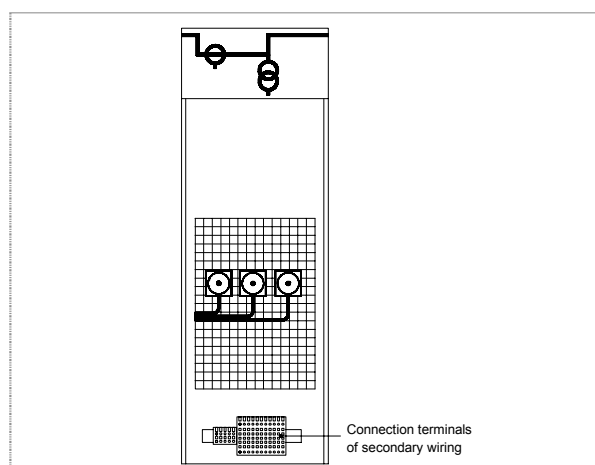
See figure 3.



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2.2.6 BUSBAR CONNECTION PANEL

A busbar connection panel (figure 1) consists of a busbar system, which enables direct connection of a cable. To this end the panel is equipped with one of the standard connection possibilities:

- Three connection cones for application of T-connectors (24 kV);
- One cable terminal block for application of the Eaton Magnefix cable boxes (12 kV);
- Three terminal blocks for cable socket connection (12 kV).

Options

- Voltage transformers on cable side;
- Overvoltage deflectors on cable side;
- Secondary instrument compartment;
- Current transformers, secondary equipment.

Application

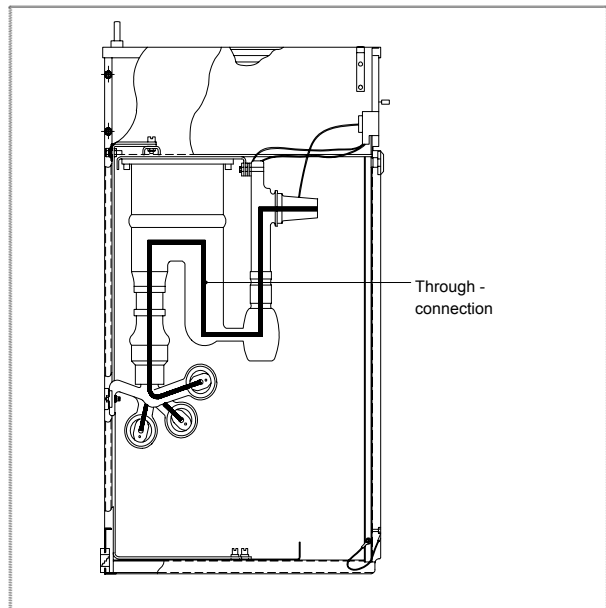
- Direct connection to another installation or an adjacent section via a cable connection, which is directly made to the main bars.

CONNECTION OF SECONDARY WIRING

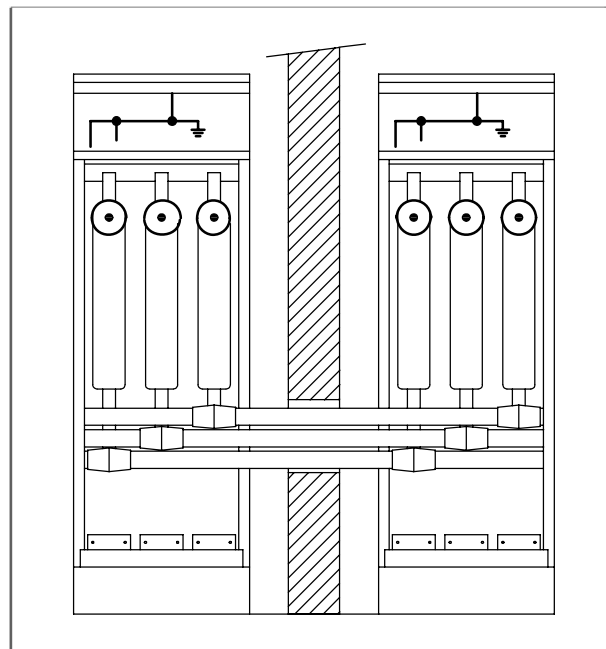
See the relevant cable panel.

2.2.7 WALL BUSHING

The wall bushing (figure 2) consists of an epoxy resin insulated busbar system in an earthed metal enclosure. It is used to connect two parts of an installation, with a screen interposed, for instance a partition wall.



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2.3 SAFETY (SYSTEM-RELATED)

2.3.1 INTERLOCKS

Definitions

- A panel in "operating position" means: the disconnecter is in busbar position, the load-break switch or circuit breaker being switched on.
- A panel in "earthing position" means: the disconnecter is in earthing position, the load-break switch or circuit breaker being switched on.
- A panel in "intermediate position" means: the disconnecter is in busbar or earthing position, the load-break switch or circuit breaker being switched off.

Disconnecter

- The disconnecter can only be operated when the load-break switch or circuit breaker is switched off.

Load-break switch or circuit breaker panel

- The load-break switch or circuit breaker can only be switched on when the disconnecter is completely in busbar position or completely in earthing position.
- A panel is provided with a padlock so as to prevent:
 - the load-break switch from being switched off when in operating position or in earthing position;
 - the circuit breaker from being switched off when in earthing position only.
- A lock on the access door of the cable compartment is optional.
 - This means that the door can only be opened in earthing position.
 - In this case the load-break switch cannot be locked anymore to prevent switching off when in operating position.
- The cable access port of the 17.5-kV cable terminal block can only be opened when the cable is earthed, so when the panel is in earthing position.
- A scissor-type interlock with padlock is optional. This scissor-type interlock can be used to lock the load-break switch or the circuit breaker in an intermediate position.

Load-break switch/fuse panel

- With the load-break switch/fuse panel, access to the fuse holders can only be obtained when the disconnecter is in earthing position and the load-break switch is switched off.
- In this position the load-break switch cannot be switched on when the disconnecter is in earthing position.

Busbar section panel

- With a busbar section panel the load-break switch or circuit breaker cannot be switched on when the disconnecter is in earthing position.
- The load-break switch can be padlocked so as to prevent switching off.
- The circuit breaker cannot be locked by means of a padlock.

Metering panel

- The door giving access to a metering panel may be provided with a padlock.

2.3.2 SAFETY

The system-related safety instructions in this manual are the instructions (like warnings, life hazard etc.) that are given before or with the relevant action in the step-by-step procedures.

The procedures describe what the user is allowed to do:

- The user must strictly follow the procedures and should only use the accessories supplied with the switchgear.
- The user must observe the safety instructions that are stated before the relevant procedures or actions.
- Other operations, of any nature whatsoever, are not allowed.
- In the case of open panels, the user is responsible for safety when work is being carried out on the installation.

2.3.3 NOISE AND RADIATION

Noise

In general it can be said that the installation does not produce any noise under operating conditions, with the exception of the switching operations.

The noise during switching operations is less than 70 dB(A), so that no noise protection measures have to be taken.

Radiation

Radiation is well below the safety standard level.

2.4 TECHNICAL DATA

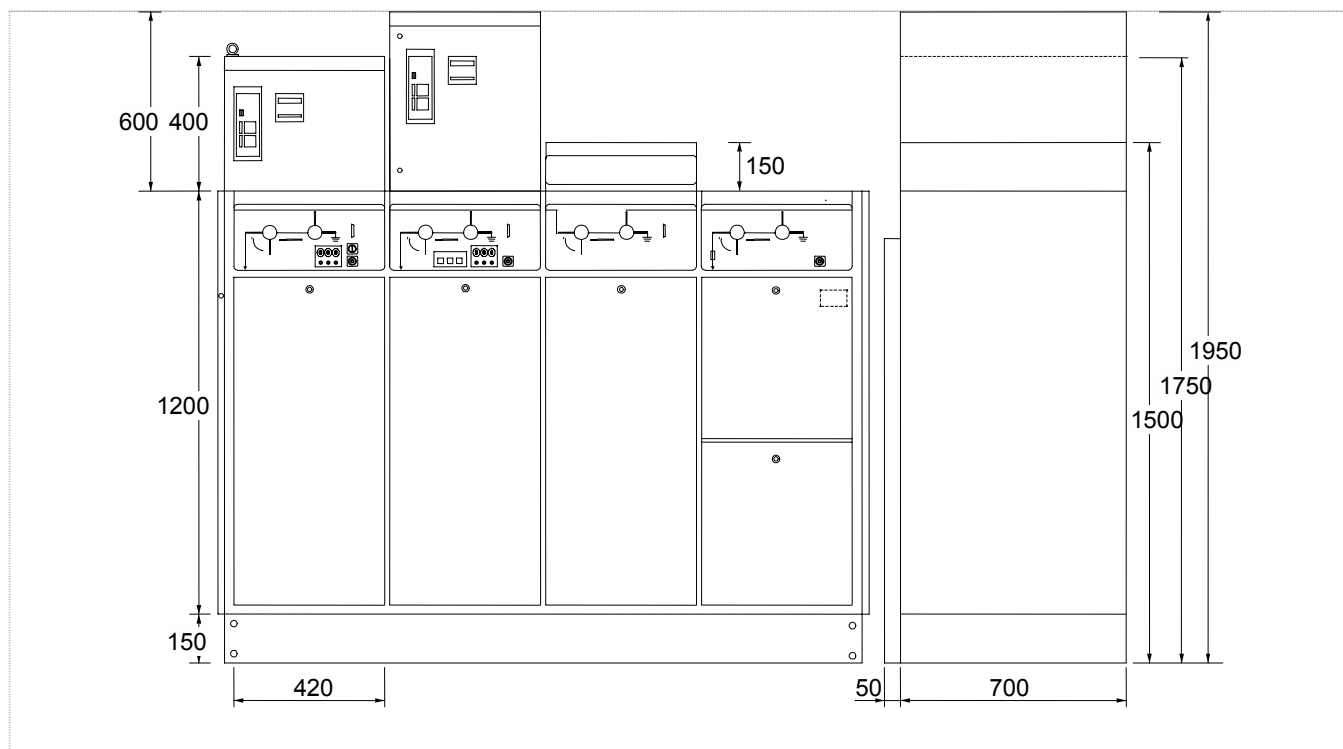
2.4.1 ELECTRICAL DATA

<i>Type Innovac SVS/08</i>		12	17.5	24
General				
Rated voltage	kV	12	17.5	24
Impulse withstand voltage	kV	75	95	125
Power frequency withstand voltage	kV	28	38	50
Rated frequency	Hz	50-60	50-60	50-60
Busbar system				
Rated current	A	800	800	800
Rated short-time withstand current 1 s/2.5 s ¹⁾	kA	20	20	16
Rated peak withstand current	kAp	50	50	40
Load-break switch				
Rated current	A	630	630	630
Rated breaking current with cos phi = 0,7	A	630	630	630
Rated short-circuit making current	kAp	50	50	40
Rated short-time withstand current 1 s/2.5 s ¹⁾	kA	20	20	16
Load-break switch/fuses				
Rated current	A	61/57	61	36
Rated breaking current ¹⁾	A	630	630	630
Rated short-circuit making current ¹⁾	kAp	50	50	40
Fuses as per DIN 43625	kV	12	12/24	24
Circuit breaker				
Rated current	A	630	630	630
Rated breaking current ¹⁾	kA	16/20	16/20	16
DC component	%	35	35	35
Rated short-circuit making current ¹⁾	kAp	40/50	40/50	40
Rated short-time withstand current 1 s/2.5 s ¹⁾	kA	16/20	16/20	16
Metering panel				
Rated peak withstand current ²⁾	kA	40/50	40/50	40
Rated short-time withstand current 1 s/2.5 s ¹⁾²⁾	kA	16/20	16/20	16
Rated current	A	630	630	630

1) Depending on execution; consult the type plate on the panel for the actual value.

2) Depending on ratio.

2.4.2 DIMENSIONS AND WEIGHTS



	without instrument compartment	with instrument compartment (400 mm high)	with instrument compartment (150 mm high)	with instrument compartment (600 mm high)	centre distance of lifting eyes	
Panel width (mm)	420	420	420	420	1 panel:	340 mm
Panel depth (mm)	700	700	700	700	2 panels:	760 mm
Panel height (mm)	1350	1750	1500	1950	3 panels:	1180 mm
					4 panels:	760 mm
Weight per panel	approx.	approx.	approx.		5 panels:	1180 mm
(kg)	150	175	165	---	6 panels:	1600 mm
					7 panels:	2020 mm

Example:

Number of panels = N;

total width B = N x 420 + 80 mm.

3. SYSTEM ASSEMBLY

3.1 GUIDELINES FOR THE OPERATING AREA

3.1.1 GENERAL

Space aspects

The dimensions of the installation are stated on the floor plan. This is part of the total documentation package (see chapter 10). The dimensions of the electrical operating area can be determined on the basis of this floor plan. The demands are stated below.

Clear area

To the front of the switchgear or between two installations situated opposite one another, enough space should be left over the entire length of the installation. This free space must be at least 3 m wide and 2 m high.

There must be no protruding parts in this space.

The width of free spaces is measured from the most protruding part, not from the front of the installation.

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

Space required for expansion (on the left or on the right side):

$N \times 420 \text{ mm} + 330 \text{ mm}$, N being the number of panels.

Escape routes

To the front of the switchgear or between two installations situated opposite one another, an escape route should be available over the entire length at least 0.5 m wide and 2 m high.

Escape routes should be in a straight line as far as possible.

There must be no protruding parts in an escape route.

The width of the escape route is measured from the most protruding part of the installation. The opening direction of doors can be taken into account here; doors opening out into escape routes must not obstruct one another under no circumstances.

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

Access

Access to areas in which switchgear is installed should be available at suitable places and should be at least 0.75 m wide and 2 m high.

It should be accessible from the escape routes, via connecting routes at least 0.5 m wide and 2 m high.

Doors:

- have to open outwardly;
- must allow opening from the inside without the use of aids.

The system dimensions should be taken into account when establishing the door sizes.

Climate

The climate in the electrical operating area must comply with the demands made in IEC 60694, par. 2.1. This directive states the nominal conditions for indoor arrangement:

- Ambient temperature: maximum 40°C and minimum - 5°C for "class minus 5 indoor";
- Altitude < 1000 m;
- The area should be free from dust, smoke, corrosive or flammable gases and salts. Only occasional condensation is allowed.
- The relative humidity must not exceed 95% (measured over a period of 24 hours).

Special operating conditions

In this case the demands made in IEC 60694, par. 2.2. have to be met. This means that specific agreements will have to be made with the user of the switchgear.

In case of stations installed in areas with a high relative humidity or in areas with a high groundwater level, prevention of condensation will have to be given special attention. This also applies to switchgear installed in areas abounding in water.

3.1.2 CEILING

In the case of condensation on the ceiling, it is recommended to fit an extra ceiling, of hardboard (Masonite), for instance. Fit this board with its rough side down and make sure there is adequate ventilation between board and roof.

3.1.3 FLOOR

The floor carrying the switchgear has to be flat and smoothly finished so that the sheet steel foundation frame of the switchgear properly matches the floor. At least four corners of the switchgear have to be fixed to the floor.

The fixing holes in the floor are to be made in accordance with the floor plan supplied with the system.

Any openings between the area in which the switchgear is installed and the area below ground level, from which the medium- and low-voltage cables are introduced, have to be sealed perfectly. This measure is necessary for areas both with and without transformer.

Cable trench

Fill the cable trench with gritty sand and then cover it with polyurethane foam, for instance.

Cable cellar

Thoroughly seal the opening between the operating area and the cable cellar using polyurethane, for instance, after proper support has been provided. The polyurethane foam should have a closed cellular structure.

3.1.4 VENTILATION

Avoid undesirable circulation; make sure that doors close properly. If the system is arranged in the vicinity of intensive motor traffic areas, the air displaced and polluted by the motor traffic should be prevented from entering directly through the ventilation openings as much as possible.

Areas without transformer

Avoid air circulation in the area; it is not necessary to cool the switchgear. If need be, a single ventilation slot may be made, but then low down in the area.

3.1.5 HEATING

The measures stated in 3.1.1 through 3.1.4 will mostly suffice to guarantee reasonable ambient conditions for the system. If, in particular cases, these measures should prove inadequate, every field with a heating element (see par 1.4.3) should be connected to an auxiliary voltage of 110 - 220 V AC or DC.

3.1.6 STORAGE CONDITIONS

- The installation has to be stored packed.
- The atmospheric conditions have to be at least equal to those of the operating area (see chapter 3.1.1).
- Suitable provisions have to be taken so as to prevent soiling due to dust and moisture (rain, snow, condensation) and to prevent mechanical damage.

3.2 TRANSPORT AND ASSEMBLY

3.2.1 TRANSPORT

Innovac SVS/08 installations that have more than 7 panels are transported in sections of up to 6 panels. Packed in Styrofoam and foil, each section is placed on 15-cm high pallet boards (figure 1). The pallets are attached to the installation by means of retaining straps.

Each installation also has four hoisting points to enable transport by a crane.

In the case of installations of up to five panels without instrument compartment, four eyebolts are supplied.

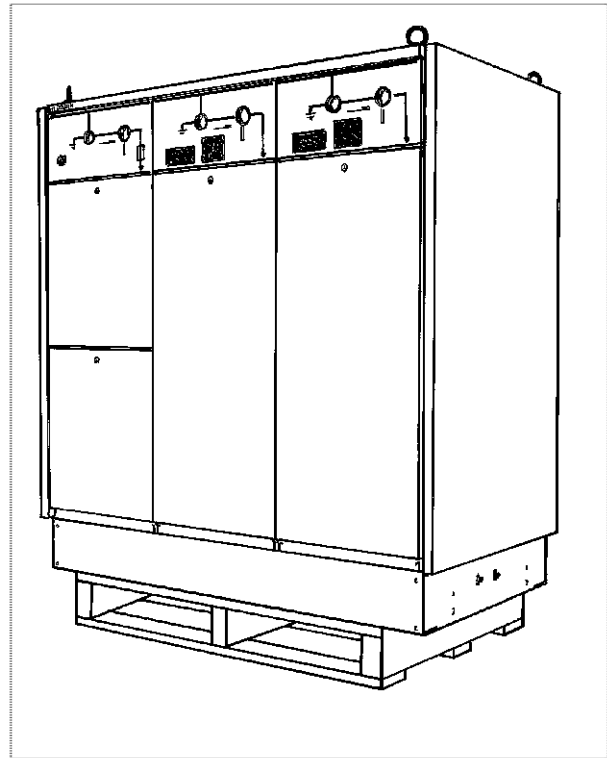
Installations with an instrument compartment or installations featuring more than 5 panels are provided with a lifting frame.

The eye bolts and the lifting frame can be removed after installation. The holes in the four hoisting points can be closed by means of the sealing plugs supplied as well.

A packed Innovac SVS/08 installation can also be moved with the aid of a hand-operated truck or a forklift truck.

NOTE

The installation must be transported in the "operating position" or "earthing position", see chapter. 2.3.1.



1.

3.2.2 INSTRUCTIONS FOR TRANSPORT

The user must follow the supplier's instructions.

Lifting

- See that the work area is safe: observe the local statutory provisions.
- Never stand underneath the load.
- The angle of the lifting cable relative to the lifting point must never be smaller than 45°.
- Lifting in extreme temperatures:
with temperatures between -5°C and 19°C and when using lifting gear made of steel, equal to or lower than grade B according to Euronorm 25-67, the work load is to be reduced by 25%.
- Lifting in windy conditions:
The lifting operations will have to be stopped in case of wind force 7 on the scale of Beaufort (wind speeds > 13.9 - 17 m/s). When lifting at great height, lifting will have to be stopped earlier.

Transport

- The installation is to be transported in vertical position.
- During transport suitable measures are to be taken so as to prevent intrusion of dust and moisture (rain, snow) and to prevent mechanical damage.

3.2.3 TRANSPORT ACCESSORIES

Hoisting accessories (figure 1):

- a. four lifting eyes
- b. four washers
- c. four sealing plugs

Transport in operating area

Innovac SVS/08 installations can be installed in the operating area, using steel rollers. Another option is to move the installation on Eaton wheeled trolleys.

3.2.4 SYSTEM ASSEMBLY

1. Make the holes in the floor, as shown in the floor plan.
2. Remove the protection covers using the supplied key, with the exception of the protection covers for the fuses.
3. Remove the bottom plates from the outer panels.
4. Position the installation at the required place and finger-tighten the fixing material.

NOTE

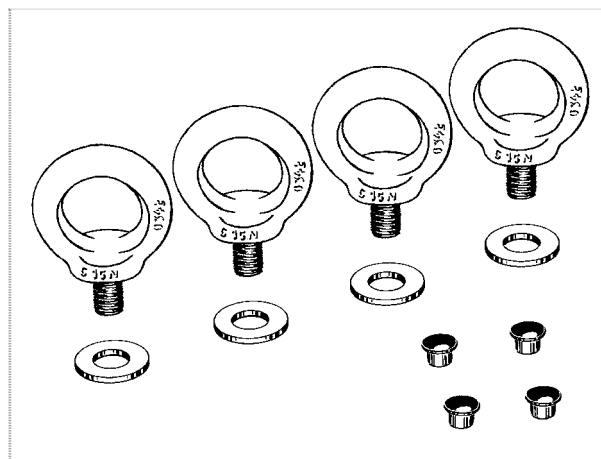
The installation has to be level. If necessary, any voids between the foundation frame and the floor can be filled with shims.

5. Fix the foundation frame using the fixing bolts (M10). Torque the bolts to 15 Nm.
6. Connect the earth bar to the earthing system. Mount the earth point between the Innovac SVS/08 switchgear and the earthing system. Mount the reducing ring, with the smallest diameter directed towards the station and torque the hexagonal bolt (M12) to 30 Nm.
7. Remove the lifting eyes and/or the lifting frame (if this was used).
Seal the cleared openings in the upper covers of the installation using the plugs supplied with the installation.

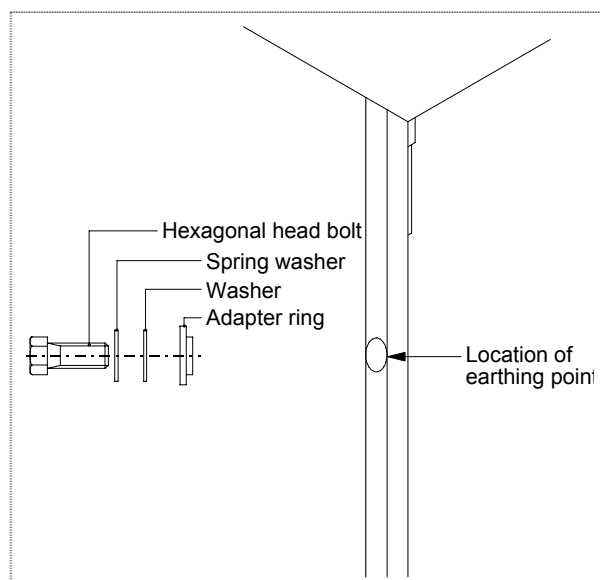
Assembling systems with more than 7 panels

Installations that have more than 7 panels are shipped in sections of up to 6 panels.

Installations supplied in sections must be put in place and coupled by the supplier.



1.

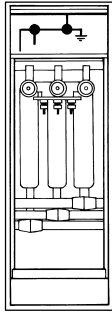
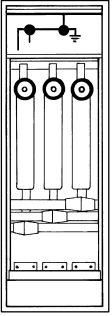
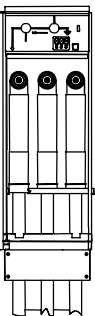
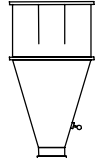
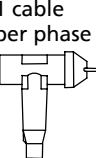
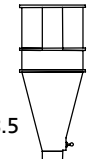
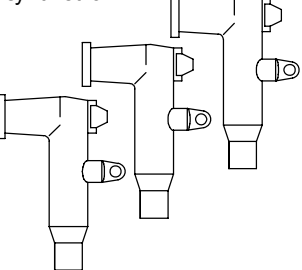
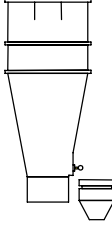
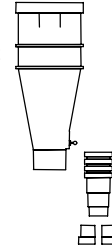
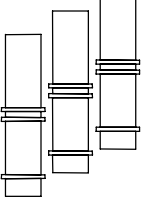


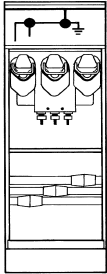
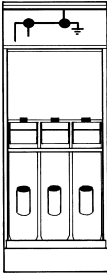
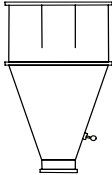
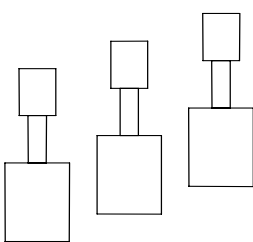
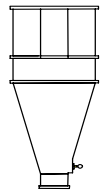
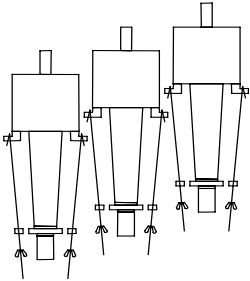
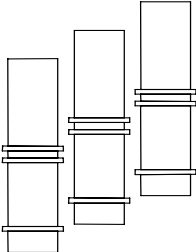
6.

3.3 CONNECTIONS

When connecting cables, observe the safety instructions (see chapter 1.3).

Different cable connections are available for Innovac SVS/08 switchgear. A summary is given below.

LOAD-BREAK SWITCH PANELS and CIRCUIT BREAKER PANELS		
12 kV	12 – 17.5 - 24 kV	12 kV
Panel equipped with: connection block with locked cable access ports for Magnefix-connections 	Panel equipped with: cones according to EN50181: types C en D 	Panel equipped with: connection block with locked cable access ports for cable socket connections 
Grease filled end seals for paper lead cable  maximum 70 mm ² Cu see chapter 3.3.4	Plug connection with T-plugs with screw connection for synthetic cables  1 cable per phase Type C: maximum 240 mm ² Cu or Al Type D: maximum 630 mm ² Cu or Al see chapter 3.3.1	Dry end seal for synthetic cables max 630 mm ² CU or Al  see chapter 3.4.2
maximum 150 mm ² Cu maximum 120 mm ² Al  see chapter 3.3.4 and 3.3.5	Plug connection with T-plugs with "elbow" plugs for synthetic cables  Type B: maximum 240 mm ² Cu or Al see chapter 3.3.1	
maximum 240 mm ² Cu or Al with soldering gland  see chapter 3.3.6		
maximum 240 mm ² Cu or Al with synthetic inlet tube  see chapter 3.3.7		
Dry end seal for synthetic cable  maximum 240 mm ² Cu or Al see chapter 3.3.10		

FUSED LOAD-BREAK SWITCH PANELS	
12 kV	12 – 17.5 - 24 kV
Panel with: 12 kV connection point beneath the fuse holders 	Panel with: 24 kV direct connection beneath the fuse holders. In cast resin with rubber sleeves and cable core connectors (Cu or Al) 
<i>Grease filled cable boxes for paper insulated lead covered Cu cables</i> Maximum 70 mm² Cu See chapter 3.3.4 	<i>Direct connection of single-core plastic insulated cables,</i>  Maximum 50 mm² Cu or Al See chapter 3.3.2
maximum 150 mm² Cu maximum 120 mm² Al  See chapters 3.3.4 and 3.3.5	<i>Connection of single core synthe- tic cables with plugs on cone according to EN50181 Type A</i>  Maximum 120 mm² Cu or Al See chapter 3.3.3
<i>Dry end seal for synthetic cable</i>  Maximum 240 mm² Cu or Al See chapters 3.3.9 and 3.3.10	

General

The front (2) of the foundation frame and the plinth (1) can be removed from the installation to make the cables easily accessible, see figure 2. The panel doors should first be removed.

If no cables are connected to a panel, the cable connection should be earthed (switch turned on and disconnect in earthing position). The cable earthing cores can be fitted to a copper earth bar. Additional safety is provided by fitting the connection cones with "dead ends". Another option would be to install 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 ON A 12 - 24-kV-LOAD-BREAK SWITCH OR CIRCUIT BREAKER PANEL

General

The panels are fitted with connection cones to enable plugging (figure 1).

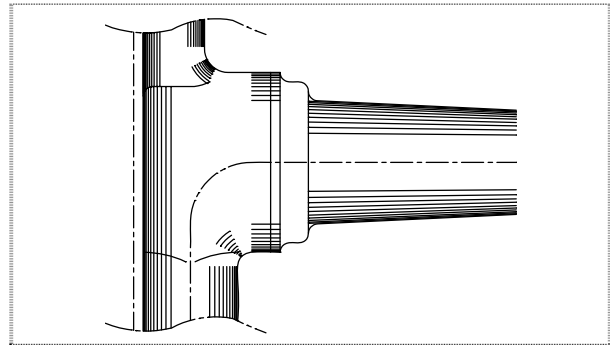
There are three versions:

- according to EN50181, type B, suitable for elbow connectors (up to 400 A) with plug connection;
- according to EN50181, type C, suitable for T-connectors (up to 630 A) with screwed connection;
- according to EN50181, type D, suitable for T-connectors (up to 630 A) with screwed connection.

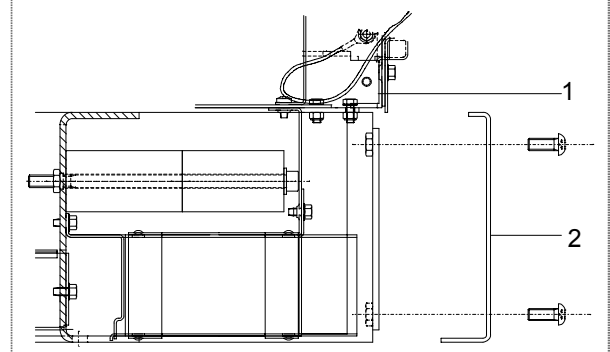
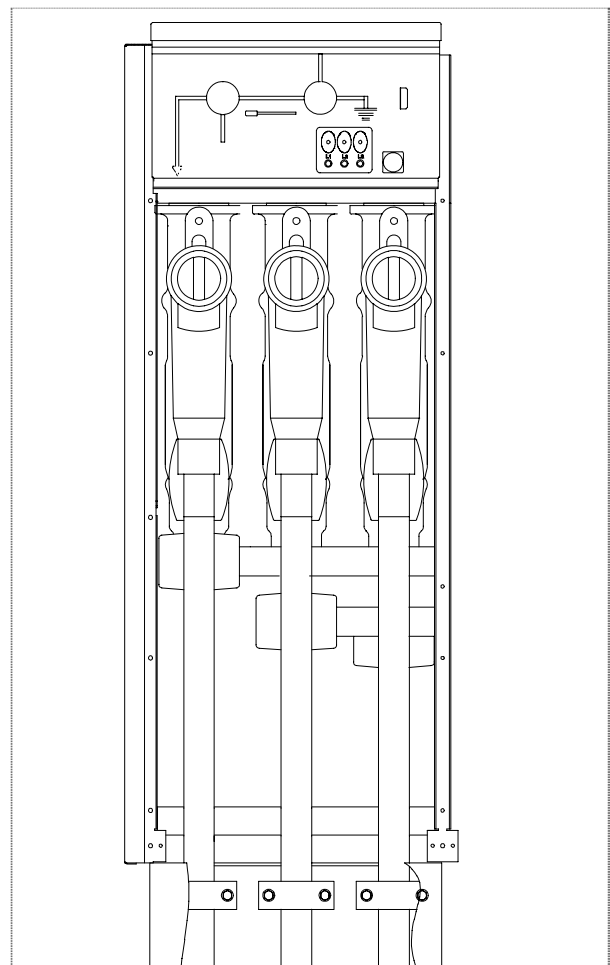
The cable cores and the connection of the cables to the connectors should be terminated in accordance with the instructions of the supplier in question.

Examples of connectors of different make:

- | | |
|----------------------------|---------|
| • Raychem RICS | (630 A) |
| • Raychem RSTI | (630 A) |
| • Kabel & Draht SEHDT | (630 A) |
| • ABB Kabeldon Kap 300/400 | (630 A) |
| • Euromold K400 TB | (630 A) |
| • Euromold K400 LR | (400 A) |
| • Pirelli | (630 A) |



1.



2.

Procedure**NOTE**

Check that the connector type matches the type of connection cone.

1. Open the panel door
 - remove the plinth
 - dismount the terminal box, if fitted, and swing it aside. Make sure the secondary cables are not damaged.
2. Remove the front bottom plate with the rubber bushing. Cut a hole of the right diameter in the bushing and slide the bushing onto the cable.
3. Clean the cable connection cone and the connector and slightly grease them with silicone grease.
4. Mount the connector to the connection cone, following the instructions of the supplier in question. Use the prescribed tightening torques
5. Fix the cable using the cable blocks:

For wood:

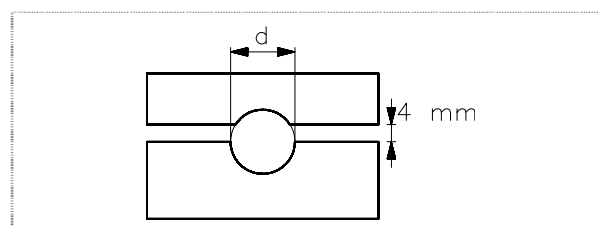
- Drill a hole in the cable block (its size depending on the cable diameter).
- Make sure that there is a 4-mm clearance between the two half-couplings so that the cable can be properly clamped.

For plastic:

- Select the plastic cable clamp for the corresponding cable diameter.
6. Earth the cable sheath with the earth bar.
 7. Fit the bottom plate with rubber bushing(s), the plinth and the terminal box, if any.

NOTE

If connectors are without an earthed outer layer, Eaton recommend that an extra interlock is fitted on the protection panel so that the cables can only be reached when the panel is safe and in earthing position (disconnecter in earthing position, load-break switch or circuit breaker switched on).



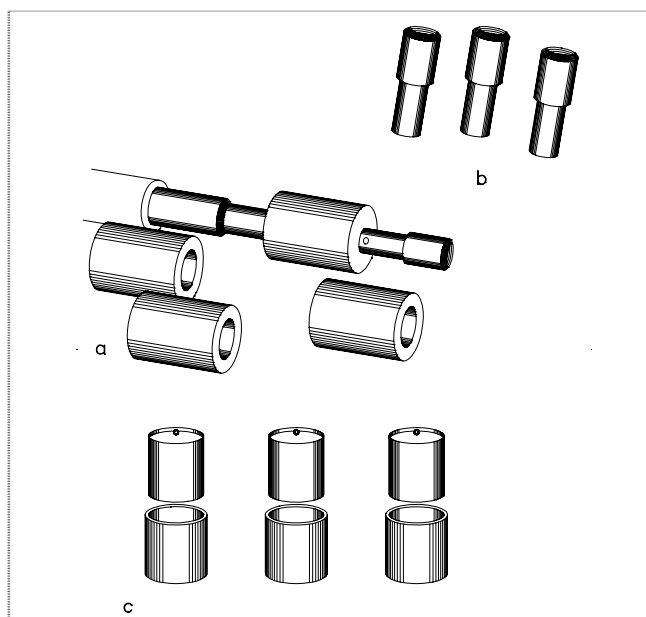
5.

3.3.2 DIRECT CONNECTION OF PLASTIC-INSULATED CU OR AL CABLES UP TO 50 MM² TO A 12 - 24-KV FUSED LOAD-BREAK SWITCH PANEL

General

The panel is provided with cast resin-insulated 24-kV connections underneath the fuse holders. They are suitable for connection of any type of Cu or Al single-core plastic-insulated cable up to 50 mm². The cables should be terminated in accordance with the supplier's instructions and the connection used.

For these panels Eaton can also supply completely terminated plastic-insulated cables for operating voltages up to 24 kV. These cable cores have a cross-sectional area of 16 mm² and are available in any desired length.



1.

Required materials (figure 1)

- 3 rubber sealing sleeves (a) for the cables
- 3 cable core connectors (b) with M8 internal thread
- 3 rubber sealing sleeves (c) with 3 sealing plugs for the non-cable side
- 3 hexagonal socket screws M8 x 25 (d) with cup spring washers and washers

The sizes of the sealing sleeves (table 1) and the cable core connectors (table 2) match that of the cable that is to be connected. In this respect the cable data below are important:

- The diameter across the primary core insulation after removal of the semiconductive layer on the cable core
- The diameter of the cable core
- The material used for the cable core (copper or aluminium)
- The type and make of the cable.

Assuming these cable data, the following sealing sleeves and cable core connectors are available:

Diameter across primary core insulation (mm)	Sealing sleeves		
	Inside diameter (mm)	Code	Article number
13.8 to 15.3	12.3	6	612.423
15.3 to 17.3	13.8	1	612.424
17.3 to 18.75	15.8	16	612.425
18.75 to 20.5	17.5	3	612.426
20.5 to 22.0	19.5	18	612.427
22.0 to 23.5	21.0	13	612.341
Remark: To seal on the non-cable side, sleeve no. 1 (article number 612.424) is to be used in combination with the plastic pin (article number 106.081) supplied with the system.			

Table 1 Sealing sleeves (grey EPR)

Diameter of cable core (mm)	Article no. of cable core connectors	
	Copper	Tool no. *
4.7 to 5.75	106.117	8
5.8 to 6.50	612.410	10
6.6 to 7.75	612.428	12
8.0 to 9.75	612.340	14
	Aluminium	
6.1 to 7.40	612.430	14
7.2 to 9.10	612.429	16

* as per DIN 48083

Table 2 Cable core connectors

Procedure

Termination of cables (non-Eaton-cables)

1. On the basis of tables 1 and 2 on the page before, check that the correct parts are at your disposal.
2. Terminate the cable cores at the proper length, as shown in figure 2.
 - Finish the cable core insulation so that the outside is perfectly smooth; any grooves and ridges may lead to the insulation not offering full protection against spark-over voltages.
3. Fit the cable core connectors to the cable cores using a suitable crimping tool (see table 2). Grooves in the cable core connectors mark the position and the number of crimping rings.

Connection of cables (Eaton and non-Eaton cables).

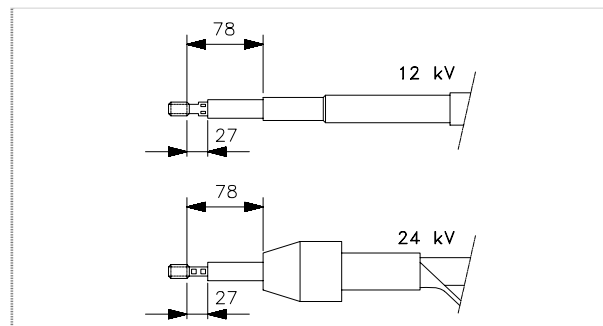
4. Feed the three cables through the underside (from the cellar) or through the wall into the installation.
5. Depending on the cable diameter, make a hole in the rubber bushing. Slide the rubber bushing onto the cable.
6. Grease the cable local to the primary cable insulation and position the 3 cable sleeves on the cable core connectors.

NOTE

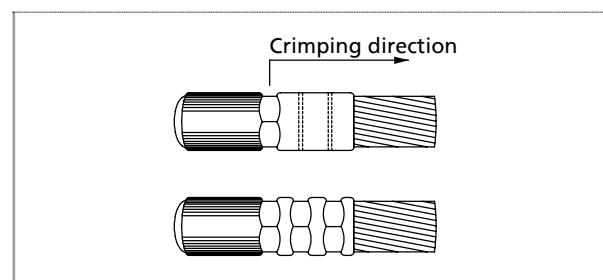
Use the correct type of grease:

- Vaseline for red (older) rubber sleeves
- Silicone grease for grey rubber sleeves

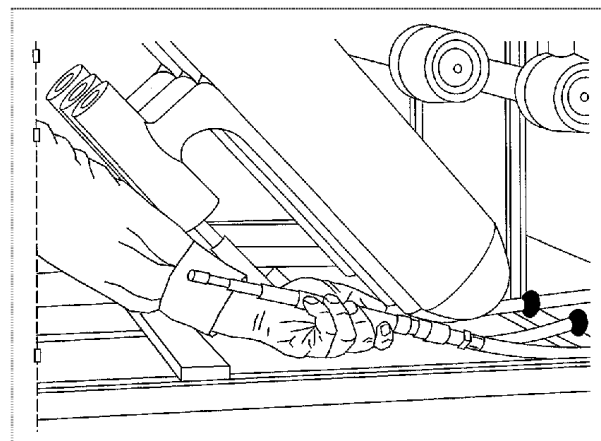
7. Insert the cable and sleeve carefully in the cable connection via the underside. Check that the sleeves are not rolled up.
8. Push the cable in, from the underside, until the cable core connector touches the contact face in the connection.



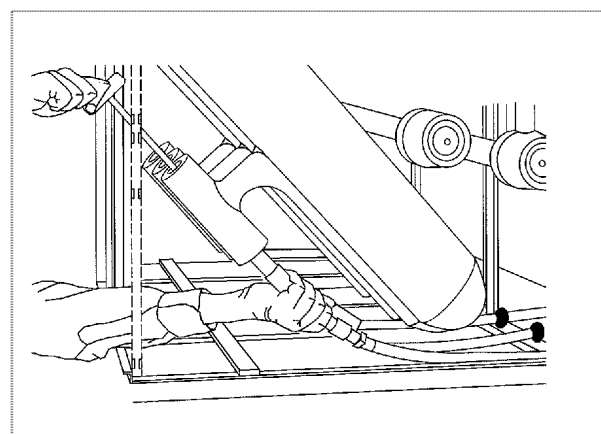
2.



3.



4.



7.

9. Now fix the cable from the top side (torque: 15 Nm) using the hexagonal socket screw M8 x 25 (with cup spring washer and washer).

NOTE

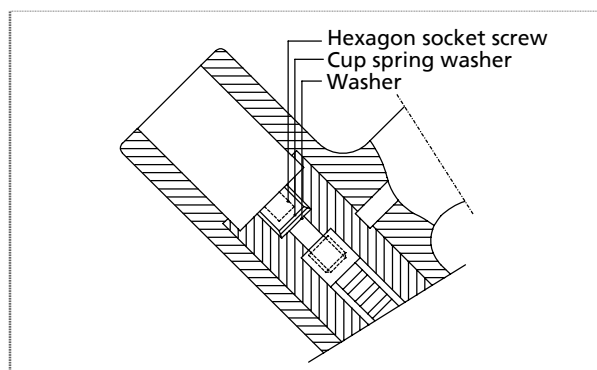
If the connection is not completely pressed against the contact face, there is a risk of the cable core getting damaged when the hexagonal socket screw is being tightened. Avoid this situation.

10. Then seal the non-cable side:
- Fit the sleeve with the sealing plug in the opening of the cable connection.
 - In so doing, fit a nylon vent thread between the sleeve and the cast resin and pull this thread away afterwards.

NOTE

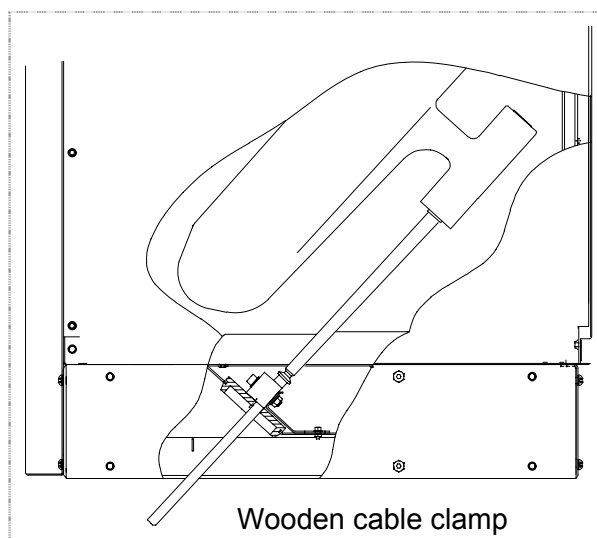
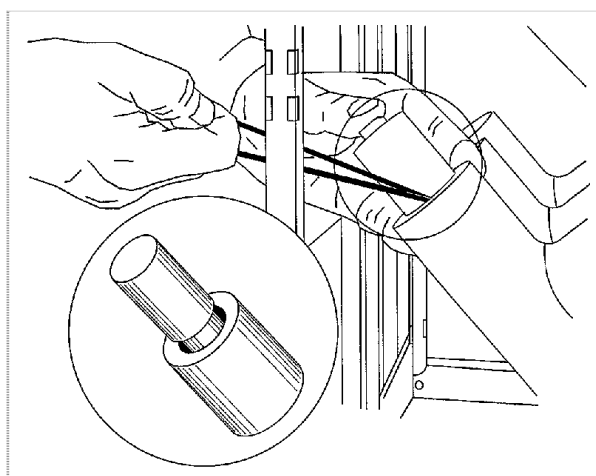
These sleeves are always coded as sleeve no. 1. The other sleeves to be used for cable connection have different codes, which depend on the cable that is to be connected.

11. Fix the cable to the frame using the wooden clamping block.
- Make sure that the cable bending radius at least equals the value indicated by the supplier.
 - For the Eaton transformer cables the bend radius is 15 times the outside diameter of the cables.
12. Earth the cable screen via the earth bar using the flexible earth connection.
13. Place the rubber bushing in the bottom plate of the panel.



9.

10.



11.

3.3.3 CONNECTION OF PLASTIC-INSULATED CU OR AL CABLES UP TO 120 M2 WITH STRAIGHT CONNECTORS TO A 12 – 24 V FUSED LOAD-BREAK SWITCH PANEL

General

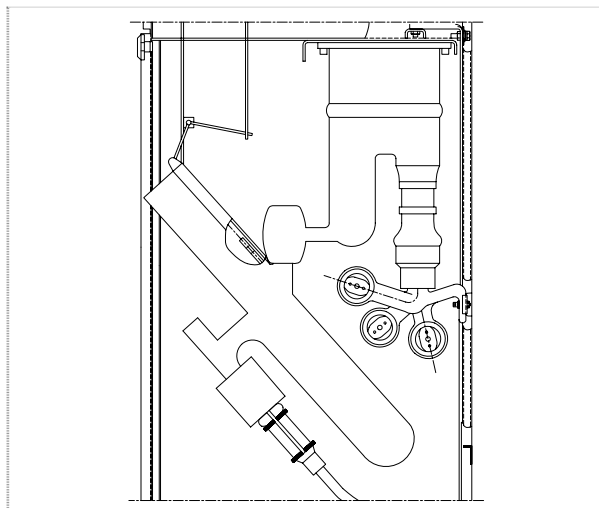
The panel has cast resin-insulated 24-kV connections underneath the fuse holders. Single-core plastic-insulated Cu or Al cables up to 120 mm² can be plugged into these connections by means of straight connectors. These connection points are to be provided with an adapter on the cable side. The adapter has a connection cone as per DIN 47636-250 and CENELEC EN50181: 1994, type A. If the installation does not have an adapter upon delivery, it is to be fitted as yet.

Required materials

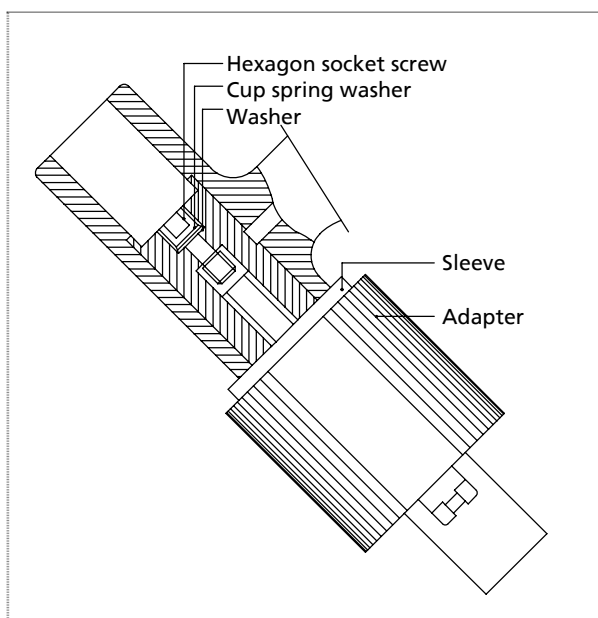
- three rubber sealing sleeves for the cable side
- three adapters
- three rubber sealing sleeves with three sealing plugs for the non-cable side
- three hexagonal socket bolts (M8 x 25) with cup spring washers and washers.

Fitting the adapter

1. Thoroughly clean the connection point on the cable side as well as the adapter, inside and out.
2. Slightly grease the outside of the connection point on the cable side with Vaseline.
3. Mount the sleeves to the connection point on the cable side and slightly grease the outside of the sleeves with Vaseline.
4. Push the adapter on the sleeve so that the adapter ears are horizontal. Check that the sleeve is not rolled up.
5. Fix the adapter from the top of the connection point (15 Nm) using the hexagonal socket screw (M8 x 25) with cup spring washer and washer.
6. Then seal the non-cable side:
 - fit the sleeve with sealing plug in the opening of the cable connection.
 - in so doing, fit a nylon vent thread between the sleeve and the cast resin and pull this thread away afterwards.



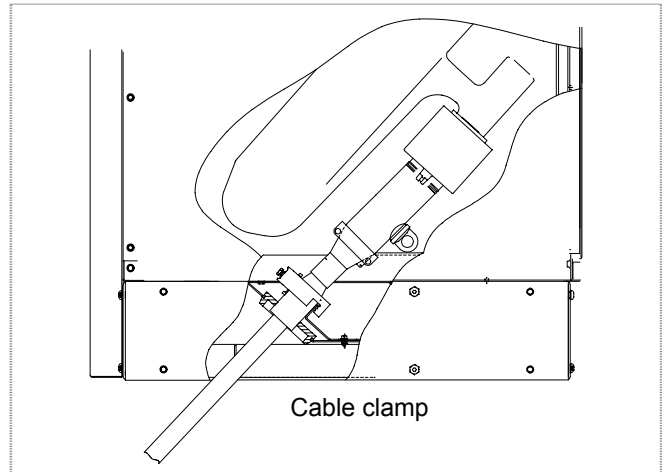
4.



5.

Mounting the straight plug connector

1. Clean the adapter and plug, and rub them with a little silicone grease.
2. Fit the plug to the special adapter as set out in the manufacturer's instructions.
3. Fit the cable to the frame, using a (wooden) cable clamp.
 - Make sure that the cable bending radius meets at least the value specified by the manufacturer.
 - The bending radius of Eaton transformer cables is 15 times the cable outside diameter.
4. Earth the cable sleeve.
5. Fit the rubber bushing in the bottom plate of the panel.



3.

3.3.4 CONNECTION OF PAPER-INSULATED LEAD-COVERED CU CABLES UP TO 95 MM² BY MEANS OF GREASE-FILLED CABLE BOXES

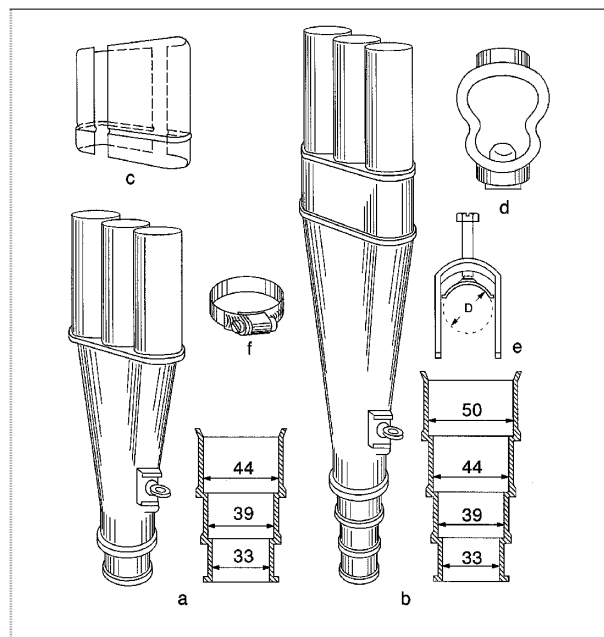
General

Paper-insulated lead-covered cables can be connected to load-break switch and circuit breaker panels and to fused load-break switch panels of up to 12 kV. The load-break switch and circuit breaker panels have a terminal block with interlocked cable access ports. The terminal block has three connection pins that are moulded in cast resin insulation.

The 12-kV connection pins on fused load-break switch panels are situated directly underneath the fuse holders.

Required materials

- One small cable box (a) for core cross-sectional areas up to 95 mm² or
- One large cable box (b) for core cross-sectional areas up to 150 mm²
- Two protective sheath halves (c)
- Three cable core clamps (d)
- One cable clamp (e) (D = cable diameter)
- One hose clip (f)
- Polyethylene tape



1.

Procedure

1. Remove the bottom plate with the rubber bushing.
2. Incise the cable at the correct length, as shown in figure 2.
 - L1 = 515 mm for a small cable box
 - L1 = 700 mm for a large cable box

NOTE

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. Terminate 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 a distance (d). Finish the sharp edges of the lead sheath.

NOTE

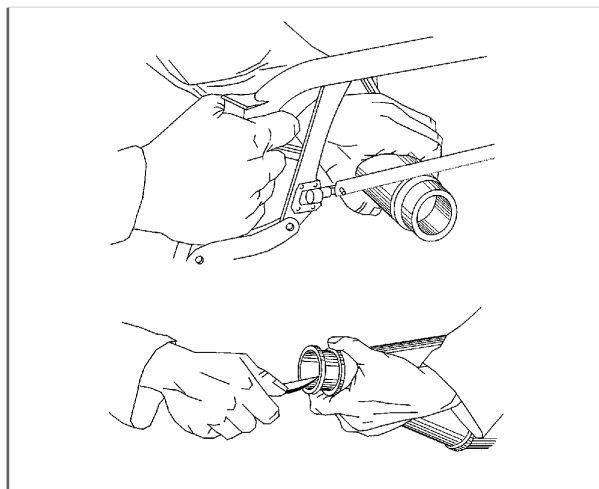
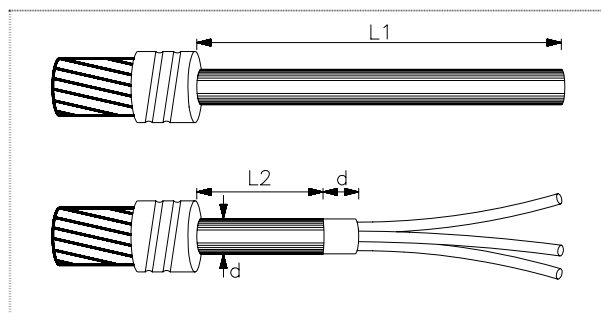
Dimensions L1 and L2 allow for a 50mm length for earthing the lead sheath.

4. Saw off the cable box in accordance with the diameter (d) measured across the lead sheath.

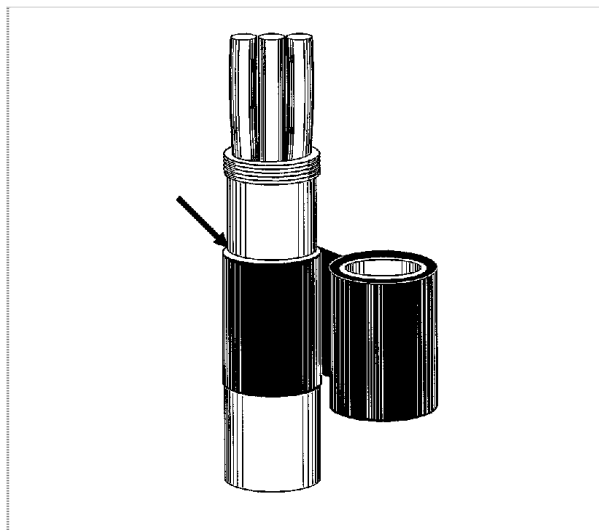
Take into account that several layers of polyethylene tape are to be applied on top of the lead sheath.

 - Deburr any sharp edges.
5. Degrease the upper side of the lead sheath and sand it lightly, for instance with a Scotchbrite 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 exactly flush with that of the lead sheath (see arrow).
 - Wind without any crinkles.
6. Depending on the cable diameter, make a hole in the rubber bushing. Slide the rubber bushing onto the cable.

2.



4.

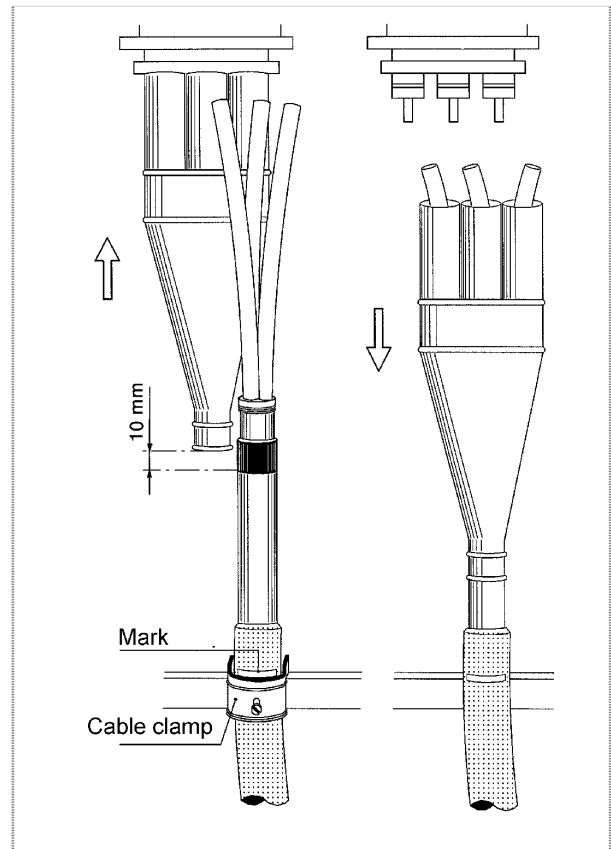


5.

7. 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 10 mm from the cable box bottom side.
 - Mark the cable just above the cable clamp.
8. Remove the cable box from the cable terminal block.
9. Insert the cable into the cable box from below and lower the cable box onto the cable as far as possible.

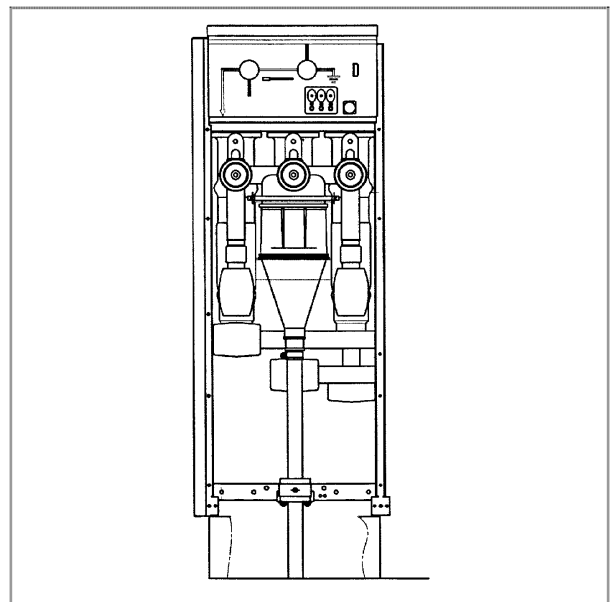
NOTE

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



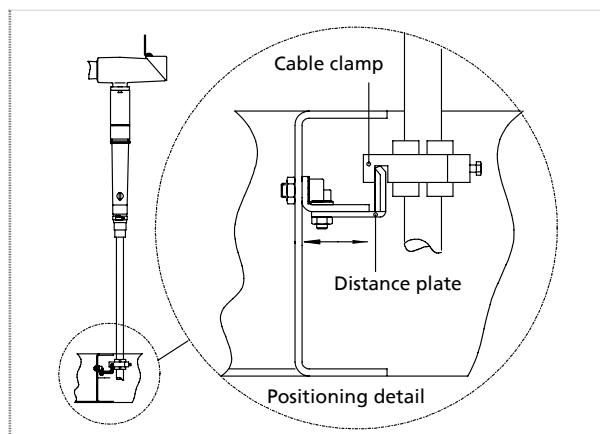
7, 9

10. Fix the cable in the cable clamp at the marked position.
Move the distance plate until the centre of the cable is exactly in line with the centre of the cable box. Firmly tighten the cable clamp.



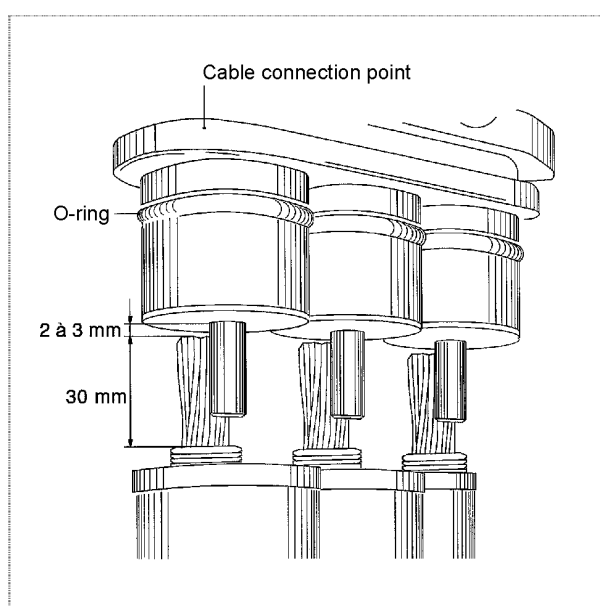
10a.

11. Seal the openings of the cable box so as to prevent intrusion of dirt.



10b.

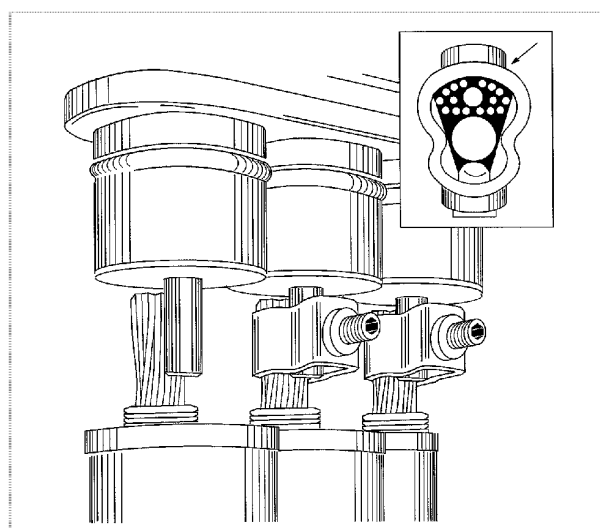
12. Cut the cable cores 2 or 3 mm below the cast resin insulation
 - Remove the paper insulation from the cable cores over a distance of 30 mm.
13. Check that the O-rings are fitted onto the cast resin insulation.
 - Slightly grease the cast resin insulation with cable grease.



12.

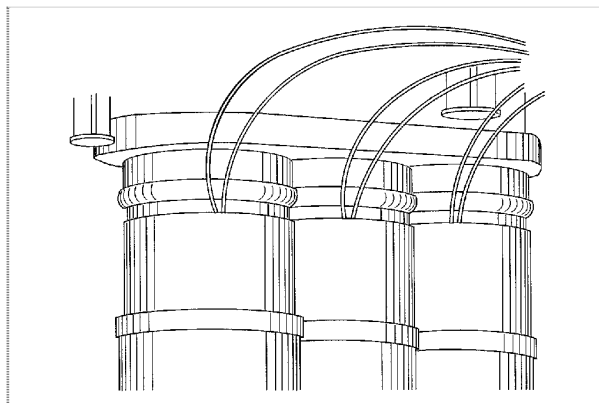
14. Connect the cable cores to the connection points using the cable core clamps.
 - Check that the cable cores are correctly positioned inside the clamps. This is where the associated cross-sectional area is stated (see detail).
 - Tighten the hexagonal socket screws (torque: 15 Nm). Make sure that in all three phases the screws are positioned straight ahead.

Retighten the screws after some time.



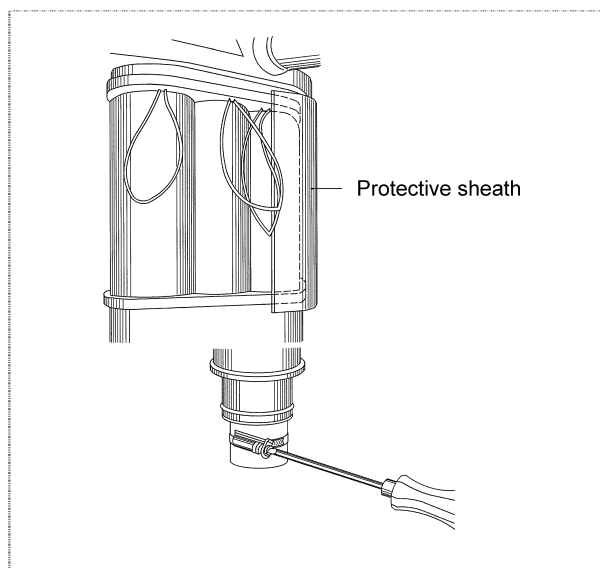
14.

15. Hang a nylon thread, folded double, over the edge of each opening in the cable box, with the ends hanging inside.
Now slide the cable box completely onto the cast resin insulation.



15.

16. Apply the protective sheath 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 protective sheath.
17. Fit the cable clamps to the end of the cable box and tighten them (torque 5 Nm).
18. Screw down the bottom plate. Place the rubber bushing in the bottom plate.
19. Fill the cable box with grease (for this, see chapter 3.3.8).



16.

3.3.5 CONNECTION OF PAPER-INSULATED LEAD-COVERED CU CABLES UP TO 150 MM² OR AL CABLES UP TO 120 MM² BY MEANS OF GREASE-FILLED CABLE BOXES

General

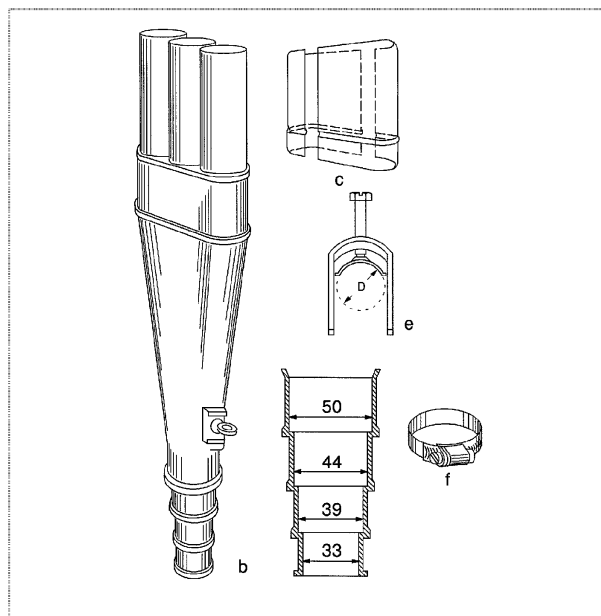
Paper-insulated lead-covered cables can be connected to load-break switch and circuit breaker panels and to fused load break switch panels of up to 12 kV. The load-break switch and circuit breaker panels have a terminal block with interlocked cable access ports. The terminal block has three connection pins that are moulded in cast resin insulation.

The 12-kV connection pins on fused load-break switch panels are situated directly underneath the fuse holders.

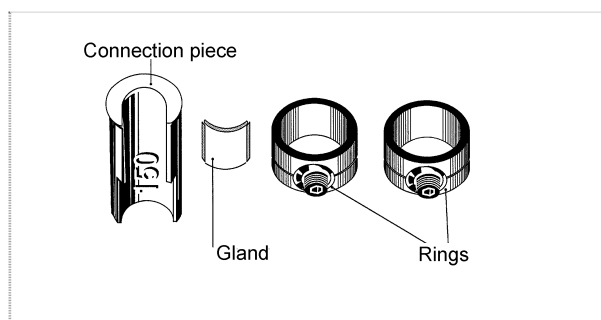
Required materials

For cables with a copper core (figures 1a and 1b):

- One large cable box (b)
- Two protective sheath halves (c)
- Three cable core clamps (d), each clamp consisting of:
 - one connecting piece
 - one gland
 - two washers with hexagonal socket screws
- One cable clamp (e) (D = cable diameter)
- One hose clip (f)
- Polyethylene tape



1.a



1.b

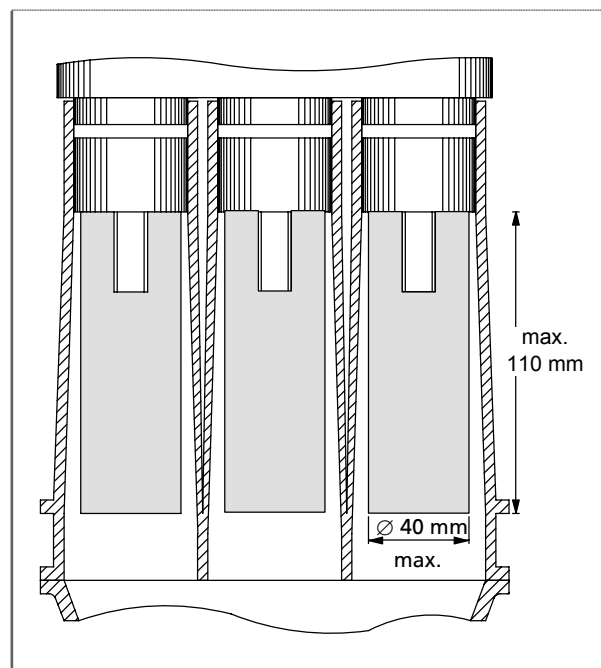
NOTE

For cables with an aluminium core (figure 1c):

The cable core clamps from Eaton are only suitable for connecting cables with a copper core.

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

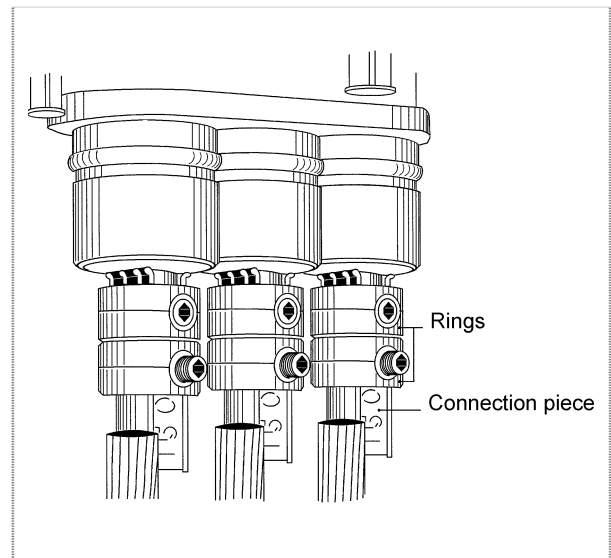
Basically, any type of cable core clamp can be used, provided it is within the permitted dimensions when crimped.



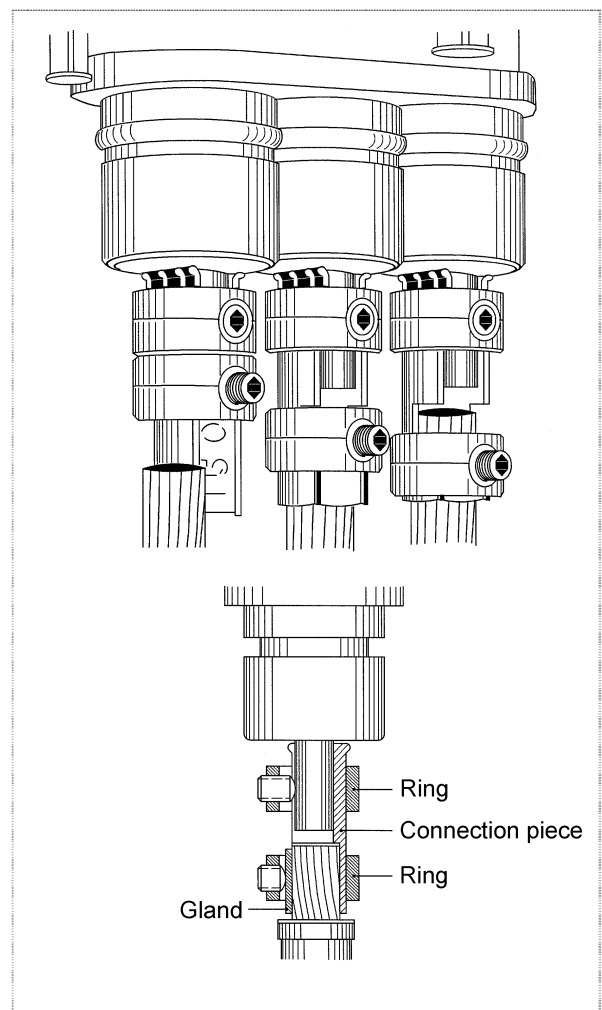
1.c

Procedure

1. Connect the cable box to the cable. To do so, follow the procedure as described in chapter 3.3.4, steps 1 through 13.
2. Fit the connecting pieces to the connection pins using one of the washers.
 - Torque the hexagonal socket screws to 15 Nm. Make sure that in all three phases the screws are positioned straight ahead.
3. Slide the other washers along the connecting pieces as far as possible and provisionally tighten the hexagonal socket screws.
4. Seal the openings of the cable box so as 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 glands onto the core ends in the recesses in the connecting pieces and slide the lower washers along the glands.
 - Retighten the hexagonal socket screws to 15 Nm. Make sure that in all three phases the hexagonal socket screws are positioned straight forward.
 - Retighten the hexagonal socket screws of the cable core clamps after some time.

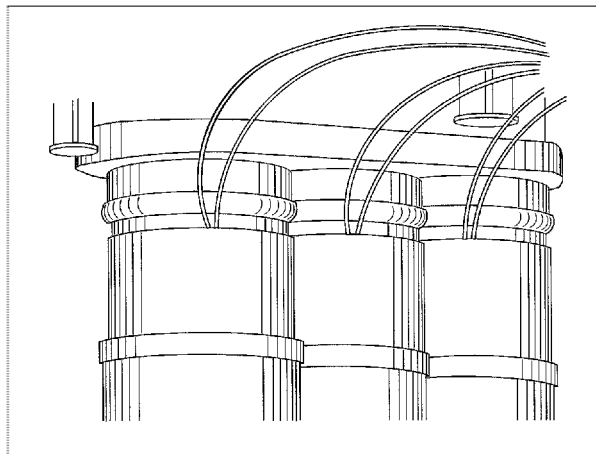


2, 3



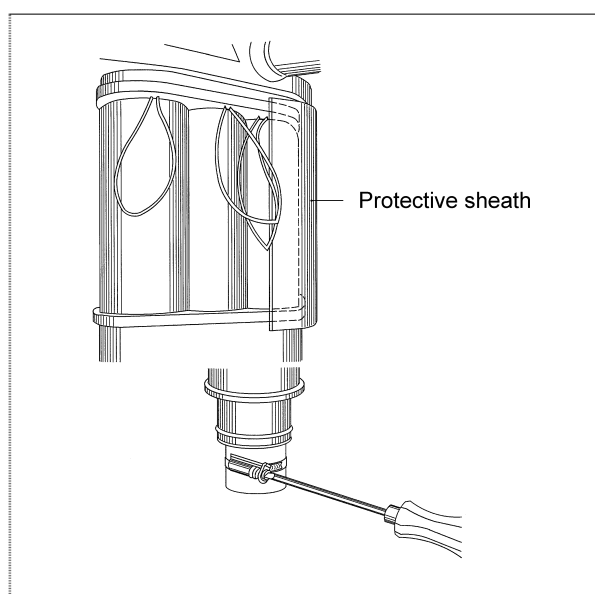
6.

7. Hang a nylon thread, folded double, over the edge of each opening of the cable box, with the ends hanging inside.
 - Now slide the cable box completely along the cast resin insulation.
8. Fit the protective sheath 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 protective sheath.
9. Fit the hose clips to the end of the cable box and tighten them (torque 5 Nm).
10. Screw down the bottom plate. Place the rubber bushing in the bottom plate.



7.

11. Fill the cable box with grease (for this, see chapter 3.3.8).



8.

3.3.6 CONNECTION OF PAPER-INSULATED LEAD-COVERED CU OR AL CABLES UP TO 240 MM² BY MEANS OF GREASE-FILLED CABLE BOXES WITH SOLDERING GLAND

General

Paper-insulated lead-covered cables can be connected to load-break switch and circuit breaker panels and to fused load-break switch panels of up to 12 kV. The load-break switch and circuit breakers panels have a terminal block with interlocked cable access ports. The terminal block has three connection pins that are moulded in cast resin insulation.

The 12-kV connection pins on fused load-break switch panels are situated directly underneath the fuse holders.

Required materials

For cables with a copper core (figure 1a):

- One cable box (a) (depending on the core diameter)
- Two protective sheath halves (c)
- Three cable core clamps (figure 1b):
 - d1: for core cross-sectional area $\leq 75 \text{ mm}^2$
 - d2: for core cross-sectional area $> 75 \text{ mm}^2$, composed of one connecting piece, one gland and two washers with hexagonal socket screws
- One cable clamp (e) ($D = \text{cable diameter}$)
- One hose clip (f)
- One gland bush (g) with O-ring
- Polyethylene tape

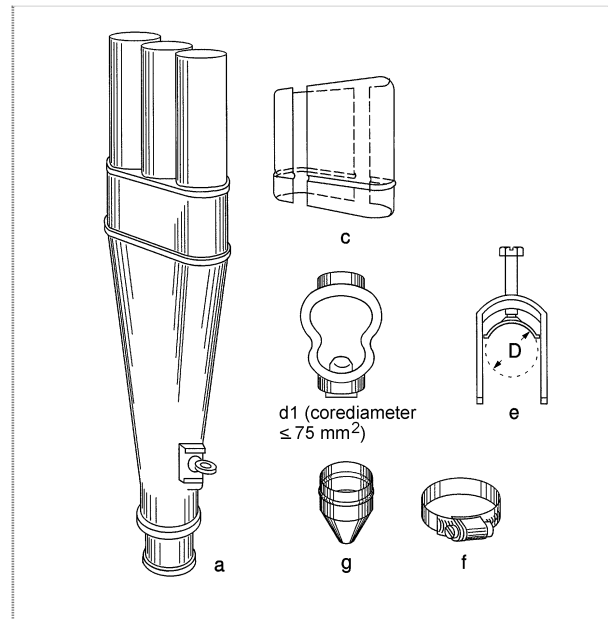
NOTE

For cables with an aluminium core (figure 1c):

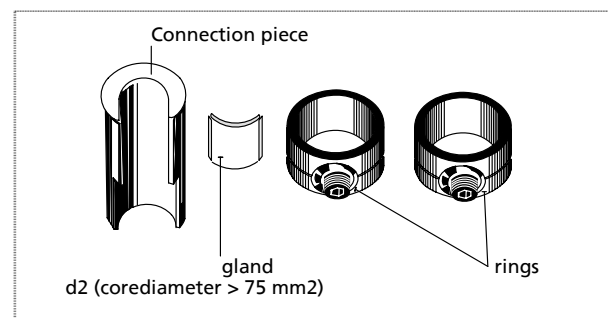
The cable core clamps from Eaton are only suitable for connecting cables with a copper core.

There is a maximum free space measuring 40 mm dia. x 10 mm to connect cables with an aluminium core by means of crimp cable sockets, for instance.

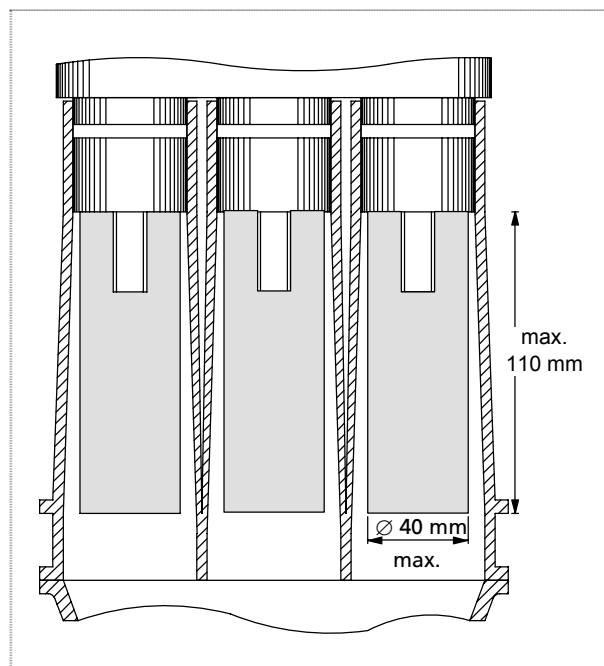
Basically, any type of cable core clamp can be used, provided it is within the permitted dimensions when crimped.



1a.



1b.



1c.

Procedure

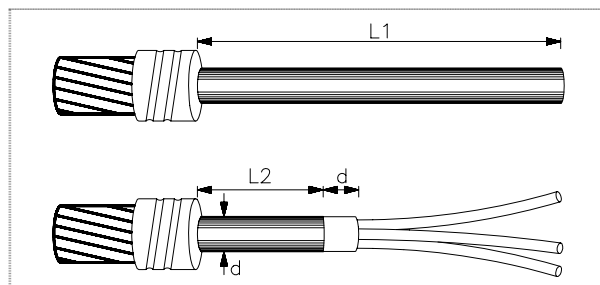
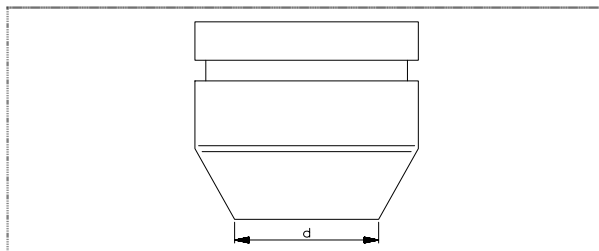
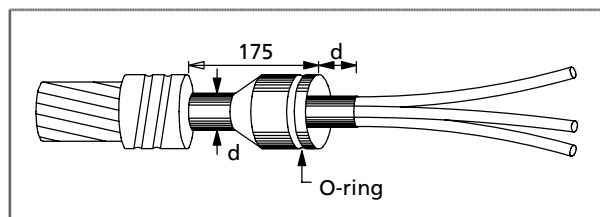
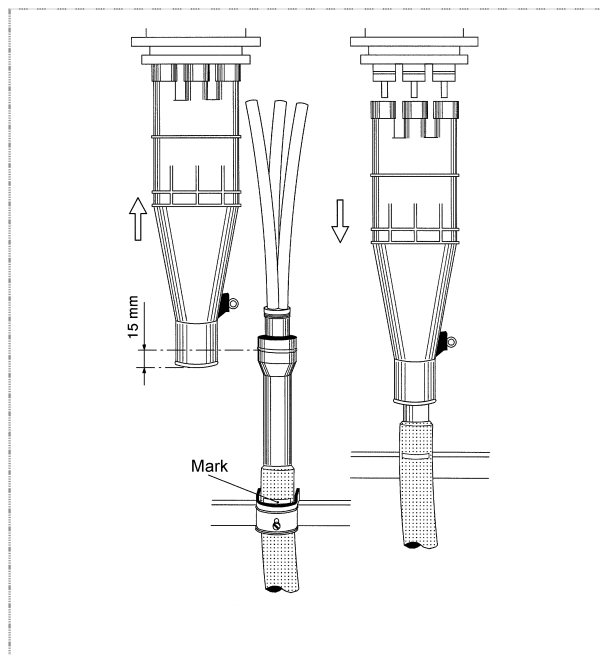
1. Remove the bottom plate with the rubber bushing.
2. Incise the cable at the correct length, as shown in figure 2.
 - $L1 = 650 \text{ mm}$

NOTE

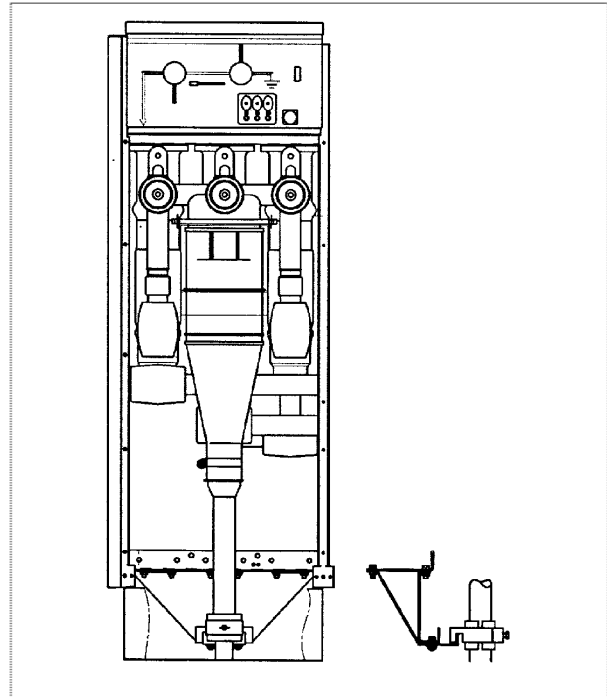
To simplify insertion of the cable cores in the right tubes of the cable box, it is recommended to cut the cable cores to different lengths.

3. Terminate the cable, as shown in figure 2.
 - $L2 = 175 \text{ mm}$
 - d = diameter across the lead sheath

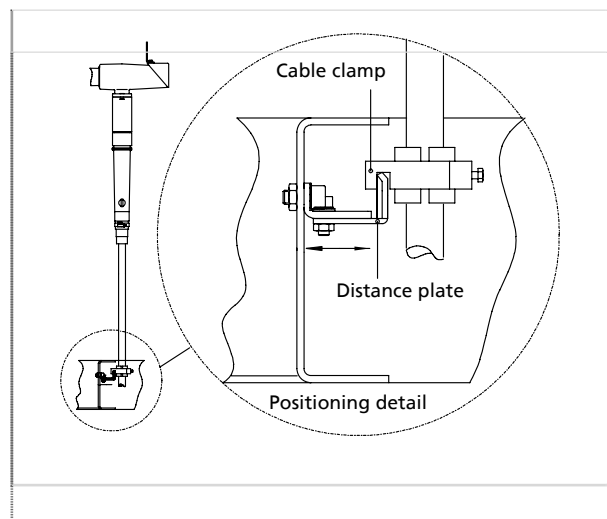
Remove the lead sheath over a distance (d). Finish the sharp edges of the lead sheath.
4. Depending on the cable diameter, make a hole in the rubber bushing. Slide the rubber bushing onto the cable.
5. Remove the O-ring from the gland bush.
 - Saw off the underside of the gland bush, resulting in a hole whose inside diameter equals the diameter (d) measured across the lead sheath.
6. Slide the gland bush along the lead sheath.
7. Solder the gland bush straight onto the lead sheath.
 - Preferably use soldering tin containing 35 % tin and 65 % lead so that the soldering temperature can be kept as low as possible.
 - Check that the top of the gland bush and the end of the lead sheath match.
8. Grease the O-ring using silicone grease or acid free Vaseline and slide it onto the gland bush.
9. 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.

**3.****5.****7.****9.**

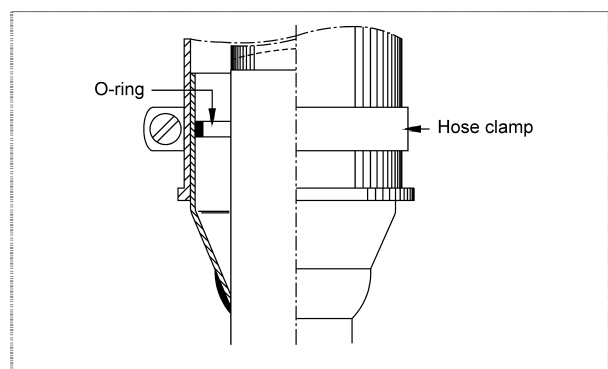
10. Remove the cable box from the cable terminal block.
11. Slide the cable box onto the cable as far as possible.
Take care that the paper insulation of the cable cores does not get damaged in the process.
12. Fix the cable in the cable clamp at the marked position.
Move the distance plate so that the centre of the cable is exactly in line with the centre of the cable box.
Firmly tighten the cable clamp.
13. In case of cables with an aluminium core:
Once the crimp cable clamps have been applied, these can be fixed in accordance with the instructions.
In this case step 14 can be skipped.
14. Depending on the diameter of the core, follow the procedure described in:
 - Chapter 3.3.4, steps 11 through 16
 - Chapter 3.3.5, steps 2 through 8
15. Fit the hose clip to the gland bush, at the level of the O-ring.
16. Screw down the bottom plate. Place the rubber bushing in the bottom plate.
17. Fill the cable box with grease (for this, see chapter 3.3.8).



12a.



12b.



15

3.3.7 CONNECTION OF PAPER-INSULATED LEAD-COVERED CU OR AL CABLES UP TO 240 MM² BY MEANS OF GREASE-FILLED CABLE BOXES WITH PLASTIC ENTRY BUSHING

General

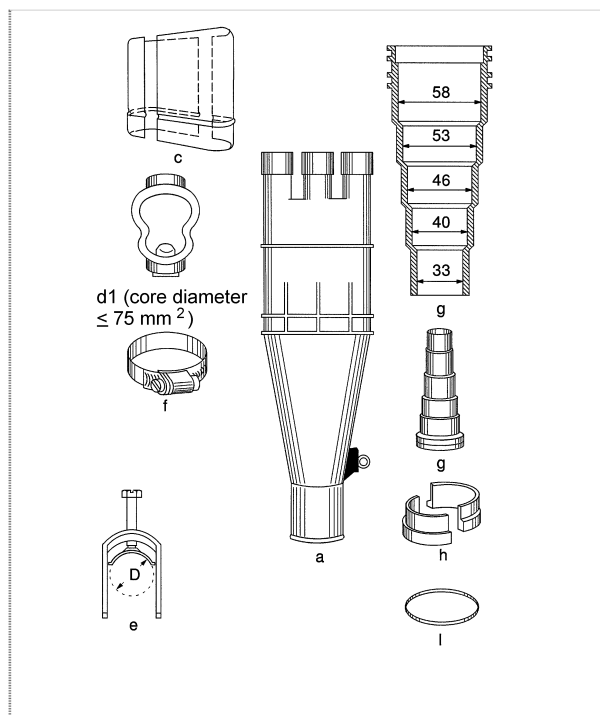
Paper-insulated lead-covered cables can be connected to lead-break switch and circuit breaker panels and to fused load-break switch panels of up to 12 kV. The load-break switch and circuit breaker panels have a terminal block with interlocked cable access ports. The terminal block has three connecting pins that are moulded in cast iron insulation.

The 12-kV connection pins on fused load-break switch panels are situated directly underneath the fuse holders.

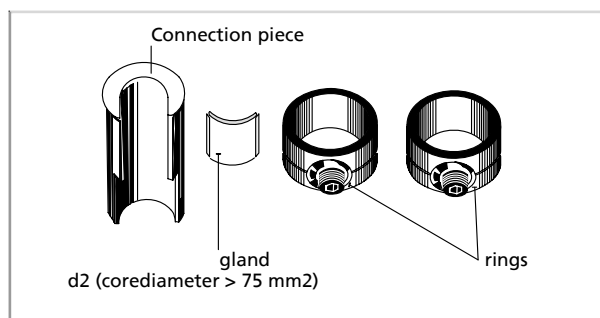
Required materials

For cables with a copper core (figures 1a and 1b):

- One cable box (a) (depending on the core diameter)
- Two protective sheath halves (c)
- Three cable core clamps:
 - d1: for core cross-sectional area $\leq 75 \text{ mm}^2$
 - d2: for core cross-sectional area $> 75 \text{ mm}^2$, composed of one connecting piece, one gland and two washers with hexagonal socket screws
- One cable clamp (e) ($D = \text{cable diameter}$)
- Two hose clips (f)
- One plastic entry bushing (g) with two fixing shells (h) and one O-ring (i)
- Polyethylene tape



1a.



1b.

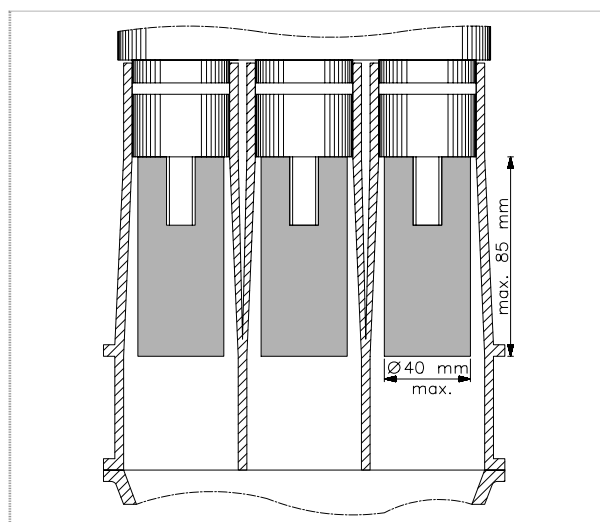
NOTE

For cables with an aluminium core (figure 1c):

The cable core clamps from Eaton are only suitable for connecting cables with a copper core.

There is a maximum free space measuring 40 mm dia. x 110 mm to connect 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.



1c.

Procedure

1. Remove the bottom plate with the rubber bushing.
2. Incise the cable at the correct length, as shown in figure 2.
 - $L1 = 650 \text{ mm}$

NOTE

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.

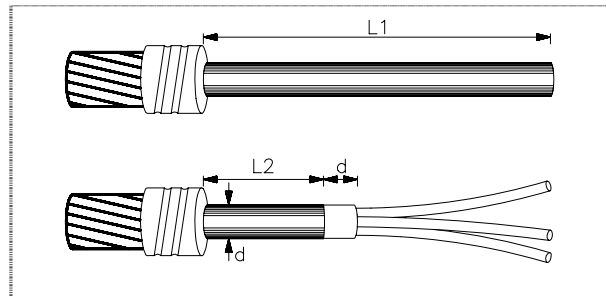
3. Terminate the cable, as shown in figure 3.

- $L2 = 175 \text{ mm}$
- $d = \text{diameter across the lead sheath}$

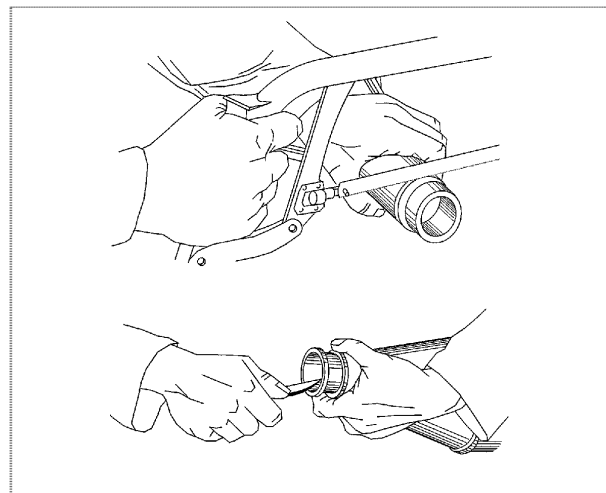
Remove the lead sheath over a distance d . Then finish the sharp edges of the lead sheath.

4. Depending on the cable diameter, make a hole in the rubber bushing. Slide the rubber bushing onto the cable.
5. Saw off the plastic cable 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 on top of the lead sheath.
 - Deburr any sharp edges.
6. Grease the O-ring using silicone grease or acid-free Vaseline.
 - Fit the O-ring in the upper recess of the plastic entry bushing (g).
7. Press the plastic entry bushing in the cable box and fit the two fixing shells (h) in the lower recess of the entry bushing. Then clamp it using the hose clip (f).

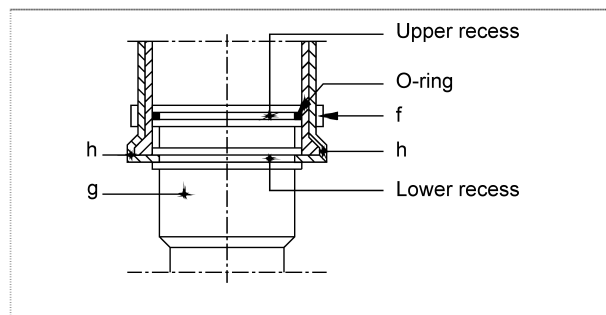
8. Degrease the upper side of the lead sheath and sand it lightly, for instance with a Scotchbrite scouring pad.
 - Apply a couple of layers of polyethylene tape to the lead sheath, so that the diameter measured across the tape equals the inside diameter of the plastic entry bushing.
 - Make sure that the upper side of the tape is flush with that of the lead sheath (see arrow).
 - Wind without any crinkles.



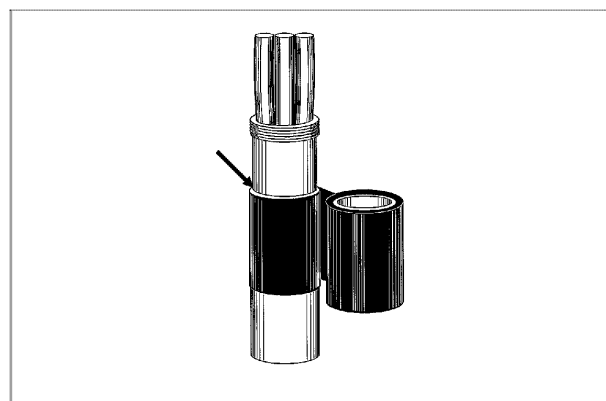
3.



5.

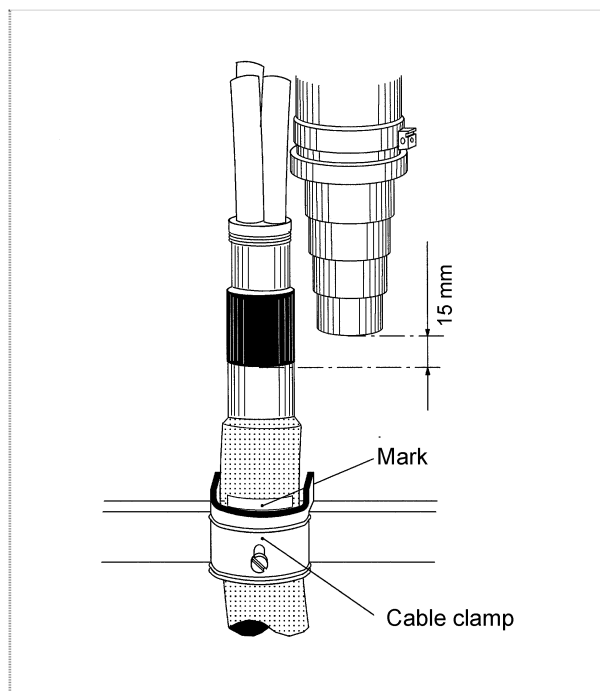


6, 7



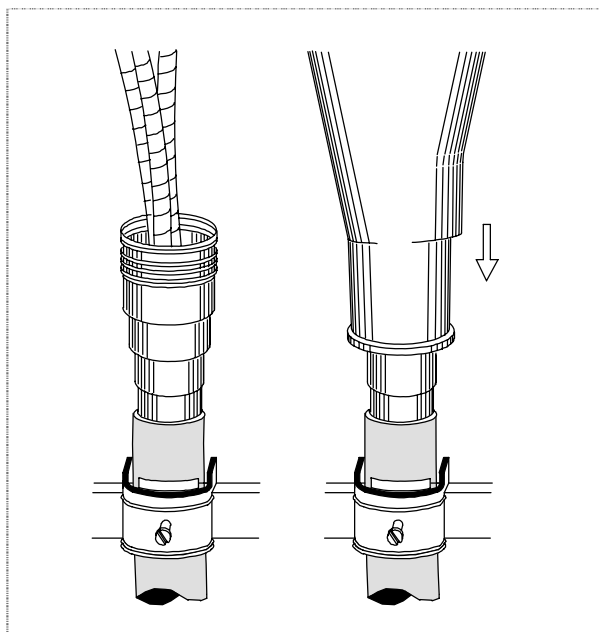
8.

9. 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 from the plastic entry bushing bottom side.
 - Mark the cable just above the cable clamp.
10. Remove the cable box from the cable terminal block.



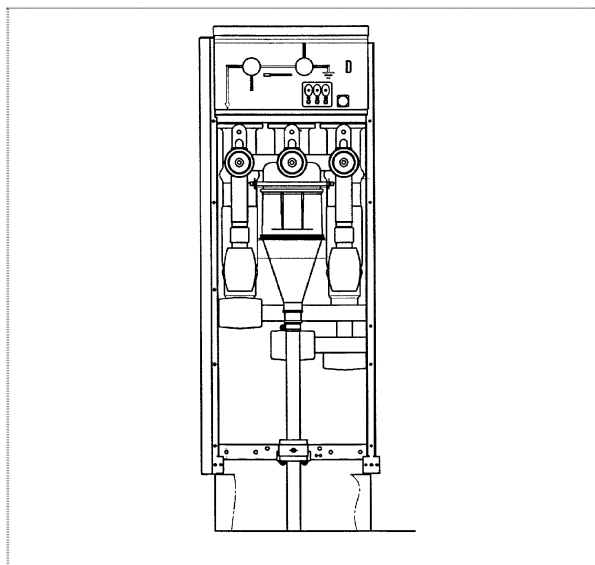
9.

11. Remove the plastic entry bushing from the cable box and slide it onto the cable.
 - If applicable, the crimp cable sockets can now be applied to the aluminium cable. In this case step 14 can be skipped.
12. Slide the cable box onto the cable and then onto the plastic entry bushing.

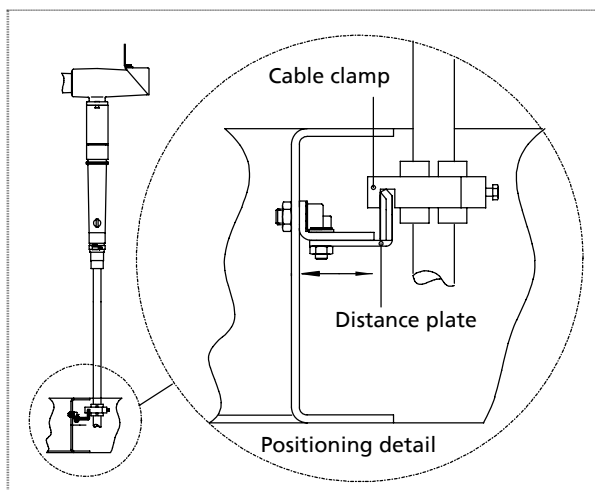


11, 12.

13. Fix the cable in the cable clamp at the marked position.
Move the distance plate so that the centre of the cable is exactly in line with the centre of the cable box.
Firmly tighten the cable clamp.
14. Depending on the diameter of the core, follow the procedure described in:
 - Chapter 3.3.4, steps 11 through 16 or
 - Chapter 3.3.5, steps 2 through 8

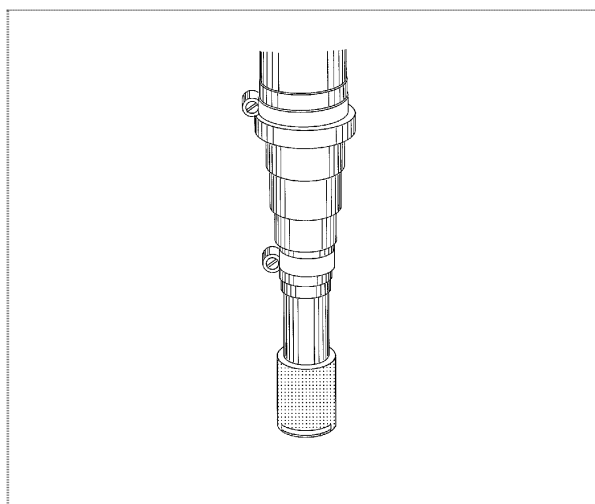


13a.



13b.

15. Firmly clamp the plastic entry bushing onto the cable box using the hose clip (torque: 5 Nm).
16. Screw down the bottom plate. Place the rubber bushing in the bottom plate.
17. Fill the cable box with grease (for this, see chapter 3.3.8).



15

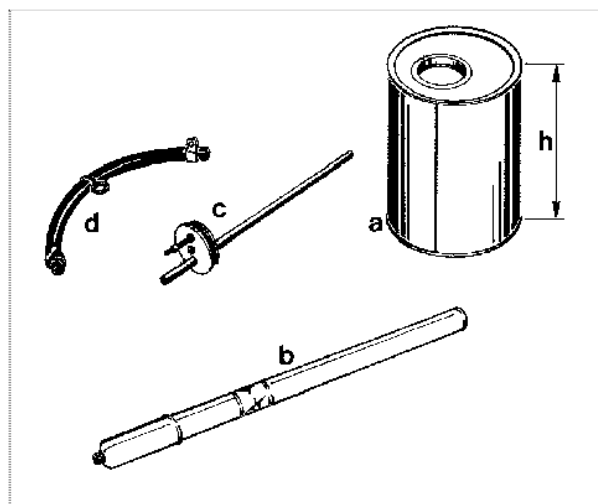
3.3.8 FILLING THE CABLE BOXES

Required materials (figure 1)

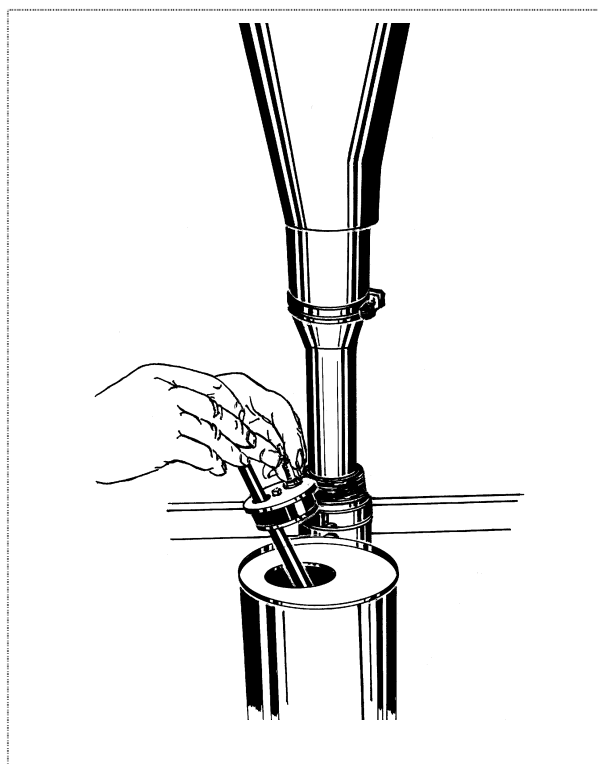
1. Can of grease for the cable box:
 - for a small cable box:
contents = 1.5 l
h = 135 mm
 - for a large cable box:
contents = 2.25 l
h = 205 mm
 - for a cable box with gland:
contents = 3.5 l
h = 282 mm
2. Hand-operated pump.
3. Filling device with filling tube and valve and connecting nipple.

Procedure

1. Heat the can to a temperature not exceeding 100°C while stirring its contents. At this temperature the grease will be entirely fluid. When heating with a naked flame, keep it away from joints and the filling opening of the can.
 - Allow the grease to cool down to a temperature of approximately 80 °C.
2. Place the filling device on the can and push the filling tube down to the bottom.

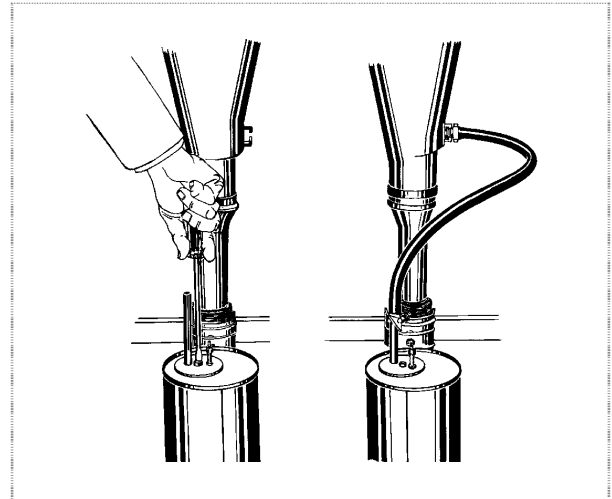


1.



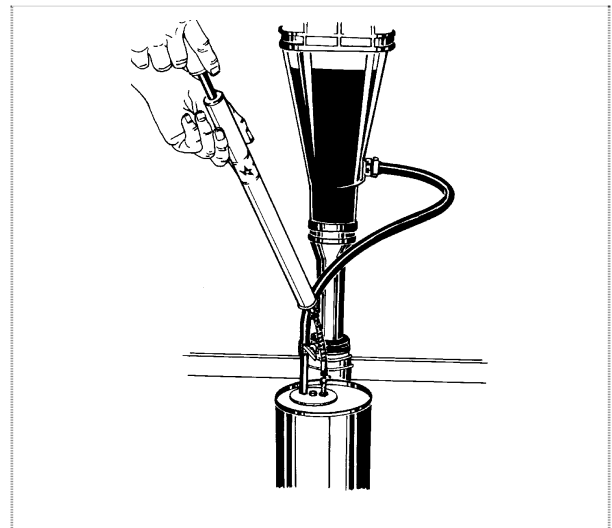
2.

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 into the filling hole as far as possible and give it a quarter turn. Check that the nipple snaps into the filling hole lock.



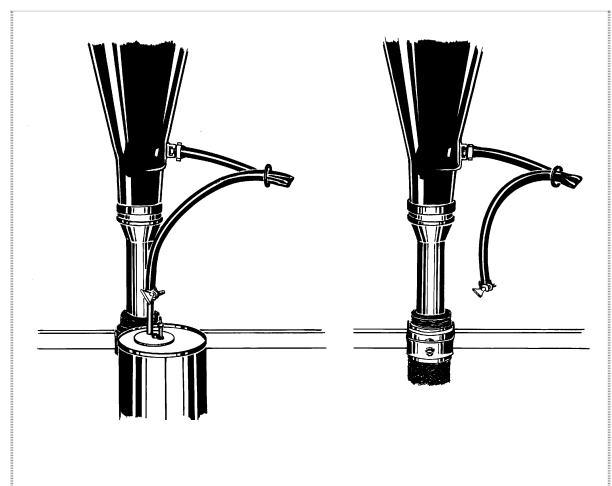
3, 5

6. Put the hand-operated pump onto the valve and fill the cable box by pumping steadily (so as to prevent air bubbles from developing).
The cable box has to be completely filled.
7. When the grease in the cable box touches the cast resin insulation, continue pumping steadily until the cable box has expanded by about 2 cm.
 - Wait for the grease to come out of one of the spigots and then pull away the nylon thread. Repeat this for the other spigots.
8. Apply the protective sheath 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 protective sheath.



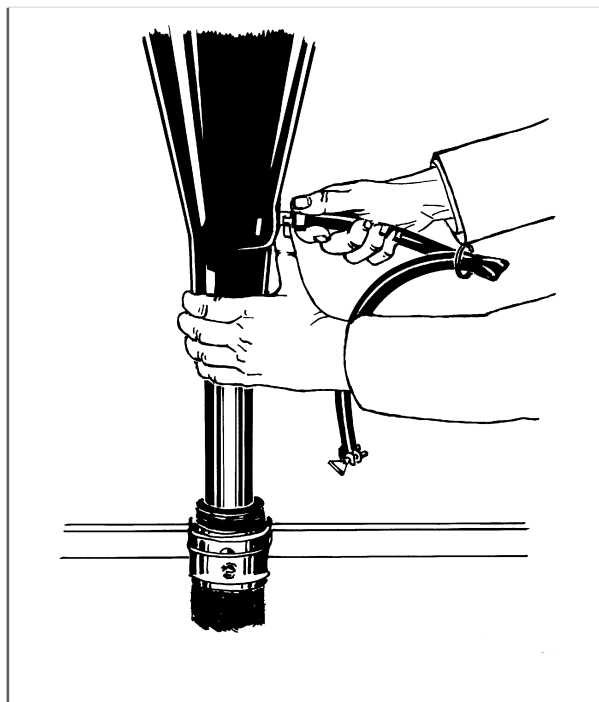
6.

9. Remove the pump from the valve.
 - Now depressurise the cable box, using the valve, until the box remains about 1 cm thicker than before.
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 in the filling hose cannot get into contact with the valve.



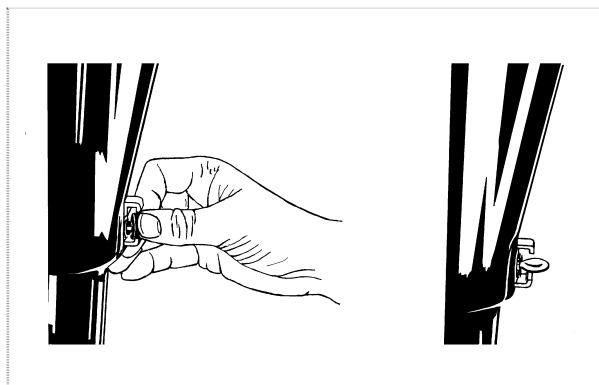
9, 10.

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.



11.

12. Fit the rubber sealing and push it into the opening of the cable box, making a circular movement. 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 is to be done right above the outer cable sheath so that the cable box can be lowered, should this be necessary. This earth connector has to be attached to the horizontal earth bar.



12, 13.

3.3.9 CONNECTION OF PLASTIC-INSULATED CU CABLES UP TO 70 MM² BY MEANS OF DRY CABLE BOXES

General

Plastic-insulated cables can be connected to load-break switch or circuit breaker panels and to fused load-break switch panels of up to 12 kV.

The load-break switch and circuit breaker panels have a terminal block with interlocked cable access ports. The terminal block has three connection pins that are moulded in cast resin insulation.

The 12-kV connection pins on the fused load-break switch panel are situated directly underneath the fuse holders.

WARNING

Termination of the cable cores and the splicing point is to be done in accordance with the cable supplier's instructions.

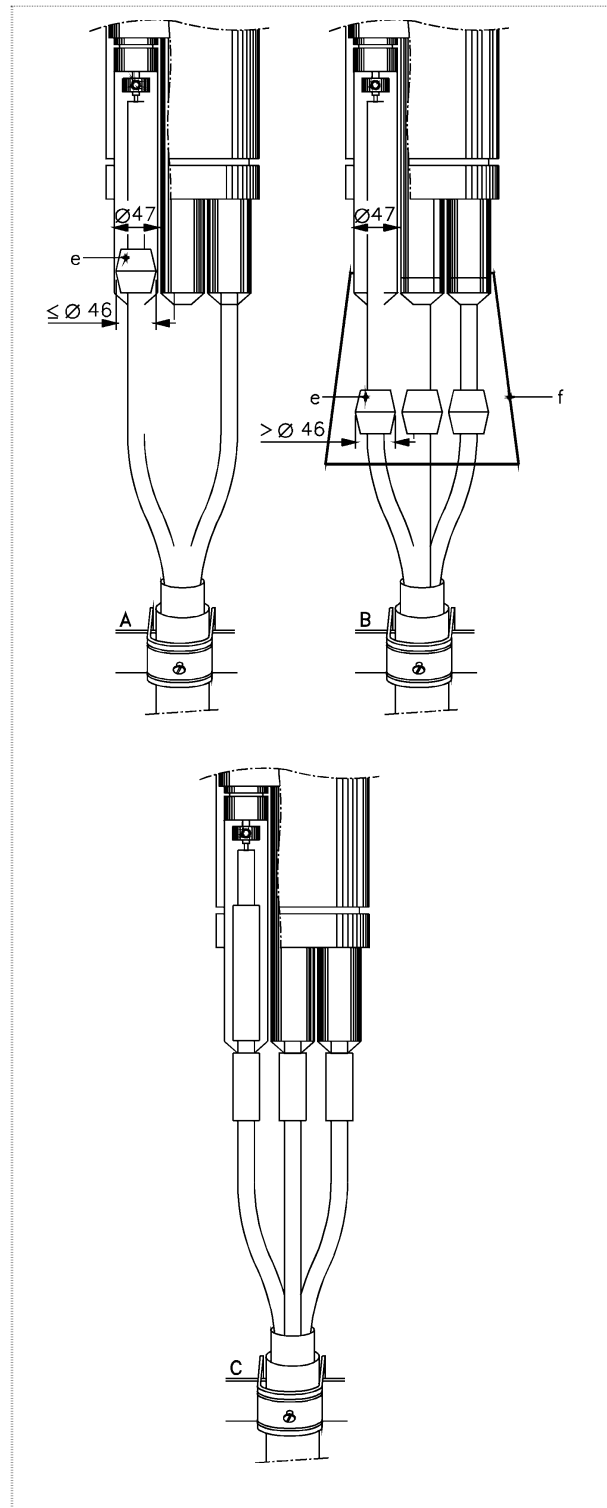
To terminate the earth screen, the cable cores must be provided with pilot cones.

If the pilot cones, when mounted, are smaller or equal to 46 mm in diameter, they will fit into the terminal box, as shown in figure 1A.

If the pilot cones, when mounted, are larger than 46 mm in diameter, they will not fit into the cable box and they will have to be mounted underneath, as shown in figure 1B.

In that case fit the protective cover so as to make sure that the part above the pilot cones is insulated as well.

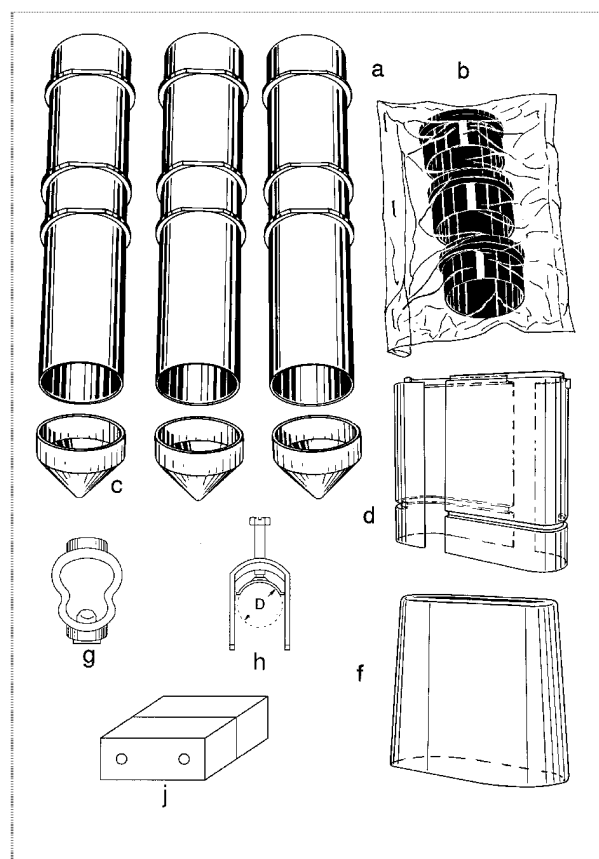
Figure 1C shows the situation in which a cable is terminated without using a pilot cone. This is the situation with cables supplied by Eaton, for instance.



1.

Required materials (figures 1 and 2)

- Three insulating conduits (a)
- One bag containing three greased rubber sleeves (b)
- Three sealing plugs (c)
- Two protective sheath halves d)
- Three pilot cones (e)
(dia. ≤ 46 mm or dia. > 46 mm) (figure 1)
- One protection cover (f) (only in the case of pilot cones having diameters of 46 mm and upwards)
- Three cable core clamps (g)
- Cable clamps (h)
- Cable block (j)



2.

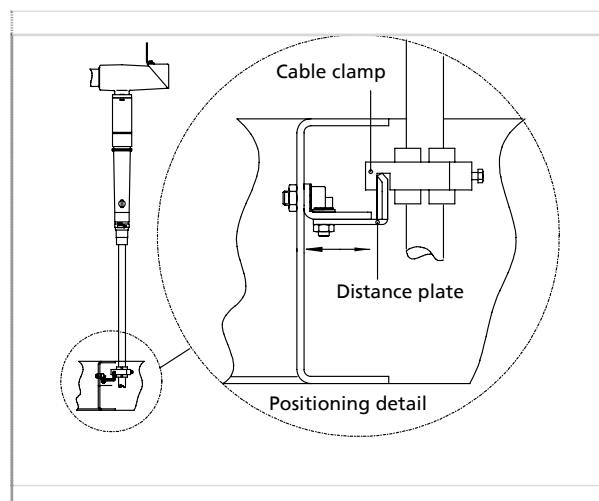
Procedure

1. Remove the bottom plate with the rubber bushing.
2. Pull the cable up and fix it.
There are two ways to do this, depending on the type of cable:

- "3-core cable"
- "3x1 core cable" on cable panel

2.1. 3-core cable

- Fix the cable at the desired position in the cable clamp.
- Move the distance plate until the centre of the cable is exactly in line with the centre of the cable box.
- Firmly tighten the cable clamp.

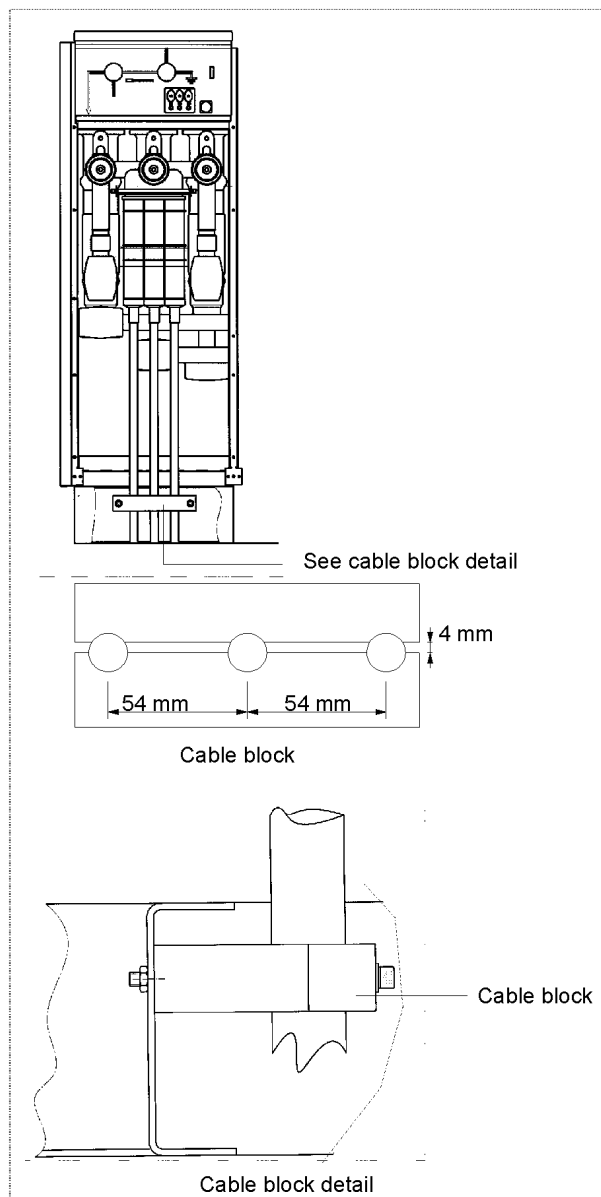


2.1.

2.2. Three 1-core cables on cable panel

Fix the cable using the cable block (j)

- Drill 3 holes in the cable block (depending on the cable diameter), the centre distance being 54 mm.
- Make sure there is a 4-mm clearance between the two half-couplings so that the cable can be clamped properly.

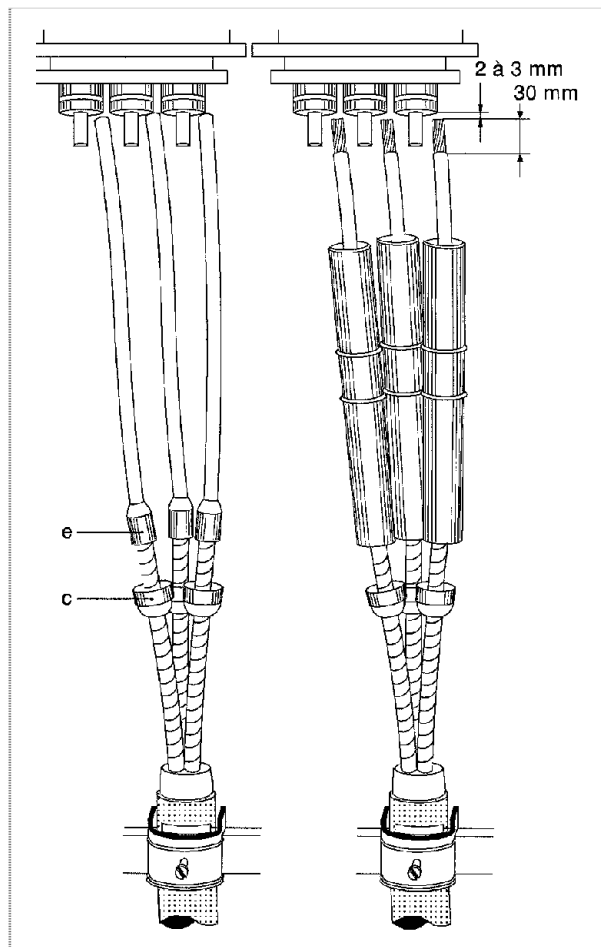


2.2.

3. Cut off the cable cores 2 to 3 mm below the cast resin insulation.
 - Strip the insulation from the cable cores over a distance of about 30 mm.
4. Depending on the cable diameter, make a hole in the rubber bushings. Slide the rubber bushings onto the cable.

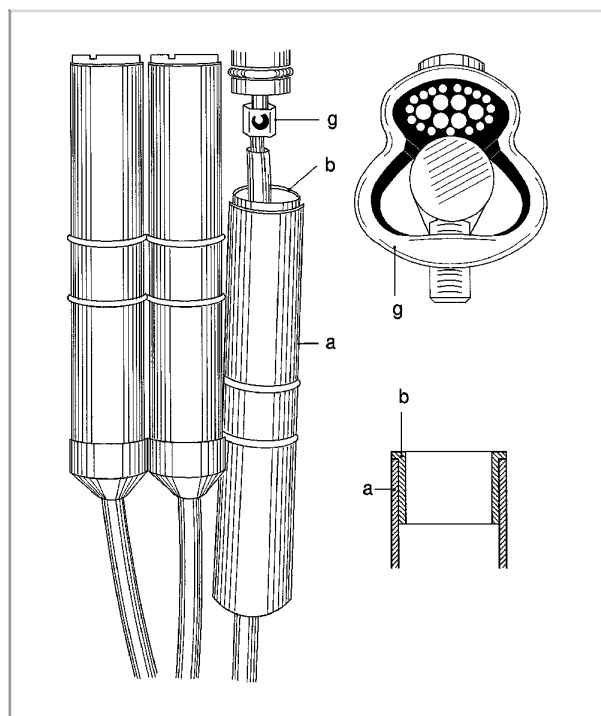
5. Turn the sealing plugs (c) inside out.
 - Carefully cut a hole in the conical part of the sealing plugs, so without making any notches. The diameter of this hole should be half the diameter of the core insulation.
 - Restore the sealing plugs to their normal shape.
6. Mount the pilot cones (e) and the sealing plugs (c) to the cable.

The mounting sequence depends on the fact whether the pilot cone ends in (figure 1A) or below (figure 1B) the insulating conduit.



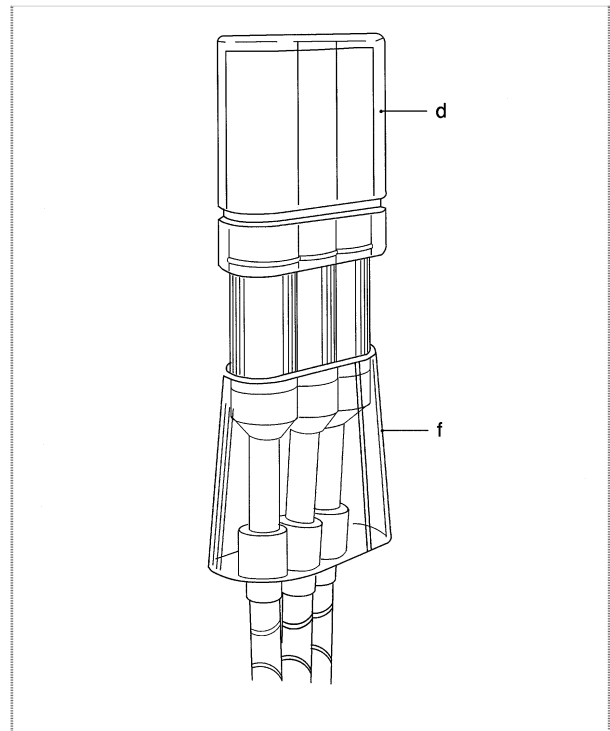
5.

7. Slide the rubber sleeves (b), which have already been rubbed down with silicone grease, into the upper feed opening of the insulating conduits (a) and slide the conduits up the cores.
 - Slide the protection cover (f) onto the insulating conduits, if necessary.
8. Fix the cable cores to the connection pins. Make sure that the cable cores are correctly positioned in the connection clamps, that is at the position indicating the relevant cross-sectional area.
 - Torque the hexagonal socket screws to 15 Nm. Make sure that in all three phases the screws are positioned straight ahead.
 - Retighten the screws after some time.
9. Slide the insulating conduits and the rubber sleeves onto the cast resin insulation. Check that the flattened sides of the washers around the insulating conduits abut.



7 - 9

10. Fit the two protective sheath halves (d) and secure them. Make sure that the conduits adequately rest on the bearing faces of the sheaths.
11. Fit the sealing plugs and lower the protective cover (f) into its final position, if applicable.
12. Screw down the bottom plate with the rubber bushing.



10, 11

3.3.10 CONNECTION OF PLASTIC-INSULATED CU CABLES OF 95 MM² TO 240 MM² BY MEANS OF DRY CABLE BOXES

General

Plastic-insulated cables can be connected to load-break switch or circuit breaker panels and to fused load-break switch panels of up to 12 kV.

The load-break switch and circuit breaker panels have a terminal block with interlocked cable access ports. The terminal block has three connection pins that are moulded in the cast resin insulation.

The 12-kV connection pins on fused load-break switch panels are situated directly underneath the fuse holders.

WARNING

Termination of the cable cores and the splicing point is to be done in accordance with the cable supplier's instructions.

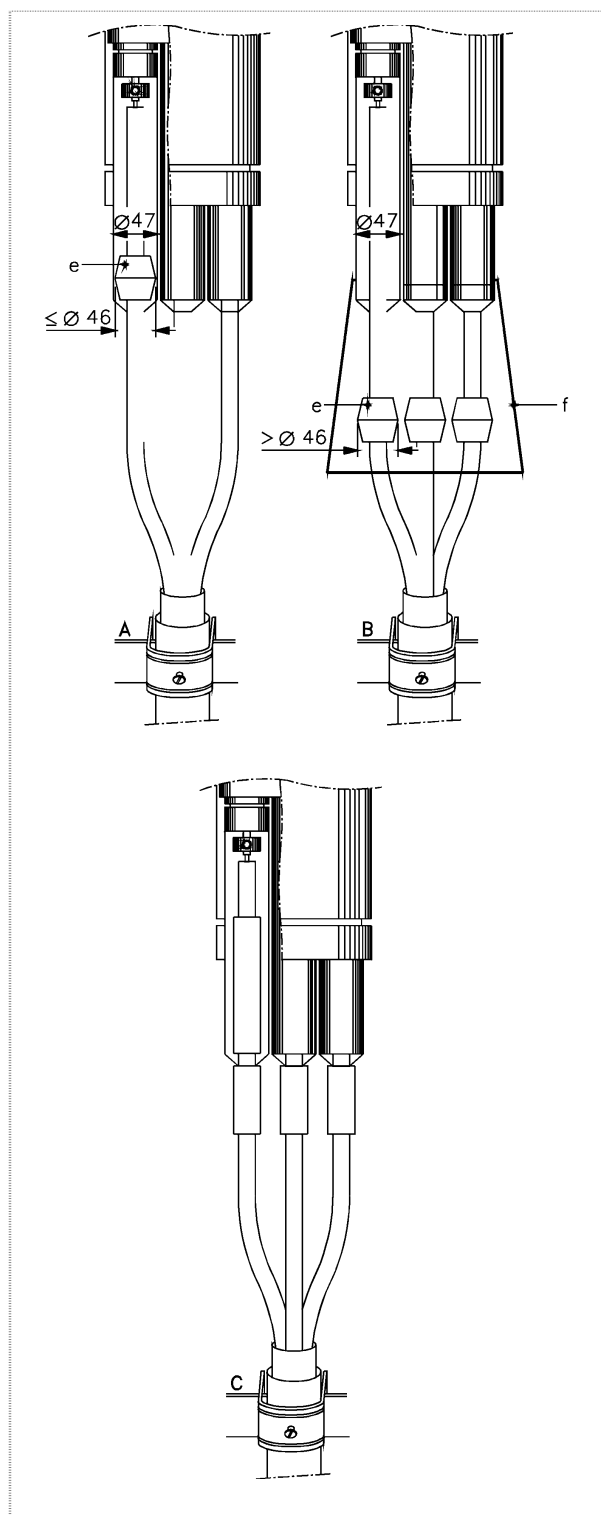
To terminate the earth screen, the cable cores must be provided with pilot cones.

If the pilot cones (e), when mounted, are smaller or equal to 46 mm in diameter, they will fit into the cable box, as shown in figure 1A.

If the pilot cones (e), when mounted, are larger than 46 mm in diameter, they will not fit in the cable box and they will have to be mounted underneath, as shown in figure 1B.

In that case fit the protective cover (f) so as to make sure that the part above the pilot cones is insulated as well.

Figure 1C shows the situation in which a cable is terminated without using a pilot cone. This is the situation with cables supplied by Eaton, for instance.



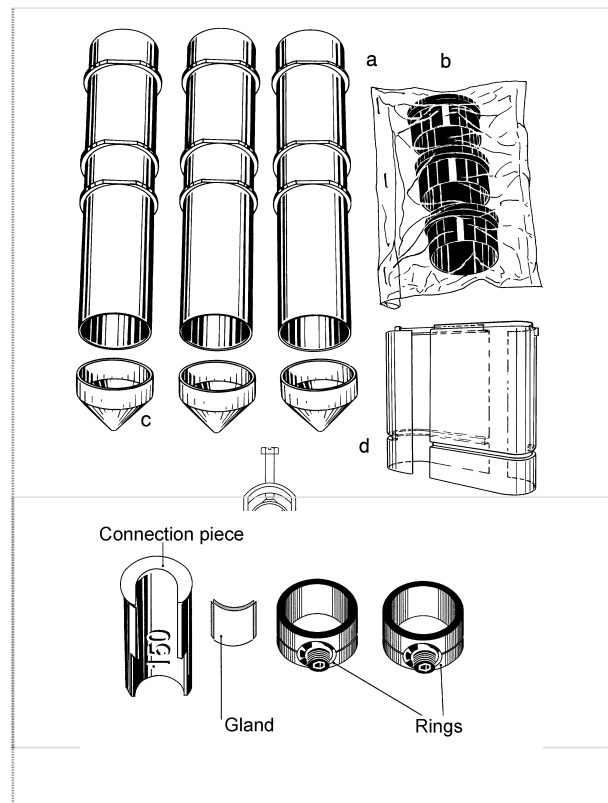
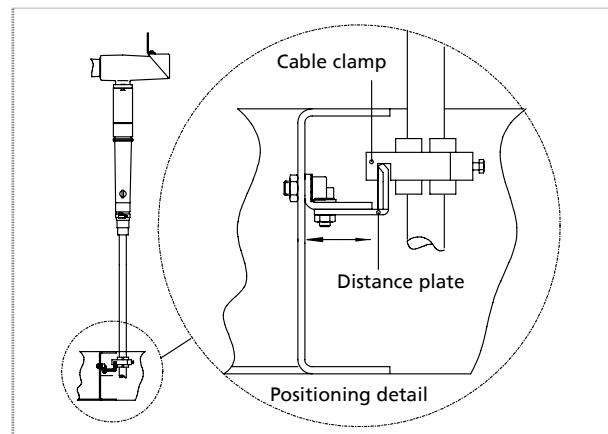
1.

Required materials (figures 1, 2a and 2b)

- Three insulating conduits (a)
- One bag containing three greased rubber sleeves (b)
- Three sealing plugs (c)
- Two protective sheath halves (d)
- Three pilot cones (e) (figure 1) (dia. ≤ 46 mm or dia. > 46 mm)
- One protection cover (f) (only in the case of pilot cones having diameters of 46 mm and upwards)
- Three cable core clamps (see figure 2b), consisting of:
 - one connecting piece
 - one gland
 - two washers with hexagonal socket screws
- Cable clamps (h)
- Cable block (j)

Procedure

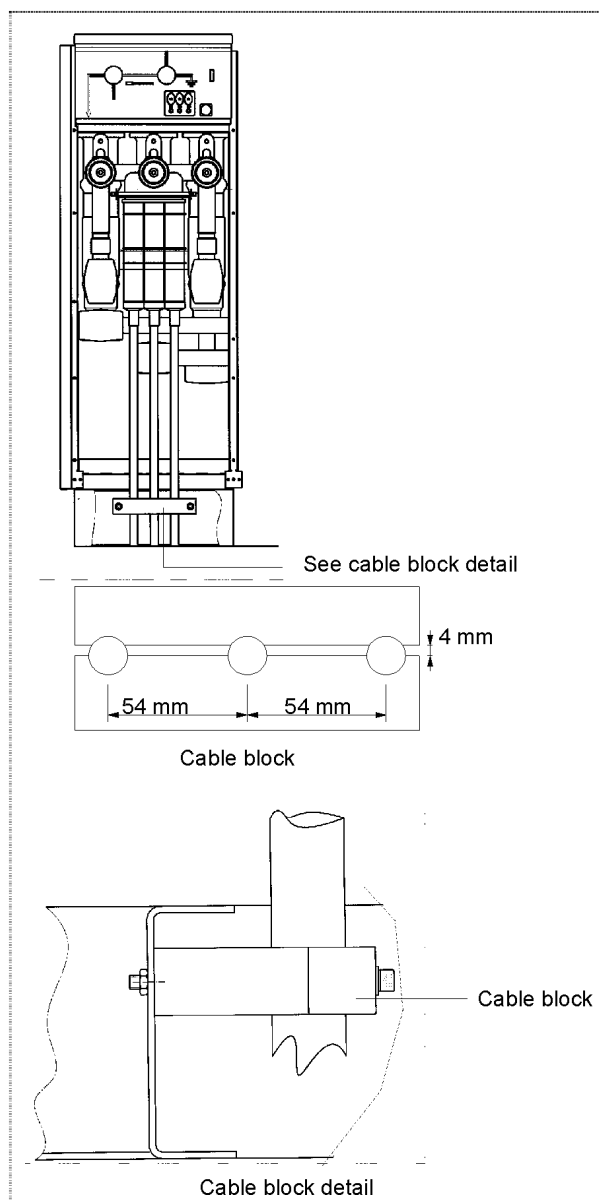
1. Pull the cable up and fix it in the cable clamps. There are three ways to do this, depending on the type of cable:
 2. Pull the cable up and fix it. There are two ways to do this, depending on the type of cable:
 - "3-core cable"
 - "3x1 core cables" on cable panel
- 2.1. 3-core cable
 - Fix the cable at the desired position in the cable clamp.
 - Move the distance plate until the centre of the cable is exactly in line with the centre of the cable box.
 - Firmly tighten the cable clamp.

2a**2b****2.1**

2.2. Three 1-core cables on cable panel

Fix the cable using the wooden block (j)

- Drill 3 holes in the cable block (depending on the cable diameter), the centre distance being 54 mm.
- Make sure there is a 4-mm clearance between the two half-couplings so that the cable can be clamped properly.

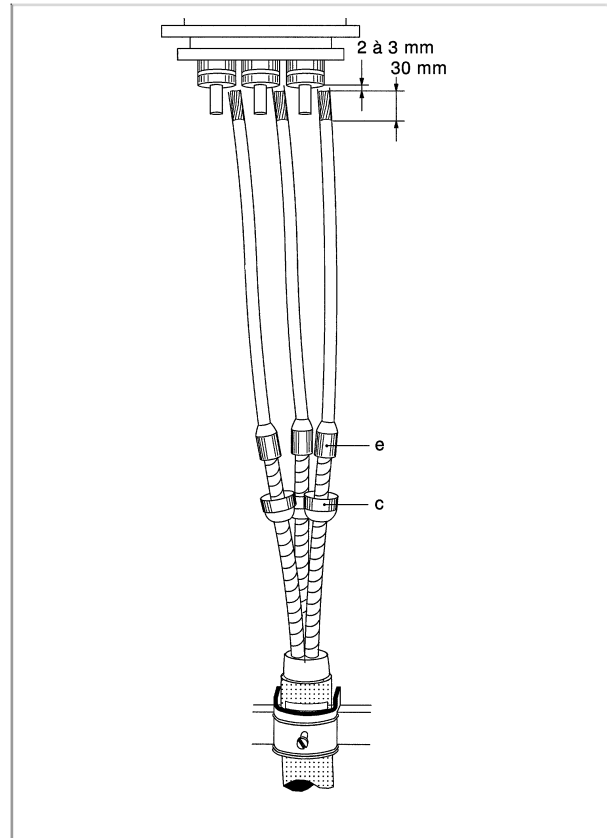


2.2.

3. Cut off the cable cores 2 or 3 mm below the cast resin insulation.

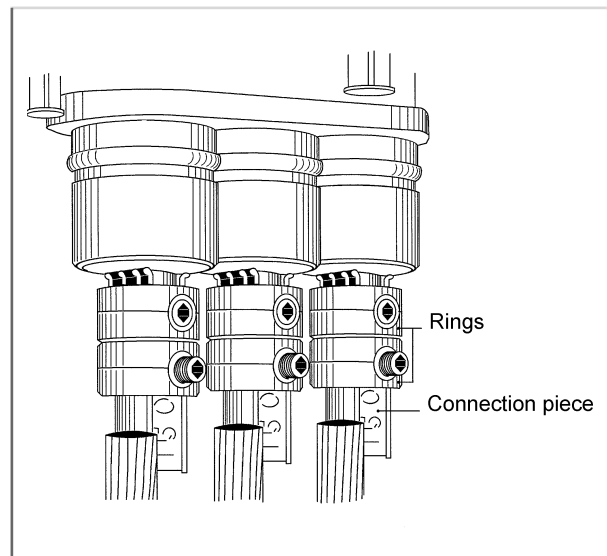
- Strip the insulation from the cable cores over a distance of about 30 mm.

4. Depending on the cable diameter, make a hole in the rubber bushing. Slide the rubber bushing onto the cable.
5. Turn the sealing plugs (c) inside out.
 - Carefully cut a hole in the conical part of the sealing plugs, so without making notches. The diameter of this hole should be half the diameter of the core insulation.
 - Restore the sealing plugs to their normal shape.
6. Fit the pilot cones (e) and the sealing plugs (c) to the cable.
The mounting sequence depends on the fact whether the pilot cone ends in (figure 1A) or below (figure 1B) the insulating conduit.
7. Slightly grease the cast resin insulation using silicone grease or acid-free Vaseline.



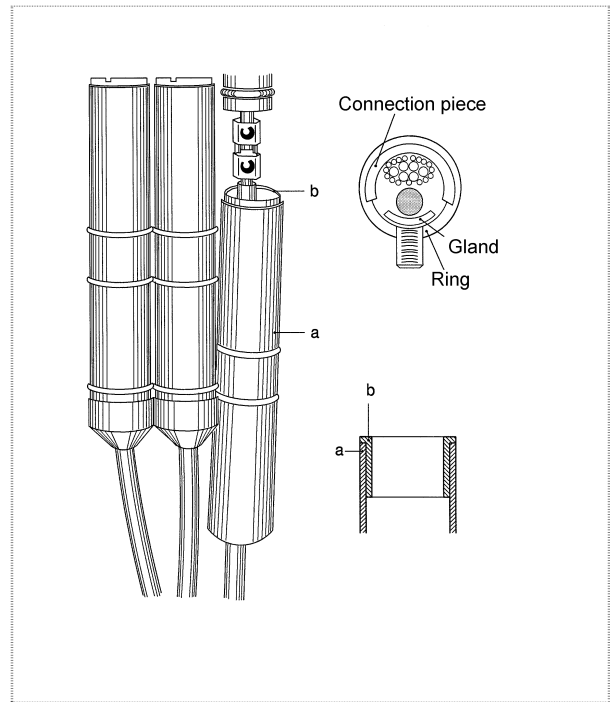
6.

8. Fix the connecting pieces on the connection pins using one of the washers.
 - Torque the hexagonal socket screws to 15 Nm. Make sure that in all three phases the screws are positioned straight ahead.
9. Slide the other washers as far as possible up the connecting pieces and provisionally tighten the hexagonal socket screws.
10. Cover the openings of the cable box so as to prevent intrusion of dirt.
11. Shorten the cable cores so that all three of them fit in the recesses in the connecting pieces.



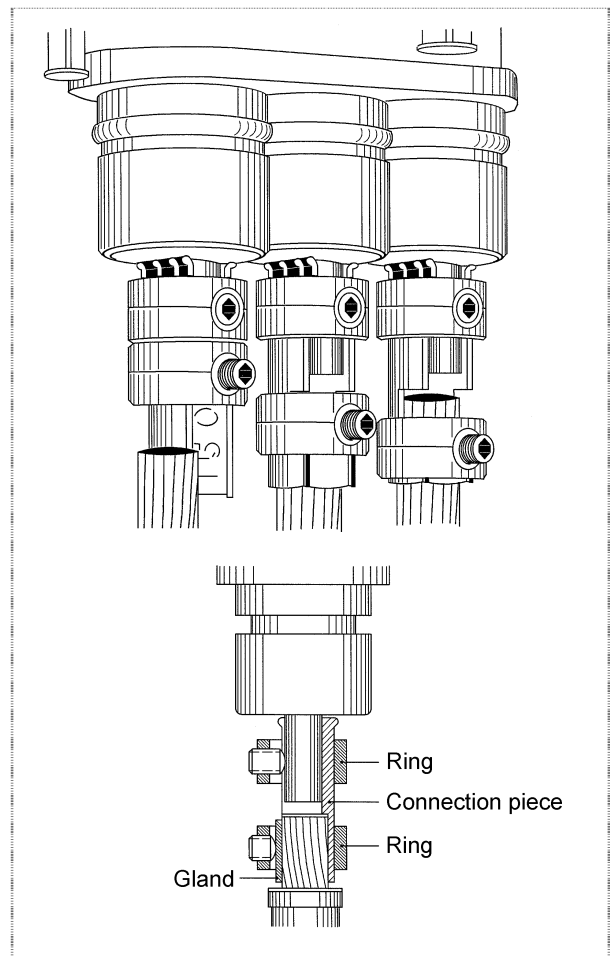
8.

12. Slide the rubber sleeves (b), which have already been rubbed down with silicone grease, into the upper feed opening of the insulating conduits (a) and slide the conduits onto the cores.
 - Slide the protection cover (f) onto the insulating conduits, if necessary.



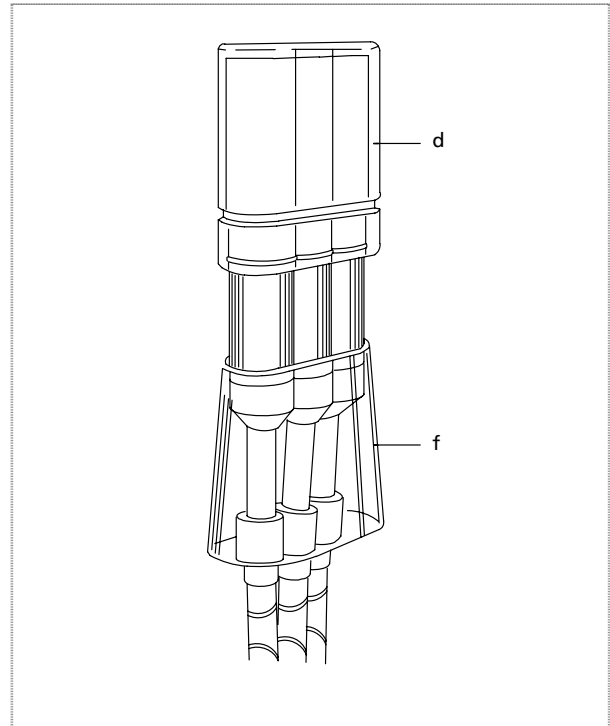
12.

13. Place the cable cores in the recesses in the connecting pieces. Place the glands on the core ends in the recesses of the connecting pieces and slide the lower washers onto the glands.
 - Torque the hexagonal socket screws to about 15 Nm. Make sure that in all three phases the screws are positioned straight ahead.
 - Retighten the hexagonal socket screws of the cable core clamps after some time.
14. Slide the insulating conduits and the rubber sleeves onto the cast resin insulation. Check that the flattened edges of the washers around the insulating conduits abut.
15. Fit the two protective sheath halves (d) and secure them. Make sure that the conduits adequately rest on the bearing faces of the protective sheaths.



13.

16. Fit the sealing plugs and lower the protective cover (f) into its final position, if applicable.
17. Screw down the bottom plate. Place the rubber bushing in the bottom plate.



16.

3.3.11 CONNECTION OF PLASTIC-INSULATED CU OR AL CABLES UP TO 630 MM² BY MEANS OF CABLE SOCKET CONNECTIONS

General

Plastic-insulated cables can be connected to panels of up to 12 kV.

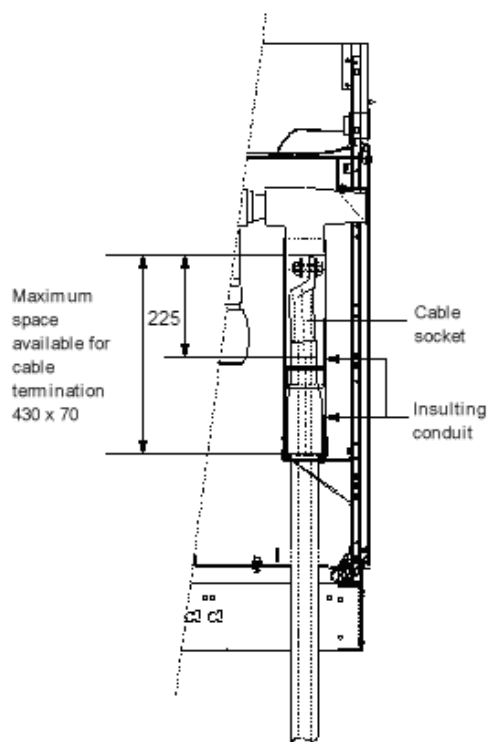
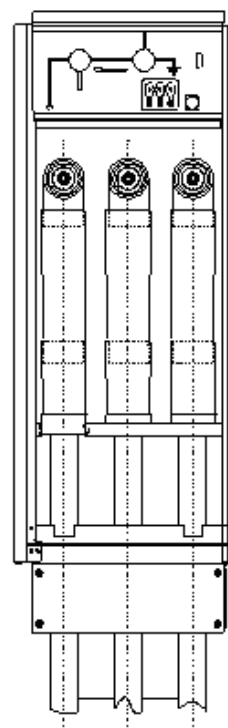
The panels are fitted with a terminal block with interlocked cable entry ports. The terminal block has three connection strips, which are moulded in the cast resin insulation.

NOTE

Termination of the cable cores and the splicing point is to be done in accordance with the cable supplier's instructions.

(Crimp) cable sockets are used for connecting the cable.

The maximum space available for cable termination and the cable socket is $\varnothing 70 \times 430$ mm. The space available for the cable socket is $\varnothing 70 \times 255$ mm.



1a.

Required materials (figure 1b)

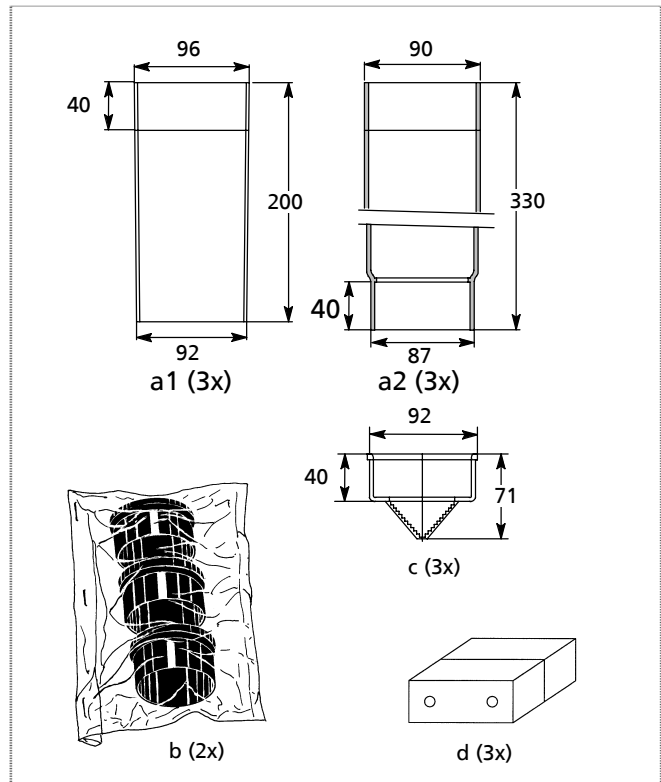
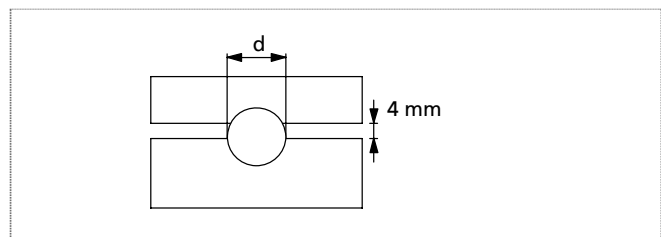
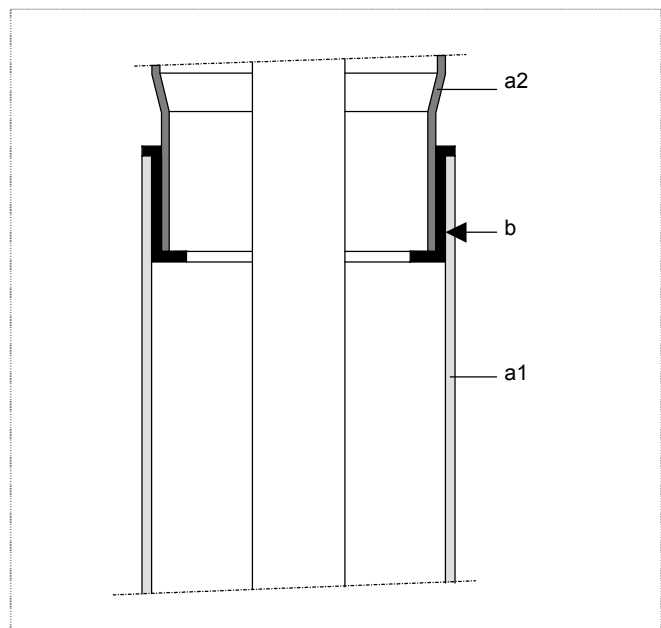
- Three insulating conduits (a), each consisting of a long part (a2) and a short part (a1)
- Two bags containing three greased rubber sleeves (b)
- Three sealing plugs (c)
- Three cable blocks (d)

Procedure

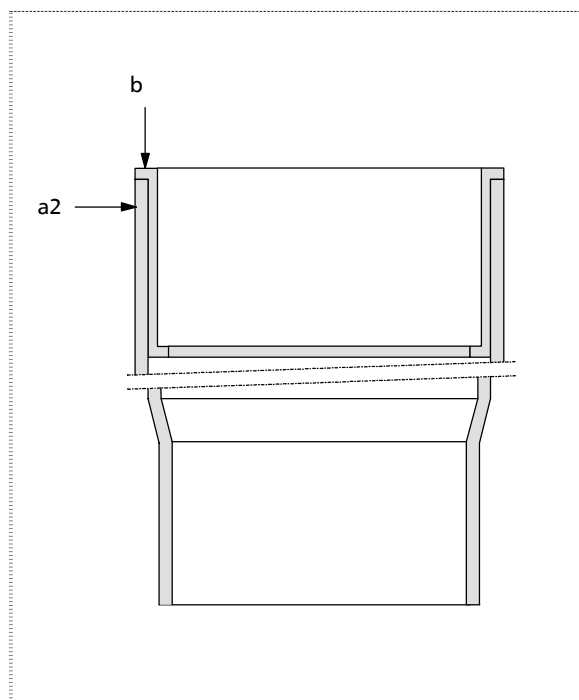
1. Remove the insulating conduits (a1, a2) and the conduit support.
2. Depending on the cable diameter, drill a hole in the cable block.
Make sure there is 4 mm space between both half-couplings for clamping the cable.
3. Terminate the cable according to the manufacturer's instructions. See figure 1 for the space available.
4.
 - Turn the sealing plugs (c) inside out.
 - Carefully cut a hole in the conical part of the sealing plugs, so without making notches.

The diameter of this hole should be half the diameter of the core insulation.

 - Restore the sealing plugs to their normal shape and grease with acid-free vaseline.
5. Slide the sealing plugs (c) onto the cable.
6.
 - Slide a greased sleeve (b) onto the long conduit (a2) on the $\varnothing 87$ side and slide the short conduit (a1) onto it.
 - Slide the assembled conduit (with the short conduit downward) onto the cable.
7. Fit the cable socket according to the manufacturer's instructions.

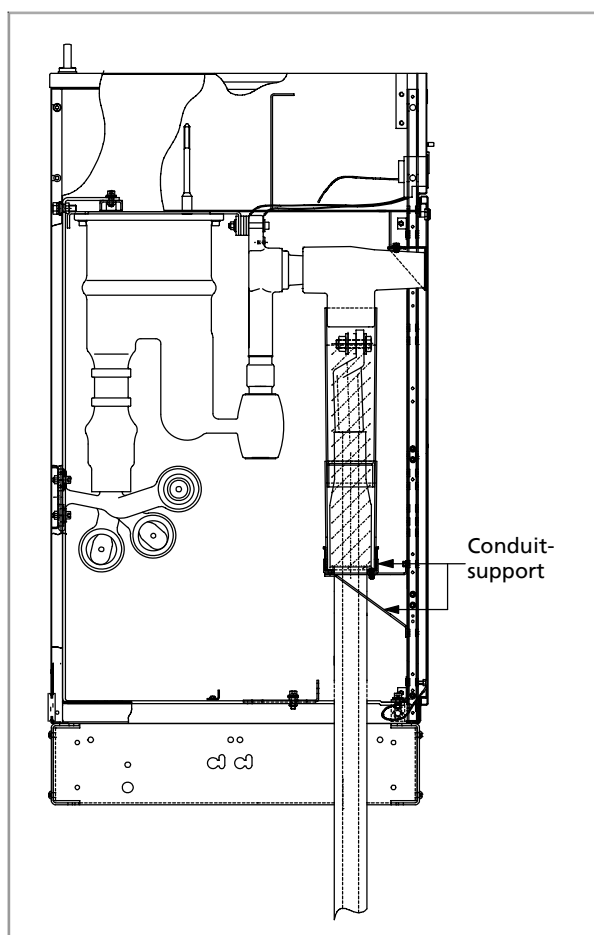
**1b.****2.****6.**

8. Apply a little acid-free grease to the cast resin insulation of the terminal blocks.
9. Fit the three greased sleeves (b) to the terminal blocks.
10. Fit the cable sockets to the terminal blocks.
11. Slide the assembled insulating conduits onto the cast resin insulation of the terminal blocks.



11.

12. Fit the loosened conduit support onto the conduits.
13. Fix the cables in the cable blocks.



12.

3.3.12 FITTING THE CAPACITIVE ELEMENT

Required materials

Voltage indication on a 12 - 24-kV fused load-break switch panel is available as an option. For this, a capacitive element is to be mounted to the non-cable side connection of the fuse box.

Procedure

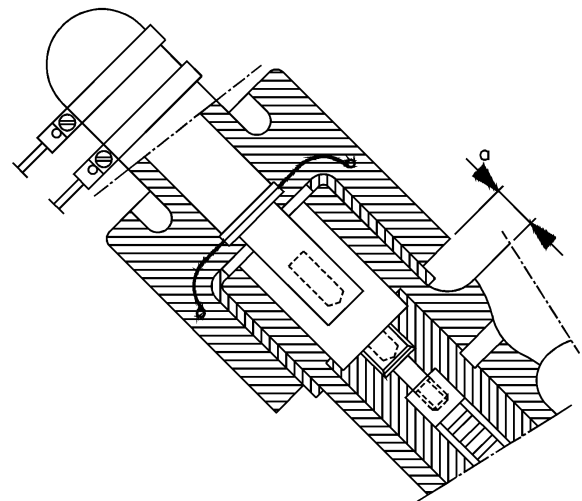
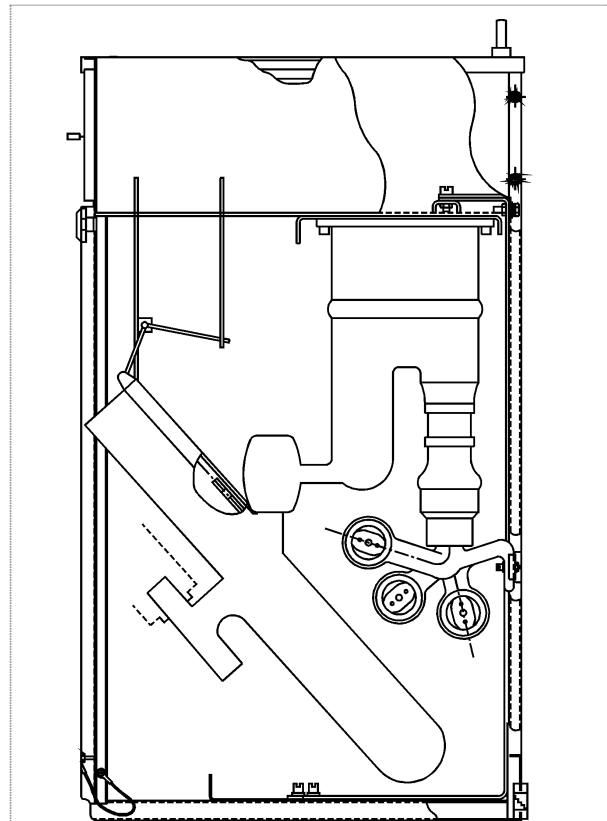
The capacitive element is mounted as follows:

1. Mount the primary cables, following the procedure described in manual no. 991.127 Cable connections, but do not seal the fuse box connection on the non-cable side.
2. Clean the outside of the fuse box connection on the non-cable side and apply a little grease. Use the Vaseline supplied for this purpose.
3. Mount the three sleeves and slightly grease them on the outside.
4. Clean the inside of the capacitive element and apply a little grease.
5. Position the nylon thread on the sleeve and push the capacitive element in position, making a linear movement.

Check that:

- distance $a = 15 \text{ mm}$
- the sleeve is not rolled up

6. Attach the secondary connections to the plug connections.
Check that the codes are right: L1, L2 and L3.
7. Check the voltage indicator using the voltage tester (see chapter 4.2.4).



Detail of capacitive element

5.

3.3.13 CONNECTION OF SECONDARY WIRING

The electrical data on the secondary wiring are stated in the diagrams that are part of the documentation package supplied with the system (see also the description of the panels).

The installation comes with sealing foam to seal the entry of the secondary wiring.

4. SYSTEM OPERATION

4.1 WHO IS ALLOWED TO OPERATE THE SYSTEM?

4.1.1 TRAINING LEVEL

Control operations are only to be performed by or by order of a responsible expert or an operating specialist.

4.1.2 OPERATING CONDITIONS

The operating conditions must not deviate from the conditions stated in chapter 3.1.1.

4.1.3 PERSONAL PROTECTION EQUIPMENT

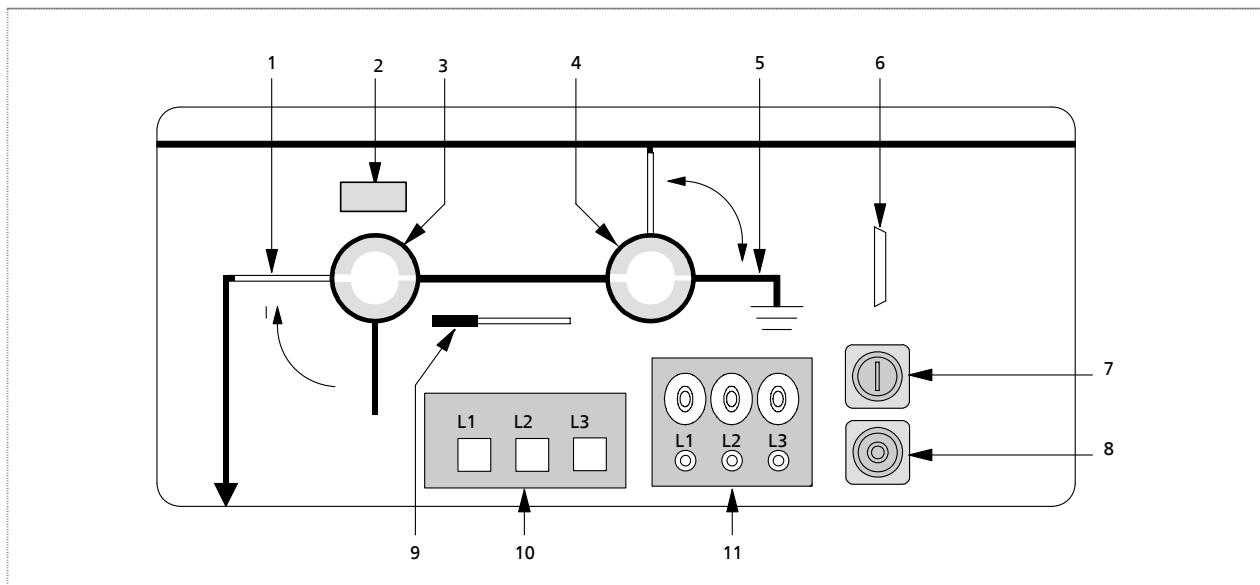
No personal protection equipment will be required under normal operating conditions.

4.1.4 POTENTIAL HAZARDS FOR BYSTANDERS

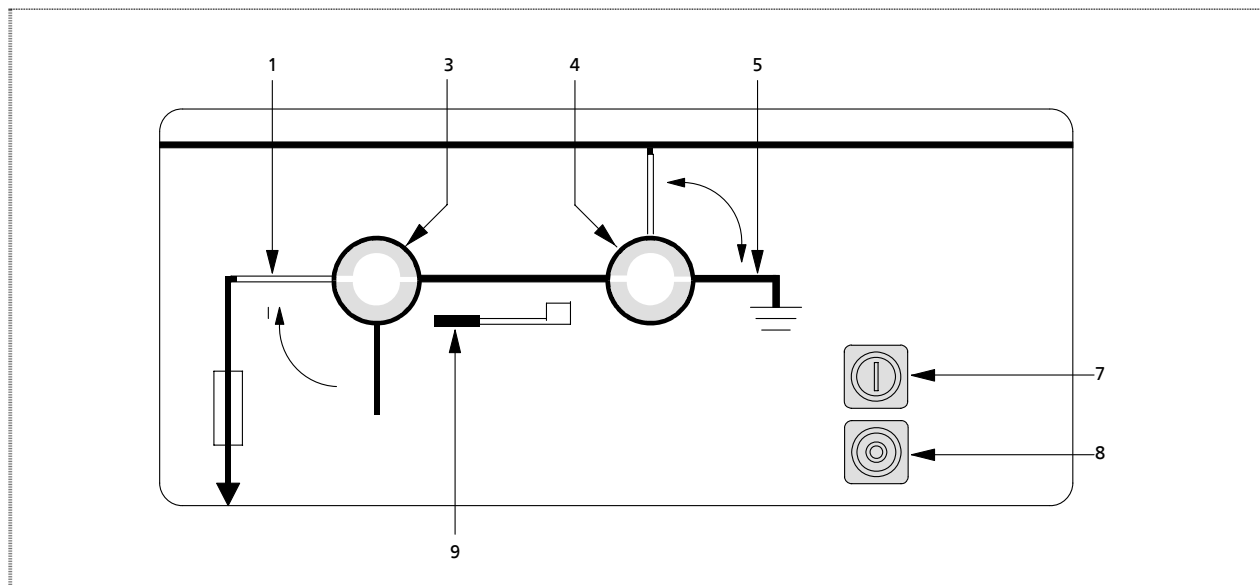
Given the fact that no switchgear is completely without risk, you should prevent as much as possible that people linger about the switchgear without good reason. Only personnel of necessity (see chapter 4.1.1) performing operations on the switchgear are allowed to be in the area.

4.2 OPERATION

4.2.1 CONTROL PANEL



1. Control panel of load-break switch or circuit breaker panel



2. Control panel of fused load-break switch panel

- | | |
|--|---|
| 1. Position indicator of load-break switch or circuit breaker. | 8. Opening button for load-break switch or circuit breaker. |
| 2. Function indicator of load-break switch or circuit breaker (optional). | 9. Selector. |
| 3. Operating shaft for load-break switch or circuit breaker. | 10. Automatic resetting overcurrent indicator (optional). |
| 4. Operating shaft for disconnecter. | 11. Voltage indicator. |
| 5. Position indicator of disconnecter. | |
| 6. Strip for padlock interlock. | |
| 7. Closing button <u>with key</u> for load-break switch or circuit breaker (optional). | |

4.2.2 SWITCHING ON AND OFF

Switching on mechanically

1. Check on the position indicator (5) whether the disconnecter is completely in busbar position or completely in earthing position.
2. The selector slide (9) should be in left position.
3. Put the operating handle on the operating shaft (3) of the load-break switch or circuit breaker. For motor-operated switches you may have to apply additional force when placing the handle.
4. Turn the operating handle in clockwise direction, until the installation is switched on.
The position indicator (1) should be horizontal.
- 4.1 If the panel is fitted with an electrical closing coil, the installation can only be switched on mechanically by means of the closing button (7), which is located on the panel. This closing button has a key lock. Switch the panel on mechanically by turning this key in clockwise direction and subsequently depressing the button.
5. Remove the operating handle.

Switching on electrically

1. When the secondary voltage is switched on, the spring charging motor will charge the closing springs.
2. Check on the position indicator (5) whether the disconnecter is completely in busbar position or completely in earthing position.
3. The selector slide (9) should be in left position.
4. Depress the closing button, which is located on the panel or (possibly) at a distance.
 - The position indicator (1) should be horizontal.

The closing button can also have a key lock so as to prevent unauthorised switching on.

Switching on electrically and mechanically with "high-speed switch-on" facility

The switch may be fitted with a "high-speed switch-on" facility, which may be operated electrically and mechanically.

1. Check on the position indicator (5) whether the disconnecter is completely in busbar position or completely in earthing position.
2. The selector slide (9) should be in left position.

Switching on mechanically

3. Put the operating handle on the operating shaft (3) of the switch.
 - Turn the operating handle clockwise until the spring is tensioned.
4. Turn the switch on by turning the key of knob (7) clockwise and then pressing the knob.

Switching on electrically

3. In the case of electrical operation, the spring is pretensioned by the motor.
4. The switch is turned on by remote operation of a closing coil.

Switching off mechanically

1. The selector slide (9) should be in left position.
2. Firmly push the opening button (8).
The position indicator (1) should now change to vertical.

Switching off electrically

1. The selector slide (9) should be in left position.
2. Depress the opening button (which may be located at a distance).

The position indicator (1) should now change to vertical.

Zero voltage release

As an option, the installation may be fitted with a zero voltage release, which meets the requirements set out in IEC 60694-5.8.4.

The zero voltage release operates as follows:

- If the secondary voltage drops below 35% of the rated value (U_n), the zero voltage release drops out and the switch is turned off. When the zero voltage release has dropped out, the switch can no longer be turned on mechanically or electrically.
- If the secondary voltage exceeds 85% of the rated value (U_n), the zero voltage release is energised and the switch can be turned on again.
- The functions of the zero voltage release can be tested by varying the secondary voltage and checking that the zero voltage release drops out and is re-energised within the above-mentioned limits.

When doing this, the switch must be turned off.

Tripping coil

The tripping coil turns off the switch electrically. The tripping coil is operated by a (remote) tripping button.

Note:

The tripping button (8) on the switch is always mechanical.

Another tripping coil or a zero voltage release may be installed next to a tripping coil.

NOTE

IF an installation is equipped with zero voltage release without locking coil, operation is **not** allowed if the auxiliary voltage is **not** on.

REMARK

Without auxiliary voltage it is not possible to earth the cable in a cable panel with switch.

4.2.3 OPERATION OF THE DISCONNECTOR

Description of the disconnecter

The disconnecter has two positions:

- the busbar position
- the earthing position.

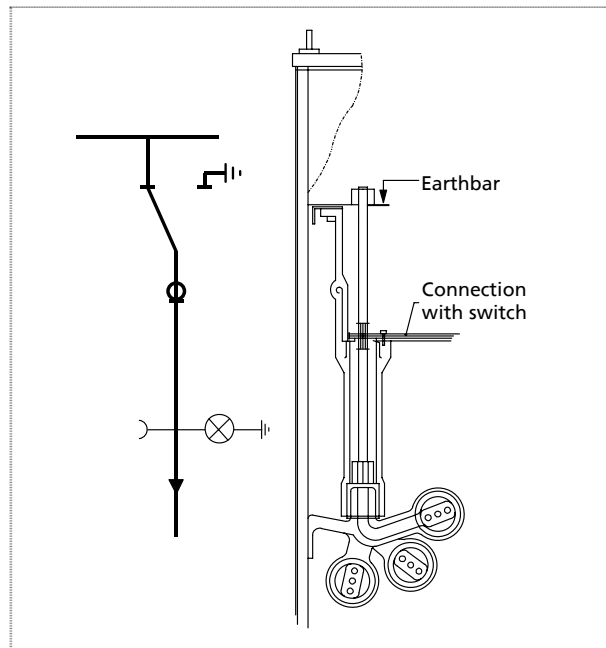
NOTE

Changing from one position to another is only possible when the load-break switch or circuit breaker is switched off.

Busbar position

When in busbar position, the disconnecter is connected to the busbar system, so that also the cable is connected to the busbar system when the load-break switch or circuit breaker is switched on.

See figure 1.



1.

Earthing position

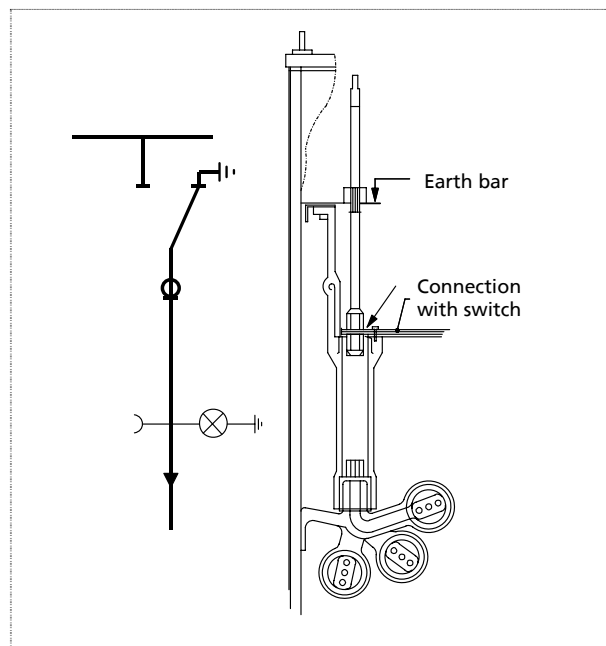
When in earthing position, the disconnecter is connected to the earth bar.

See the arrow in figure 2.

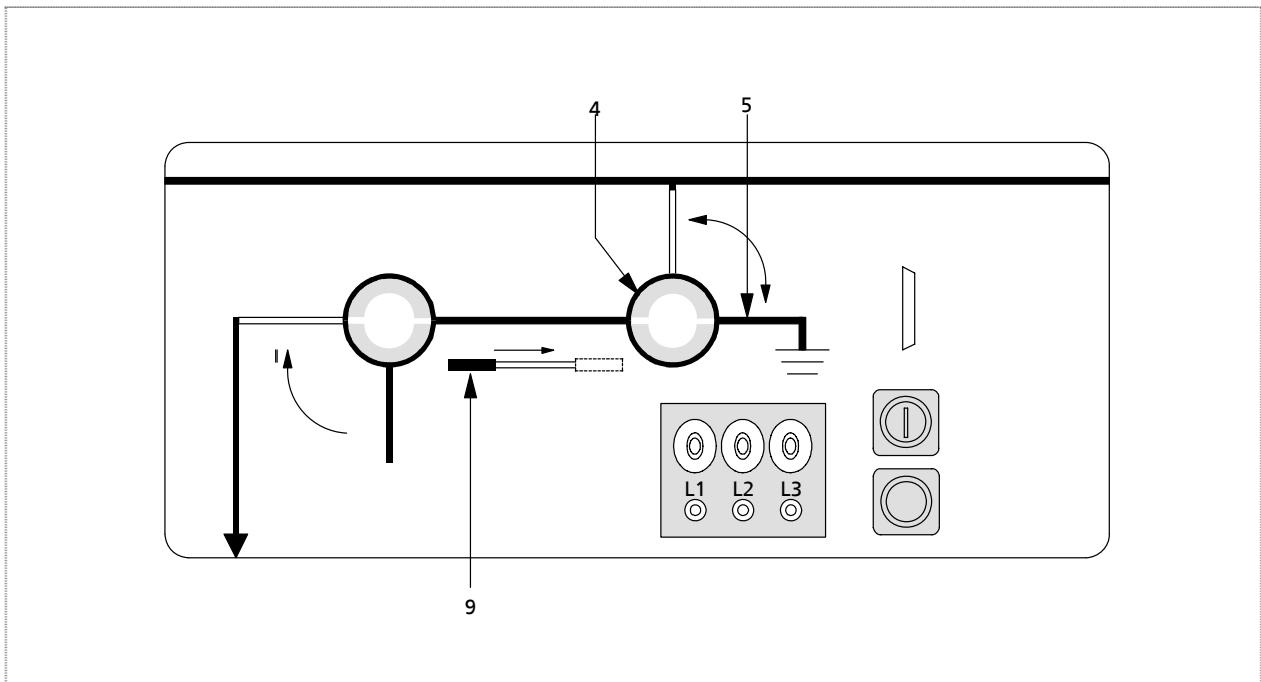
Also the cable is connected to the earth bar when the load-break switch or circuit breaker is switched on.

In the case of an opened load-break switch or circuit breaker, the disconnecter forms an earthed barrier between the busbar system and the cable.

In earthing position there is also a safe air distance between the cable and the busbar system.



2.



Operation of the disconnect

1. Control panel of a load-break switch or circuit breaker panel

Mechanical interlocks

The disconnect can only be operated when the load-break switch or circuit breaker is switched off.

Changing from busbar position to earthing position

1. Switch off the load-break 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 (4) of the disconnect.
3. Turn the operating handle in clockwise direction until resistance is felt; changeover is now completed. The position indicator (5) of the disconnect should be horizontal.

NOTE

The cable and the busbar system are now separated by an earthed barrier.

4. Remove the operating handle.

Changing from earthing position to busbar position

1. Switch off the load-break 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 (4) of the disconnect.
3. Turn the operating handle in anticlockwise direction until resistance is felt; changeover is now completed. The position indicator (5) of the disconnect should now be vertical.

NOTE

The earthed barrier separating the cable and the busbar system has now been removed.

4. Remove the operating handle.

4.2.4 VOLTAGE INDICATION AND PHASE-COINCIDENCE TESTING

Voltage indicator (figure 1)

A load-break switch, circuit breaker and busbar section panel have a voltage indicator as standard. A fused load-break switch can be fitted with a voltage indicator as an optional extra. The indicator consists of a module containing three LEDs and three socket contacts. If the LEDs will not light up, there are two possible causes:

- The cable is dead.
- The voltage indicator is defective.

Testing the voltage indicator

Test accessories supplied with the system:

- Piezo tester (figure 2)
- Adapter lead (figure 3) to be used with an old version voltage indicator.

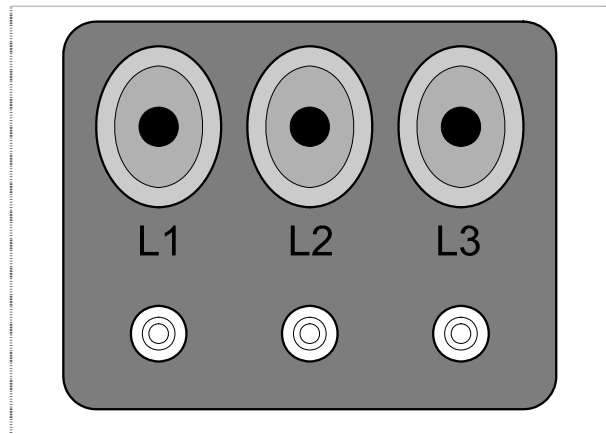
Test procedure:

- Plug the piezo tester into the socket contacts L1 - L2 and move the button of the piezo tester swiftly up and down (see figure 4). The LEDs of the relevant phases should now light up.
- Then plug the tester into the socket contacts L2 - L3 and repeat the test.

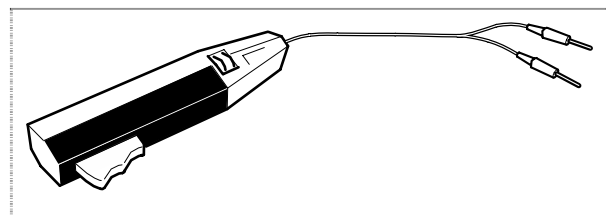
NOTE

In this test the earth connection is measured as well. It is therefore important to carry out the test via the socket contacts L1 - L2 or L2 - L3.

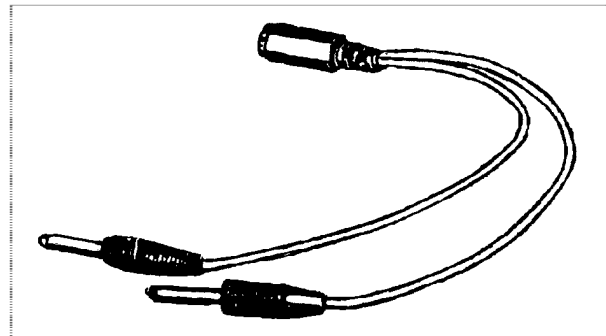
When the plugs are put into the socket contacts L1 - L3, the earth connection will not be measured.



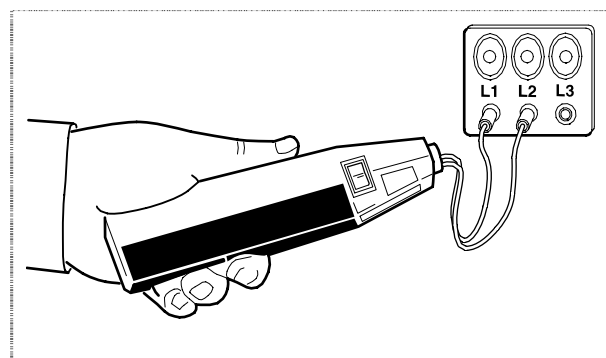
1.



2.



3.



4.

Phase-coincidence testing

Checking whether two live cables are in phase can be done with the aid of the phase coincidence indicator. The phase coincidence indicator is situated in a housing that has two cables and plugs. The housing is fitted with a LED.

When testing, the LEDs on the relevant voltage indicators have to light up, indicating that the cables are live.

When testing the phase coincidence of two panels which are both fitted with the new voltage indicator version:

- Put the plugs of the phase coincidence indicator into the relevant socket contacts of the voltage indicators of the cables to be tested.
- See figure 5.
- In the case of phase coincidence, no current will flow through the phase coincidence indicator, so that the LED in the housing will not light up; in the case of non-coinciding phases, the LED will light up.
- The LEDs in the voltage indicator will remain lit, both at phase coincidence and non-coincidence.

The phase coincidence indicator is also suitable for testing the phase coincidence of two panels, which are both fitted with the "old" voltage indicator version; an adapter lead (figure 6) will be required on both sides.

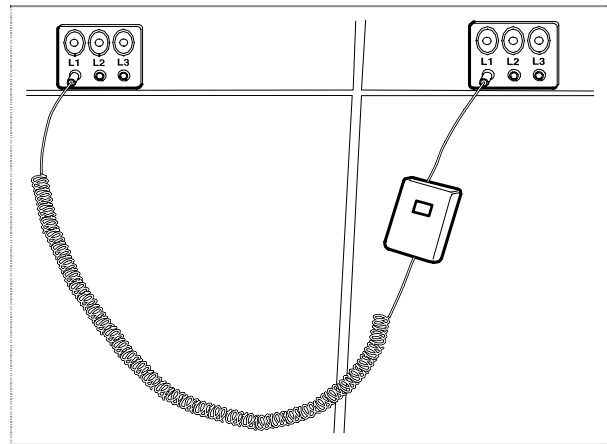
When the LEDs of both the voltage indicator and the phase coincidence indicator:

- do not light up: the phases are equal.
- do light up: the phases are different.

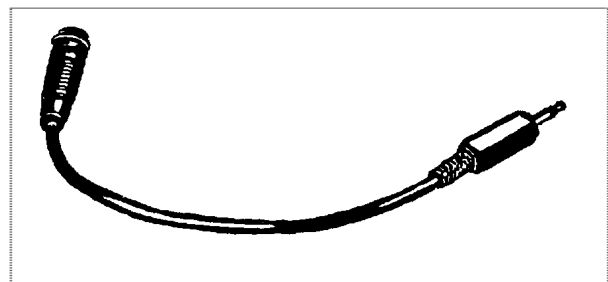
The phase coincidence indicator can also be used to test the phase coincidence of an "old" and a "new" voltage indicator. In this case an adapter lead (figure 6) is needed on the side of the "old" voltage indicator.

In this situation only the indication of the phase coincidence indicator is to be noted:

- no lighting up: the phases are equal.
- lighting up: the phases are unequal.



5.



6.

4.2.5 PADLOCK INTERLOCKS

Description

Definitions

Operating position

Disconnecter in busbar position with load-break switch or circuit breaker being switched on.

Earthing position

Disconnecter in earthing position with load-break switch or circuit breaker being switched on.

Intermediate position

Disconnecter in earthing position with load-break switch or circuit breaker being switched off.

The control panel of a load-break switch panel, a circuit breaker panel and a busbar section panel is fitted with an interlocking strip (9), which can be extracted. It can be used to attach a padlock. This mechanical interlock functions as follows:

Load-break switch

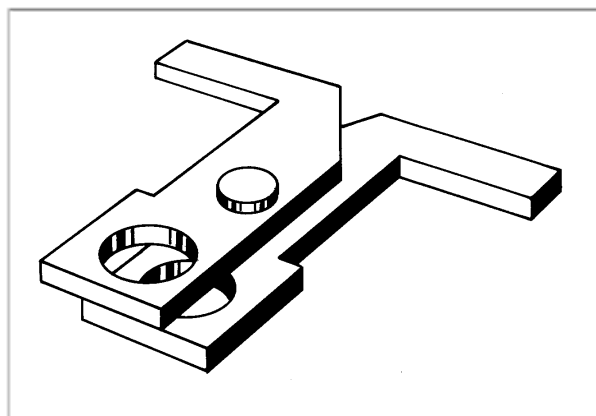
By fitting a padlock the closed switch is locked to prevent switching off in operating position and in earthing position.

Circuit breaker

By fitting a padlock, the closed switch is locked to prevent switching off in earthing position. The operating position CANNOT be locked to prevent switching off.

Locking in intermediate position by means of a scissor-type interlock

A scissor-type interlock with padlock is an optional accessory (figure 1). This scissor-type interlock can be used to lock the load-break switch or the circuit breaker in an intermediate position, for instance, the disconnecter in earthing position and the load-break switch or the circuit breaker in OFF position.



1.

Busbar section panel with load-break switch

With a busbar section panel, the load-break switch CANNOT be switched on when the disconnecter is in earthing position. By fitting a padlock, the closed switch can be locked to prevent switching off, in operating position only.

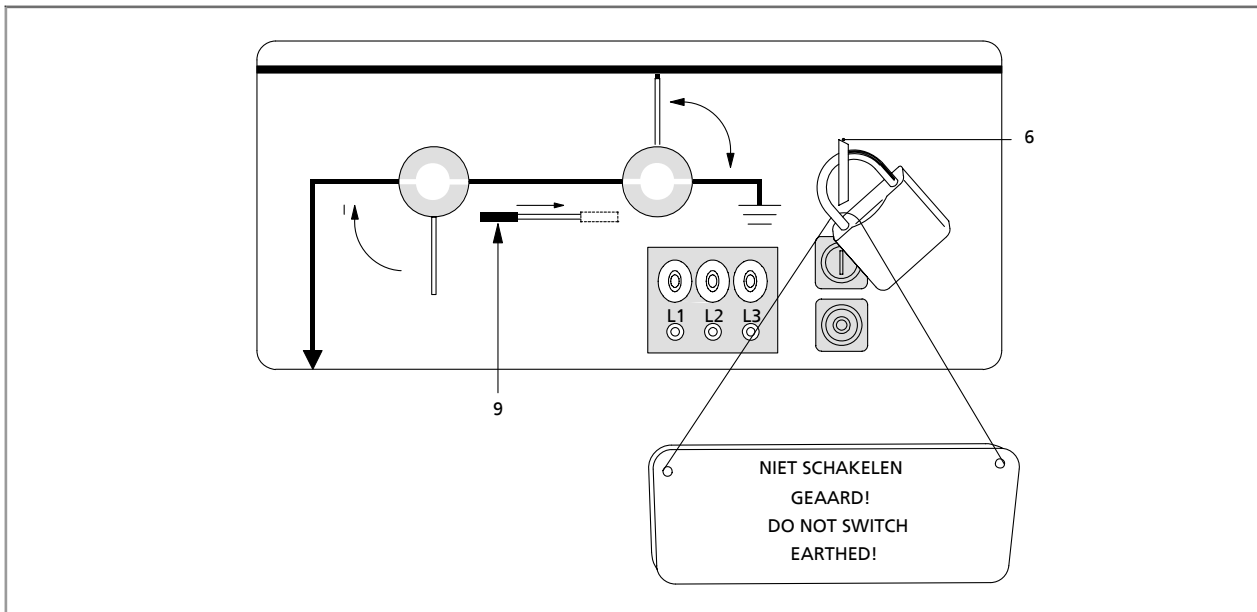
Busbar section panel with circuit breaker and fused load-break switch panel

These panels CANNOT be locked by means of a padlock.

NOTE

If an electrical closing coil is installed, this coil is locked as well to prevent electrical switching off.

Fitting padlock interlocks



1.

Locking in earthing position

If the cable is earthed through the load-break switch or circuit breaker, an interlock can be applied to prevent switching off (figure 1).

The procedure is as follows:

1. Extract the interlocking strip (6) and fit the padlock and the warning sign.
It is now impossible to switch off the load-break switch or the circuit breaker, neither mechanically nor electrically.
The interlock is released by removal of the padlock.
Now the load-break switch or the circuit breaker can be switched off (see chapter 4.2.2).

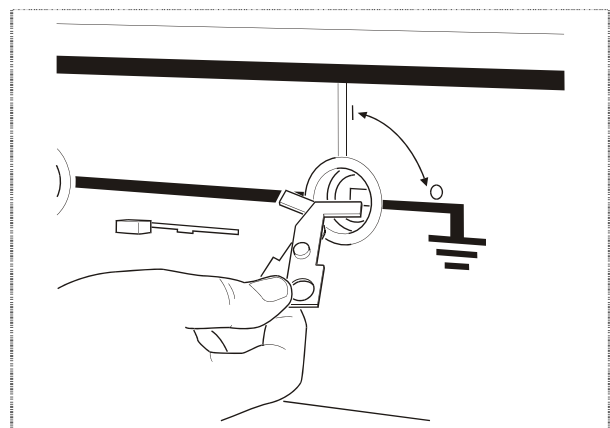
NOTE

Remove the warning sign as well.

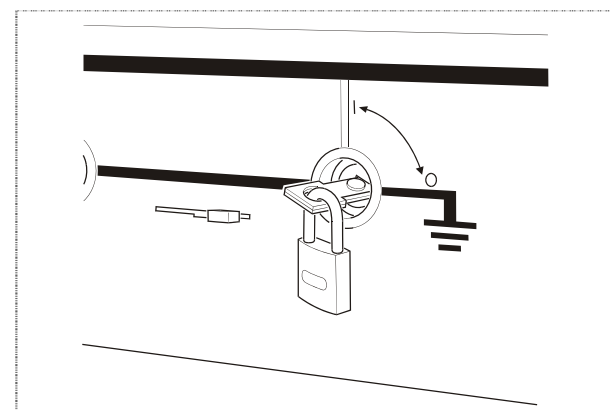
Locking in intermediate position (with scissor-type interlock)

Fit the scissor interlock as follows:

1. Check that the panel is in intermediate position.
2. Slide the selector (7) to the right.
3. Insert the half-opened scissor interlock in position in 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).



2.



3.

Option

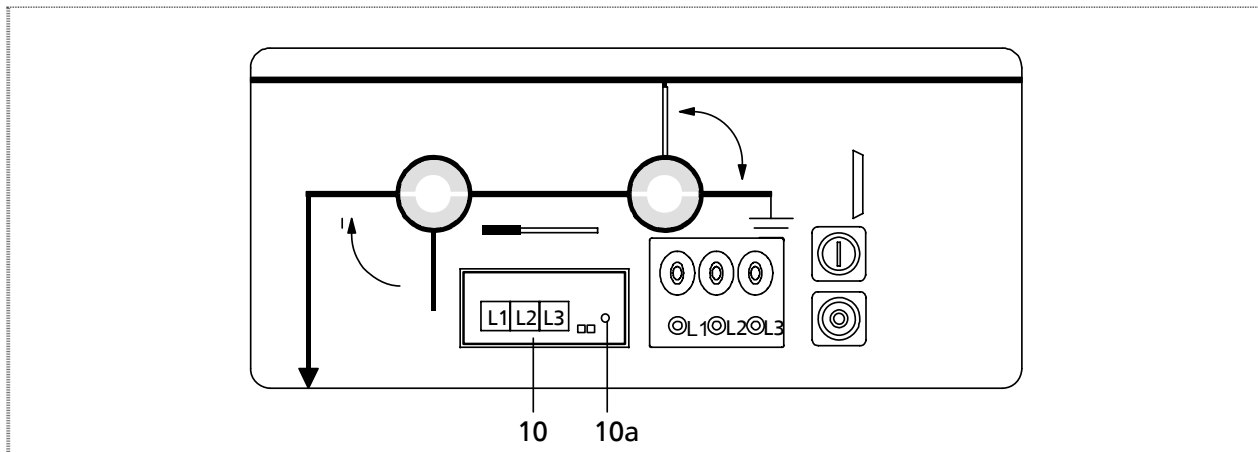
An optional extra is a facility that only allows the protection door to be removed when the cable is earthed and the interlocking strip is extracted.

In this case the load-break switch can no longer be locked to prevent switching off when in operating position.

Procedure

- Starting point:
Cable is earthed (disconnecter in earthing position, switch turned on)
- Opening the door:
Pull the interlocking strip (6) outward and lock the door with a key.
- Closing the door:
Pull the interlocking strip (6) outward and lock the door with a key.

4.2.6 AUTOMATIC RESETTING INDICATORS



1.

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

Overcurrent indicator

The overcurrent indicator (10) 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.

Short-circuit current indicator

The short-circuit current indicator (10) 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, the current must be $\leq 3 \text{ A}$.

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 (10a)
- 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 VOLTAGE TRANSFORMERS ON CABLE SIDE

General

As an optional extra, 3 voltage transformers on the cable side can be fitted in a load-break switch, a circuit breaker or a busbar section panel.

The 3 voltage transformers on the cable side (see figure) are mounted in the cable panel, below the cable connector. On the primary side, the voltage transformers are connected to the cable connector by means of a detachable epoxy resin-insulated connection. Data on the connection of the secondary side are stated in the diagram package supplied with the installation.

WARNING

Be sure to earth the cable side of the panel on which work is being carried out; see chapter 4.2.8. for instructions.

The cable must be dead; this can be checked by means of the voltage indication (see chapter 4.2.4). Remove the fuses on the secondary side of the transformer or switch off the automatic fuses, so that feedback is impossible.

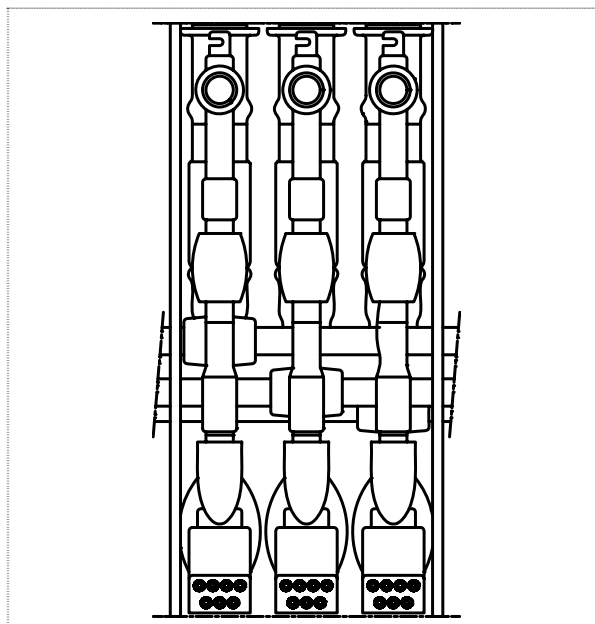
Disconnecting

1. Ensure that the cables are earthed and that the transformers are separated on the secondary side (see General).
2. Remove the protection cover.
3. Remove the 3 end caps and the 3 sleeves from the epoxy resin-insulated connector. Pullers are available to remove the end caps (see chapter 7).
4. Undo the 3 contact pins using a socket spanner (width across flats: 13) and remove them.

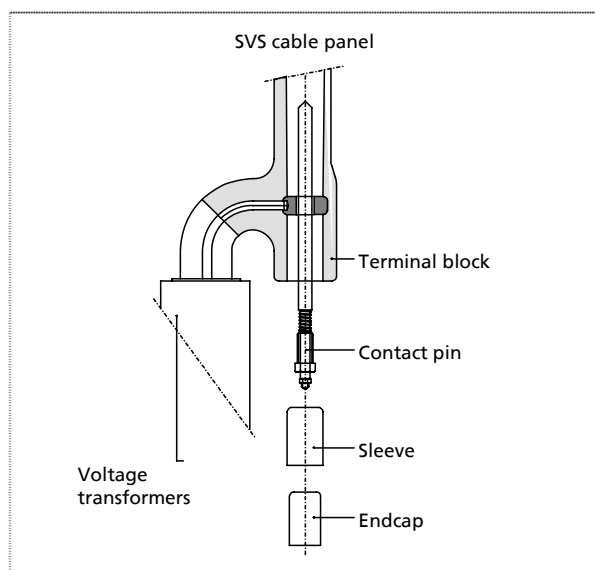
Now the cable can, for instance, be tested or measured (see chapter 4.2.15).

Connecting

1. Ensure that the cables on the primary side are earthed and that the transformers are separated on the secondary side (see General).
2. Fit the 3 contact pins and tighten them using a socket spanner (width across flats: 13); the torque is 9 Nm.
3. Clean the holes into which the sleeves are to be mounted.
Fit new sleeves rubbed down with silicone grease and then fit new end caps. Use a polyamide thread to enable venting.



1.



3.

The sleeves, end caps and polyamide thread are available from Eaton.

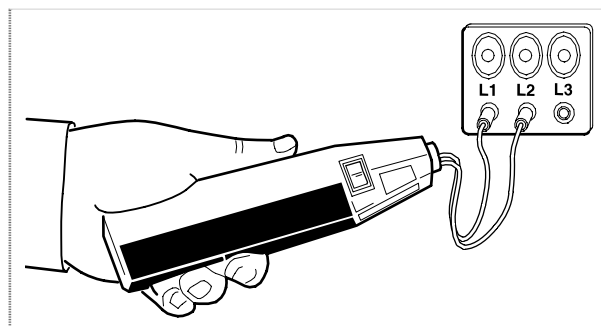
Remove the polyamide thread.

4. Fit the protection cover.
5. Fit the fuses or switch on the automatic fuses on the secondary side again.

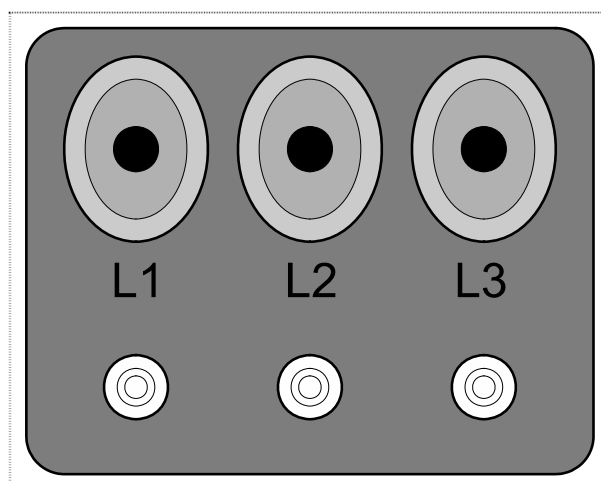
The panel can now be taken into operation again (see chapter 4.2.2).

4.2.8 EARTHING THE CABLE THROUGH THE LOAD-BREAK SWITCH OR CIRCUIT BREAKER

1. Switch the load-break switch or circuit breaker off (see chapter 4.2.2).
 2. Put the disconnecter in earthing position (see chapter 4.2.3).
 3. Check the operation of the voltage indicator with the aid of the indicator (see chapter 4.2.4).
-
4. Using the voltage indicator, check that the cable to be earthed is dead.
The LEDs are extinguished.
 5. Switch the load-break switch or circuit breaker on (see chapter 4.2.2).
The cable is now earthed through the load-break switch or the circuit breaker.
 6. Lock the installation, if necessary, by means of a padlock (see chapter 4.2.5)



3.



4.

4.2.9 EARTHING THE CABLE OF A 12 - 24-KV FUSED LOAD-BREAK SWITCH PANEL

Required accessories

Bag with earthing equipment, consisting of (see figure):

- Three earthing pins with earth contact and earth cable (25 mm²) with connecting clamp
- One insulated handle

See chapter 7 for technical data.

Interlocks

- The cables can only be earthed when the high-voltage fuses have been removed and the earthing equipment has been installed.
- Access to the high-voltage fuses can only be obtained when the load-break switch is opened and the disconnecter is in earthing position.

Earthing

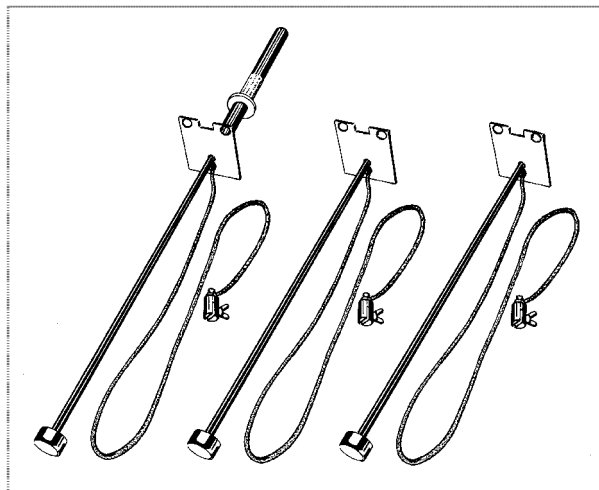
1. Remove the high-voltage fuses (see chapter 4.2.13). In this situation the disconnecter is in earthing position and the load-break switch cannot be switched on.
2. Remove the lower protection cover using the key.
3. Switch off the low-voltage side of the transformer to be earthed and check, prior to installing the earthing equipment, that the cables are indeed dead.
4. Fit the clamps of the earth cables to the earth bar of the station using the wing nuts.

5. Fit the earthing pins one by one, using the insulated handle. Proceed as follows:

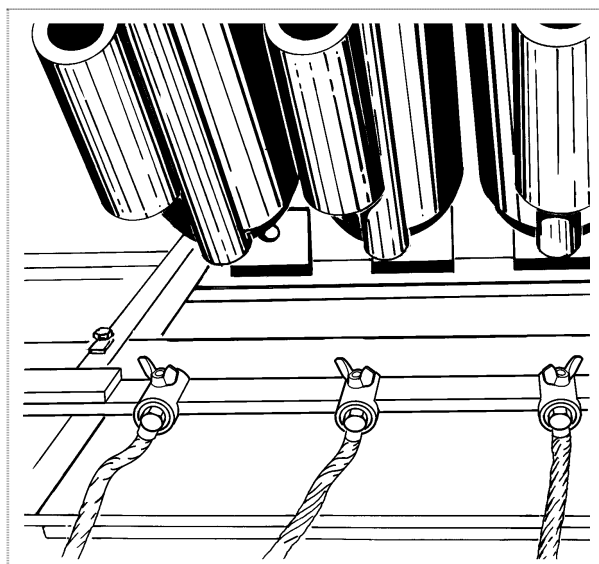
LIFE HAZARD

When fitting the earthing pins, never place your hand between the red ring on the insulated handle and the earthing pins or the stop.

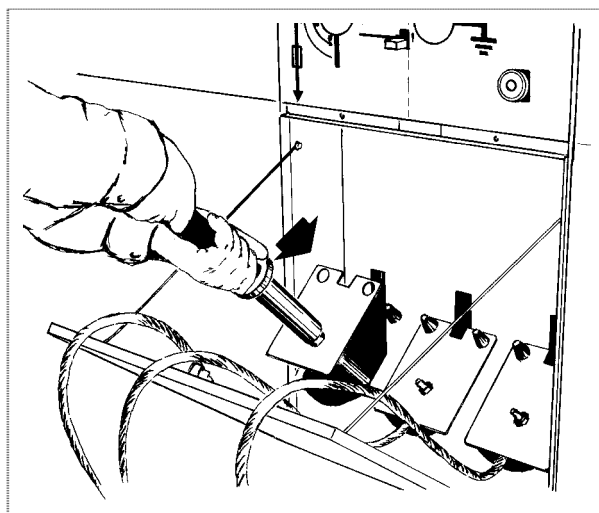
- Couple the insulated handle to the earthing pins and press the earth contacts in the socket contacts of the cable to be earthed.



1.



4.



5.

Removing earthing

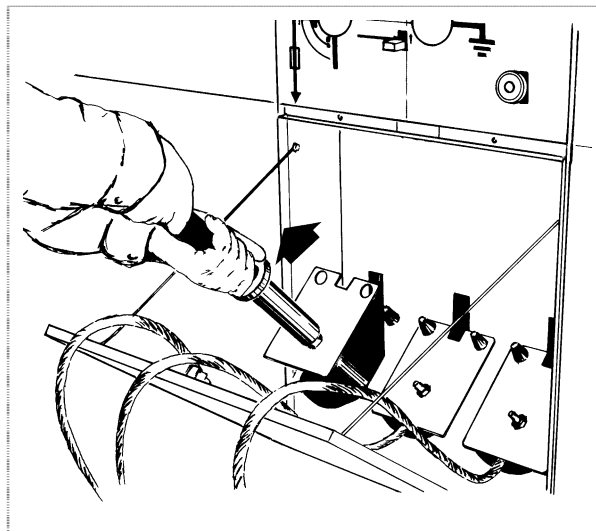
LIFE HAZARD

When removing the earthing pins, never place your hand between the red ring on the insulated handle and the earthing pins or the stop.

1. Take the earthing pins out of the socket contacts one by one, using the insulated handle.
2. Remove the clamps from the earth cables of the earth bar.
3. Mount the lower protection cover again, using the key.

Remark:

If the panel is taken into operation again after the earthing has been removed, first refit the high-voltage fuses (chapter 4.2.13); after that the panel can be taken into operation again (chapter 4.2.2).



1.

4.2.10 EARTHING THE CABLE OF A 12-KV FUSED LOAD-BREAK SWITCH PANEL

Required accessories

Bag with earthing equipment, consisting of (see figure 1):

- Three earthing pins with earth contact and earth cable (25 mm²) with connecting clamp
- One insulated handle

See chapter 7 for technical data.

Interlocks

- The cables can only be earthed when the high-voltage fuses have been removed and the earthing equipment has been installed.
- Access to the high-voltage fuses can only be obtained when the load-break switch is opened and the disconnecter is in earthing position.

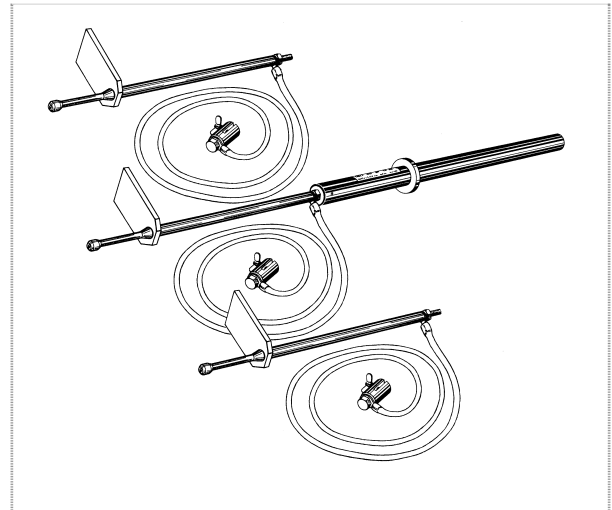
Earthing

1. Remove the high-voltage fuses (see chapter 4.2.13). In this situation the disconnecter is in earthing position and the load-break switch cannot be switched on.
2. Remove the lower protection cover using the key.
3. Switch off the low-voltage side of the transformer to be earthed and check, prior to installing the earthing equipment, that the cables are indeed dead.
4. Fit the clamps of the earth cables to the earth bar of the station using the wing nuts.
5. Fit the earthing pins one by one using the insulated handle. Proceed as follows:

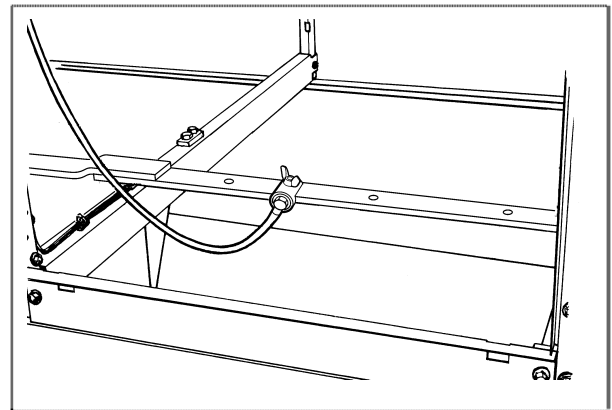
LIFE HAZARD

When fitting the earthing pins, never place your hand in between the red ring on the insulated handle and the earthing pins or the stop.

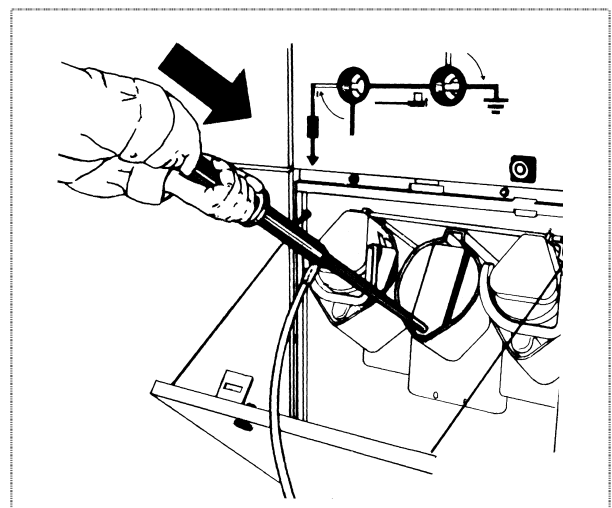
- Couple the insulated handle to the earthing pins and press the earth contacts in the socket contacts of the cable to be earthed.



1.



4.



5.

Removing earthing

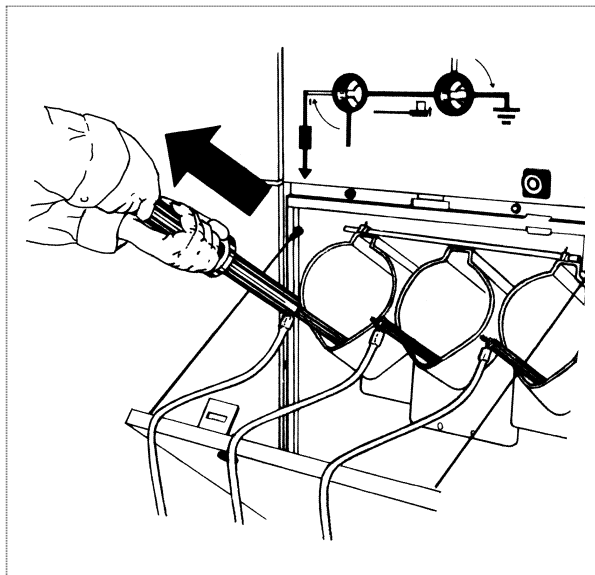
LIFE HAZARD

When removing the earthing pins, never place your hands between the red ring on the insulated handle and the earthing pins or the stop.

1. Take the earthing pins out of the socket contacts one by one, using the insulated handle.
2. Remove the clamps from the earth cables of the earth bar.
3. Mount the lower protection cover again, using the key.

Remark:

If the panel is taken into operation again after the earthing has been removed, first refit the high-voltage fuses (see chapter 4.2.13), after which the load-break switch can be taken into operation again (see chapter 4.2.2).



1.

4.2.11 THREE-POLE SHORT-CIRCUIT PROOF EXTERNAL BACK-UP EARTH

Required accessories

A bag with earthing equipment (figure 1) can be supplied for mounting a three-pole external back-up earth to the (Magnefix adapter) access port; it contains:

- One unit with three earthing contacts and two built-in interlocks with keys
- One earth cable (70 mm²) with connecting clamp

See chapter 7 for technical data.

Interlocks

Access to the cable access port can only be obtained when the cable is earthed by means of the integrated earthing of the load-break switch or circuit breaker panel. This is, however, not possible in the case of a panel with a direct busbar connection.

Fitting the three-pole external back-up earth

LIFE HAZARD

When earthing the cable through the (Magnefix cable-) terminal block, in combination with a direct busbar connection, the shutter for the access ports is fixed. The contacts behind this shutter are directly connected to the main busbar system of the installation. This will require additional safety measures.

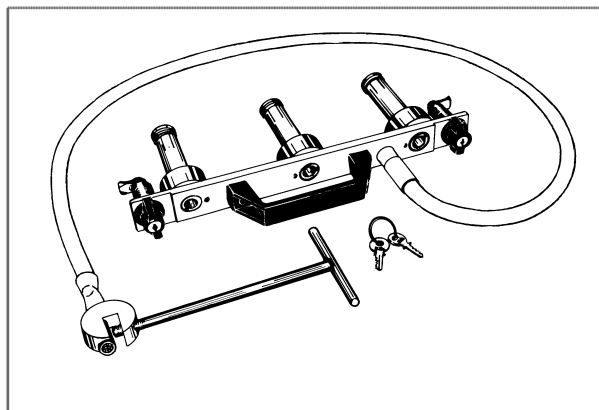
1. Earth the cable through the integrated earthing of the load-break switch or circuit breaker (see chapter 4.2.8).
2. Open the appropriate protection cover using the key.

NOTE

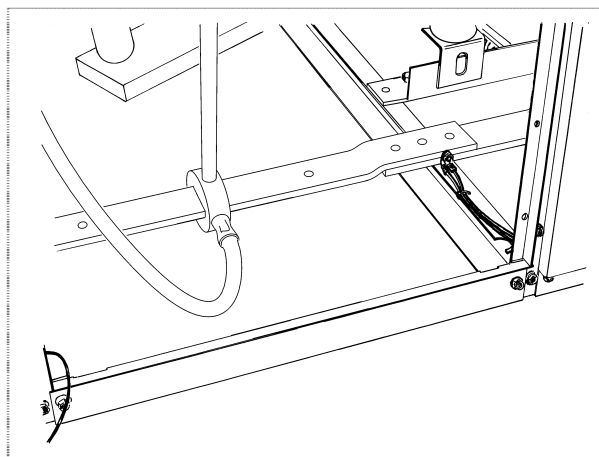
The shutter can only be opened when the disconnecter is in earthing position, with the circuit breaker or load-break switch switched on.

3. Connect the earth cable to the earth bar by means of the clamped joint.
4. Slide the shutter of the cable access port up.
5. Fit the unit so that it touches the plastic rings in the cable access port.
6. Then lock the unit by turning both interlocks behind the cabinet posts and remove the key.

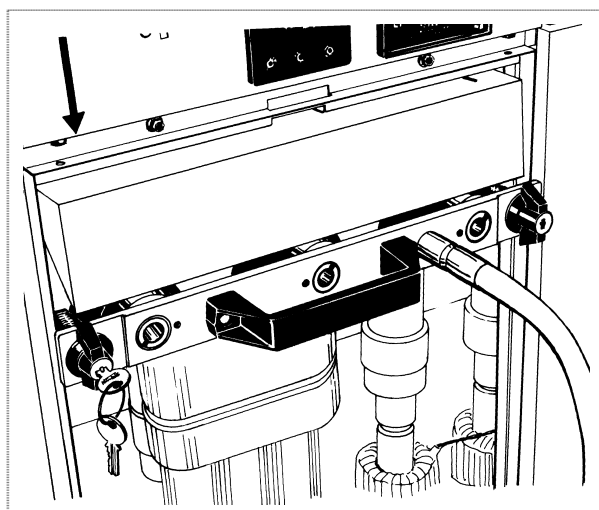
The cable is now also earthed through the external back-up earth.



1.



3.



5.

Removing the three-pole external back-up earth*Starting point*

The cable is earthed through the integrated earthing of the load-break switch or circuit breaker.

1. Unlock the unit of the external back-up earth by means of the two interlocks with key and take the unit out of the cable access port.
2. Disconnect the earth cable from the earth bar.
3. Close the installation by fitting the appropriate protection cover and lock it using the key.

The outgoing cable is now only earthed through the integrated earthing of the load-break switch or circuit breaker panel.

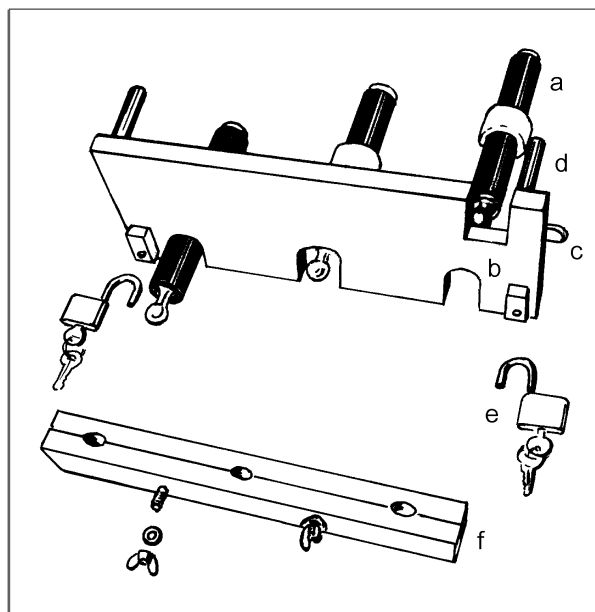
4.2.12 SINGLE-POLE SHORT-CIRCUIT PROOF EXTERNAL BACK-UP EARTH

The single-pole short-circuit proof external back-up earth can be used to earth 1, 2 or 3 phases, as needed, which allows you to test or measure at the unearthed phase.

Required accessories

A bag with earthing equipment (figure 1) can be supplied for mounting a single-pole external back-up earth to the (Magnefix adapter) cable access port; it contains:

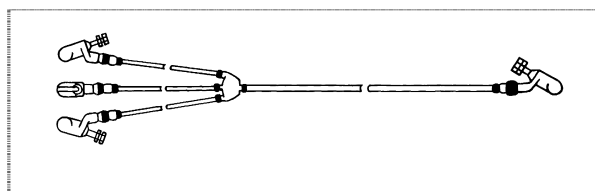
- a. Three earthing pins
- b. One insulated locking plate with:
- c. Two hooked latches and
- d. Two guide pins
- e. Two padlocks
- f. One cable clamping bar



1.

The single-pole external earth is to be connected via commercially available earth cables with ball-head bolt connectors and mounting rod

(20-mm ball head) (see figures 2 and 3, for instance). The earthbar of the relevant Innovac SVS/08 panel must have a 20-mm ball-head bolt connection point (see figure 4).



2. Earth cable with ball-head bolt connector

These earth cables with ball-head bolt connectors are also available from Eaton.

See chapter 7 for the technical data on the accessories available through Eaton.

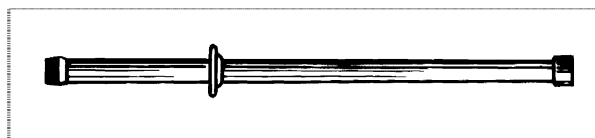
Remark:

The technical data on the earth cables and ball-head bolt connectors that are not supplied by Eaton depend on the make and type used. These cables and connectors have to satisfy the recommendations as laid down in

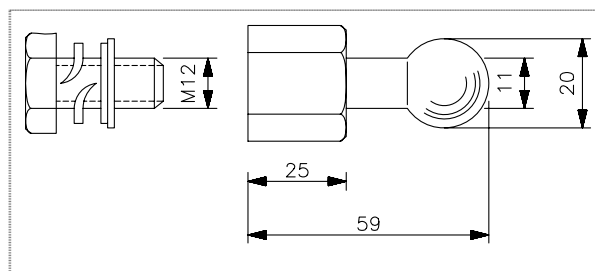
IEC-publication 60298, chapter 5.3.2.

Interlocks

Access to the cable access port can only be obtained when the cable is earthed by means of the integrated earthing of the load-break switch or circuit breaker panel. This is, however, not possible in the case of a panel with a direct busbar connection.



3. Earth mounting rod for earth cables



4. Ball-head bolt connector

Fitting the one-pole external back-up earth

LIFE HAZARD

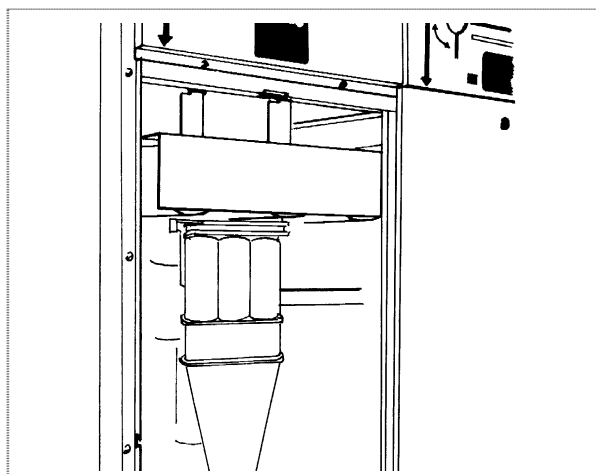
When earthing the cable through the cable terminal block, in combination with a direct busbar connection, the shutter for the access ports is fixed. The contacts behind this shutter are directly connected to the main busbar system of the installation. This will require additional safety measures.

1. Earth the cable through the integrated earthing of the load-break switch or circuit breaker (see chapter 4.2.8).
2. Open the appropriate protection cover using the key.

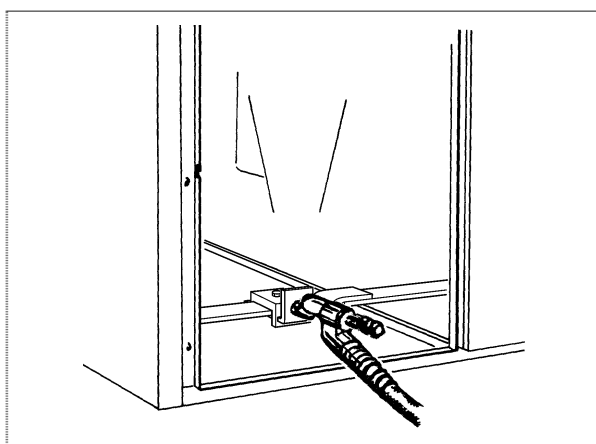
NOTE

The shutter can only be opened when the disconnecter is in earthing position with the circuit breaker or load-break switch switched on.

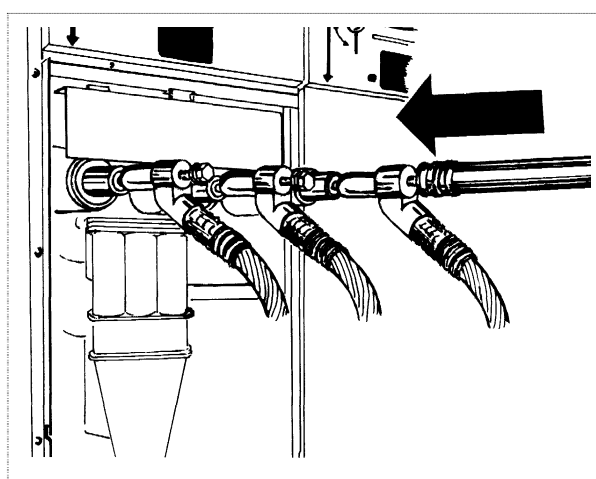
3. Connect the earth cable to the earthbar by means of the ball-head connector.
4. Mount the 3 earthing pins to the connection points of the earth cable. Proceed as follows:
Slide the shutter of the cable access port up and fit the pins in the cable access port using the mounting rod.



2.



3.



4.

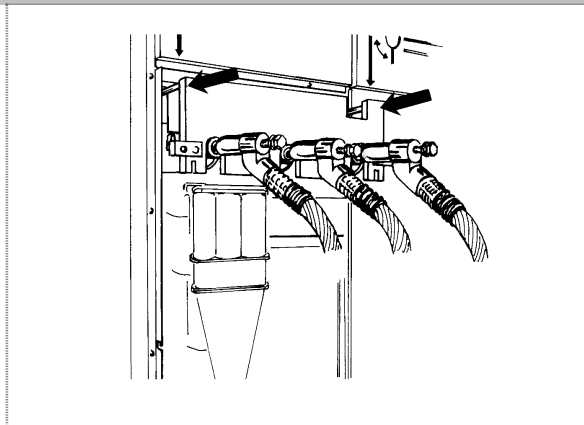
5. Fit the insulated locking plate and move it further until it touches the plastic rings on the earthing pins. Ensure that the tops of the conducting pins of the locking plate are located next to the shutter, at the top.
 6. Then turn the 2 hooked latches behind the cabinet posts and fit the padlocks.
 7. Fit the cable clamping bar as close as possible to the terminals on the ball-head bolt contacts and fix them with the two wing nuts.
- The cable is now also earthed through the external back-up earth. You can now test or measure the phase that has not been earthed via an earth cable. To do so, switch off the load-break switch or circuit breaker.

LIFE HAZARD

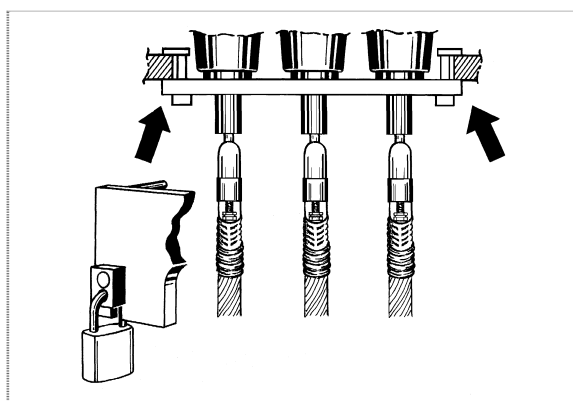
Before changing phases to test or measure, first earth the cable (see chapter 4.2.8) through the load-break switch or the circuit breaker.

Removing the one-pole external back-up earth

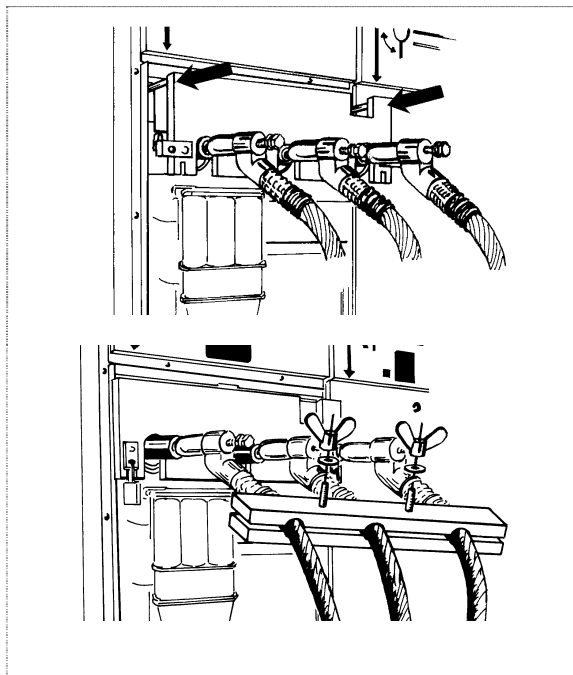
1. Remove the padlocks.
 2. Unlock and remove the insulated locking plate.
 3. Disconnect the earth cable from the earth plate.
 4. Close the installation by fitting the appropriate protection cover and lock it using the key.
- The outgoing cable is now only earthed through the integrated earthing of the load-break switch or circuit breaker panel.



5.



6.



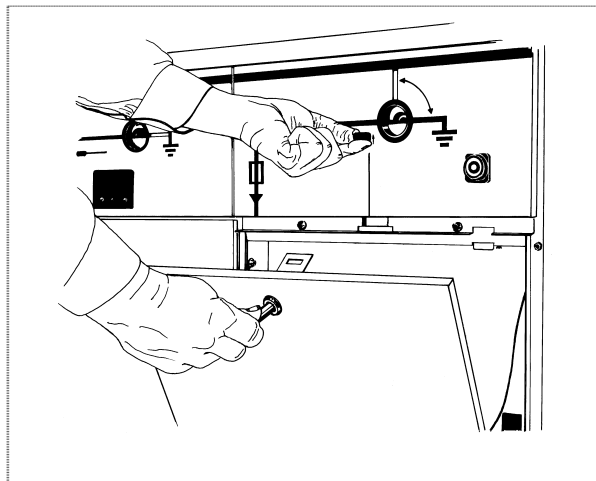
7.

4.2.13 REPLACING THE HIGH-VOLTAGE FUSES

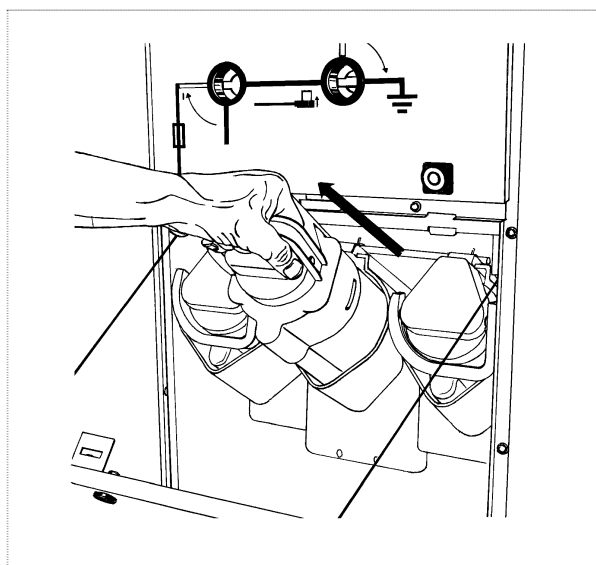
NOTE

Fuses (as per DIN 43625) should have a striker pin so as to guarantee a correct automatic tripping function of the load-break switch. The striker pin end should always be placed in the handle.

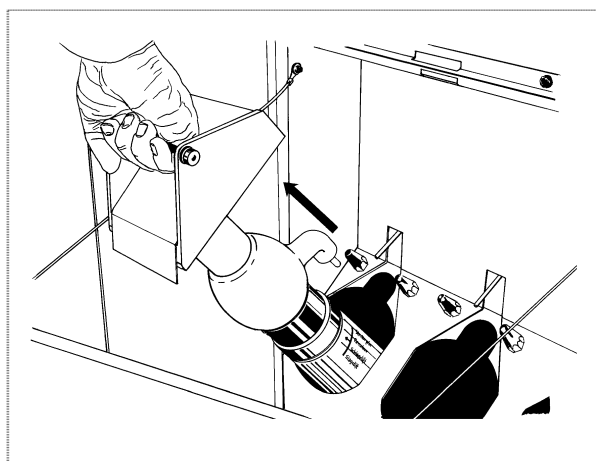
1. Switch off the load-break switch
(See chapter 4.2.2).
2. Put the disconnecter in earthing position (see chapter 4.2.3).
3. Check that the selector (7) is to the right.
4. Put the key in the lock of the protection cover for the fuses and push the selector (7) up.
5. Use the key to open the protection cover.
6. Remove the fuses with the handles.



4.



6.1.



6.2.

7. Replace the fuse in the handle.

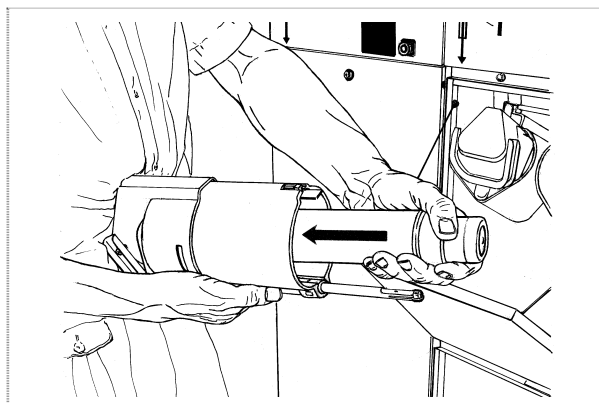
WARNING

When fitting the fuse, do not position the handle against the wall or on the floor so as to avoid damage to the fuse interior. Fit the fuse with the striker pin end placed in the handle.

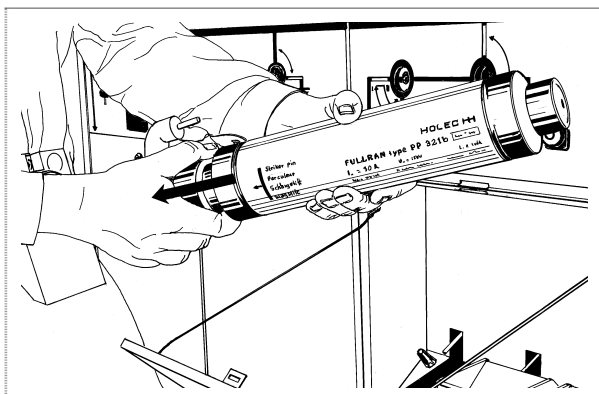
8. Slide the handle with the fuse into the installation.
9. Close the protection cover by pushing the selector (7) up and turn the key a quarter of a turn in clockwise direction.
10. Put the disconnecter in busbar position (see chapter 4.2.3).
11. Switch on the fused load break switch panel (see chapter 4.2.2).

NOTE

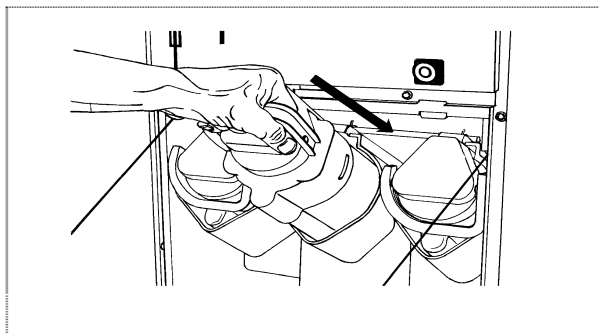
If, with a 12 - 24-kV version, the fuse is taken out of the handle, first push back the ring of the handle.



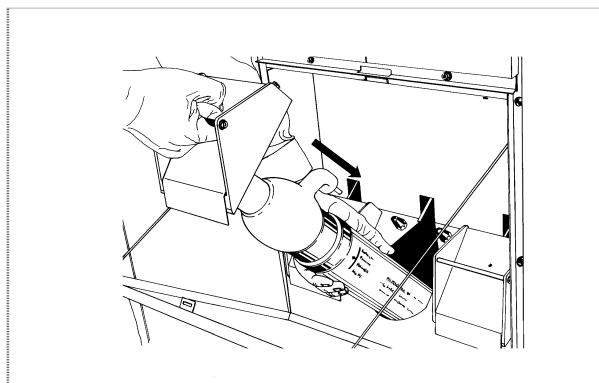
7.1 Fitting the 12-kV fuse in the handle



7.2 Fitting the 12 - 24-kV fuse in the handle



8.1 Fitting the 12-kV fuse with handle



8.2 Fitting the 12 - 24-kV fuse with handle

4.2.14 OPENING AND CLOSING THE INSTRUMENT COMPARTMENT

WARNING

If - with an opened instrument compartment - some parts are still live, the general low-voltage safety instructions are to be observed.

Instrument compartment, 400 mm and 600 mm high***Opening***

1. Give both locks in the door of the instrument compartment a quarter of a turn in anticlockwise direction, open the door.
2. Now pull the mounting board (if fitted) forwards as far as possible.

Closing

To close the instrument compartment, reverse the above procedure.

Instrument compartment, 150 mm high***Opening***

1. Slightly loosen the two bolts at the back of the installation using a spanner (width across flats; 8 mm).
2. Lift the cover at the back and slide it forward.

Closing

To close the instrument compartment, reverse the above procedure.

4.2.15 METERING AND TESTING

Required accessories

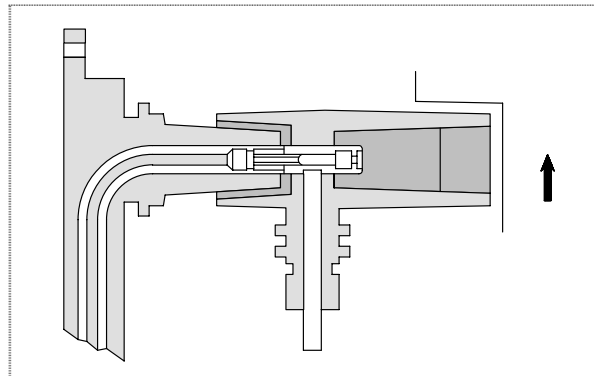
- Measuring and test pins for the 12 kV cable access port.
(Measuring and test pins for T-connectors can be supplied by the plug supplier).

Testing the cable via the cable terminal block

LIFE HAZARD

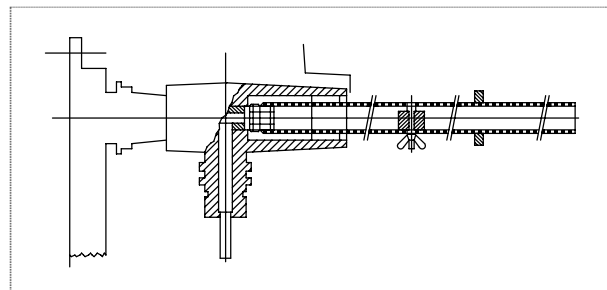
When testing the cable via the cable terminal block, in combination with a direct busbar connection, the shutter for the access ports are fixed. The contacts behind this shutter are directly connected to the main busbar system of the installation. This requires additional safety measures during test operations.

1. Earth the cable through the integrated earthing of the load-break switch or circuit breaker (see chapter 4.2.8).
Disconnect the voltage transformer mounted on the cable side, if applicable (see chapter 4.2.7).
2. Open the appropriate protection cover using the key and remove the cover.



3.

3. Slide up the shutter of the cable access port.
4. Fit the pins in the cable access port and connect the measuring or test equipment.
5. Switch off the load-break switch or circuit breaker (see chapter 4.2.2).
Testing or measuring can now be started.
6. Switch on the load-break switch or circuit breaker immediately after testing and measuring (see chapter 4.2.2).
7. Remove the pins.
8. Slide down the shutter of the cable access port.
9. Refit the protection cover and lock it using the key.



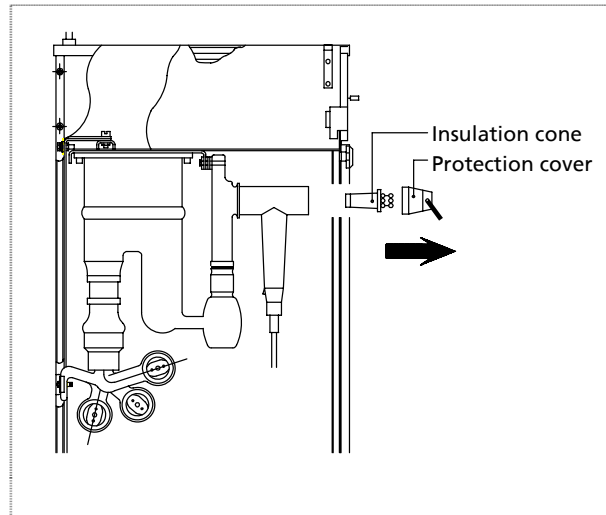
4.

Remark:

Please refer to the supplier's documentation for any additional information on the use of measuring and test equipment.

Testing the cable when using T-connectors

1. Earth the cable through the integrated earthing of the load-break switch or circuit breaker (see chapter 4.2.8).
2. Open the appropriate protection cover using the key and remove the cover.
3. Remove the protection hoods of the T-connectors.
4. Remove the insulation cones.

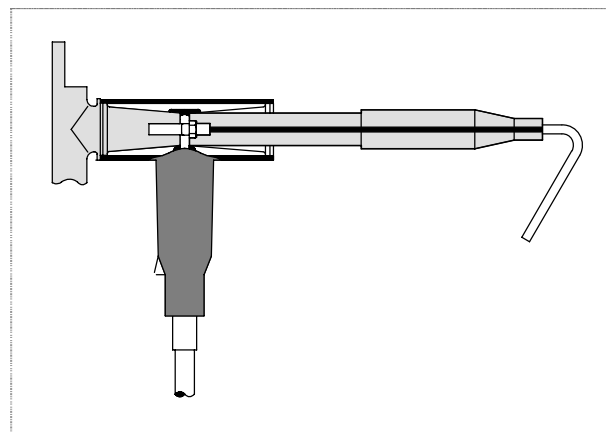


3, 4

5. Fit the measuring and test equipment in the T-connectors.
6. Switch off the load-break switch or circuit breaker (see chapter 4.2.2).
Testing or measuring can now be started.
7. Switch on the load-break switch or circuit breaker immediately after testing or measuring (see chapter 4.2.2).
8. Remove the measuring or test equipment.
9. Fit the insulation cones.
10. Fit the protection hoods.
11. Refit the protection cover and lock it by turning the key a quarter of a turn in clockwise direction.

Remark:

Please refer to the supplier's documentation for additional information on the use of measuring and test equipment.



5.

5. SYSTEM COMMISSIONING AND DECOMMISSIONING

5.1 COMMISSIONING

5.1.1 PREPARATIONS AND INSPECTION

1. Perform a visual check.

Prior to taking the Innovac SVS/08 switchgear into operation, check that:

- the area in which the switchgear is installed, meets the guidelines described in chapter 3.1.
- the switchgear is assembled steady and level.
- the cables run straight underneath the connections.
- the cable connection and support are properly tightened.
- the phase sequence of the connected cables is correct.
- the earth bar is earthed.
- the lead sheath and the earth screens of the cables respectively are earthed.
- the cable boxes for paper-insulated lead-covered cables (if applied) are completely filled.
- the hose clips (if applied) are tightened.
- the rated current values of the high-voltage fuses are correct.
- the striker pin of the high-voltage fuses are correctly positioned in the handle.
- the interior of the installation is dust-free.

2. Fit all the protection covers upon completion of the inspection.

LIFE HAZARD

If an Innovac SVS/08 panel is taken into operation without the primary cable having been connected, place the panel in question in earthing position so as to prevent contact with live connection points, meaning that the disconnector is in earthing position and the load-break switch or circuit breaker is switched on.

LIFE HAZARD

When commissioning a special version of the metering panel, with non-insulated copper connections, make sure that all screens protecting against direct or indirect contact have been fitted. With this type of panel, never remove any covers when the system is live.

3. Then perform a function test:

- Test the switch-on and switch-off functions.
- Test the interlocks.
- Test the door interlocks.

5.2 DECOMMISSIONING

5.2.1 DISMANTLING

LIFE HAZARD

Prior to dismantling, ensure that the installation is dead.

Personal protection equipment

- Safety goggles
- Protective clothing and footwear

Removing the main spring

LIFE HAZARD

Isolate the installation from the mains.

Note:

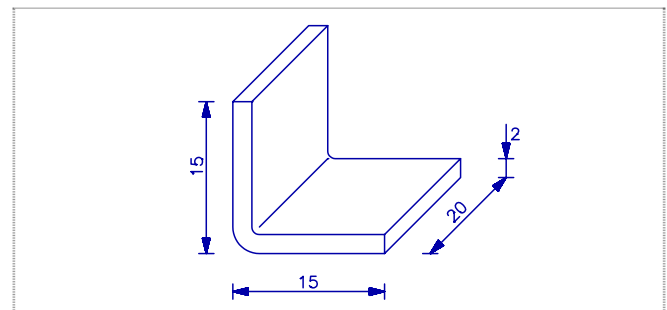
The description refers to figure 1 in chapter 6.

1. Switch the installation off (see chapter 4.2.2).
2. Position the operating handle on the operating shaft of the switch.
Give the operating shaft a quarter of a turn in clockwise direction and keep it in this position.
3. Slide an L-section into the slot cleared underneath strip G of the main spring.
4. Turn the operating shaft back.
5. Remove the pin (X) and take the complete main spring out of the mechanism.

WARNING

The main spring is still tensioned. Be sure to clamp it before removing the interlocks. After that the spring can be cautiously slackened.

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



3.

5.2.2 DISPOSAL

An installation should be disposed of in an environment-friendly manner.

Destruction, re-use and disposal of removed substances and materials should be in accordance with the regulations and requirements applicable at the time.

Eaton will send a list of the materials used on request.

- After consultation Eaton can take back the installation.

6. SYSTEM INSPECTION, MAINTENANCE AND REPAIR

6.1 INSPECTION AND MAINTENANCE

6.1.1 MAINTENANCE FREQUENCY

Under normal conditions the type Innovac SVS/08 medium-voltage switchgear does not require maintenance for a 10-year period. After that period the switchgear will require maintenance no more than once every 5 years, depending on the operating conditions.

These periodical checks can be made by suitably qualified personnel, duly observing the safety instructions, and in accordance with the guidelines below.

Eaton can carry out these operations for you or, if you wish so, provide training on the proper performance of inspection and maintenance operations.

6.1.2 CHECKING AND MAINTENANCE OF THE MECHANISM

Checking the mechanism

- Switch on and off switches that seldom if ever switch ten times.

Maintenance of the mechanism

WARNING

The following operations require access to the mechanism.

Beware of injuries as a result of uncontrolled movements of the mechanism or injuries caused by the sharp edges of the sheet metal.

Access is also obtained to the secondary wiring and components; if parts are live, the general safety requirements for low voltages must be met.

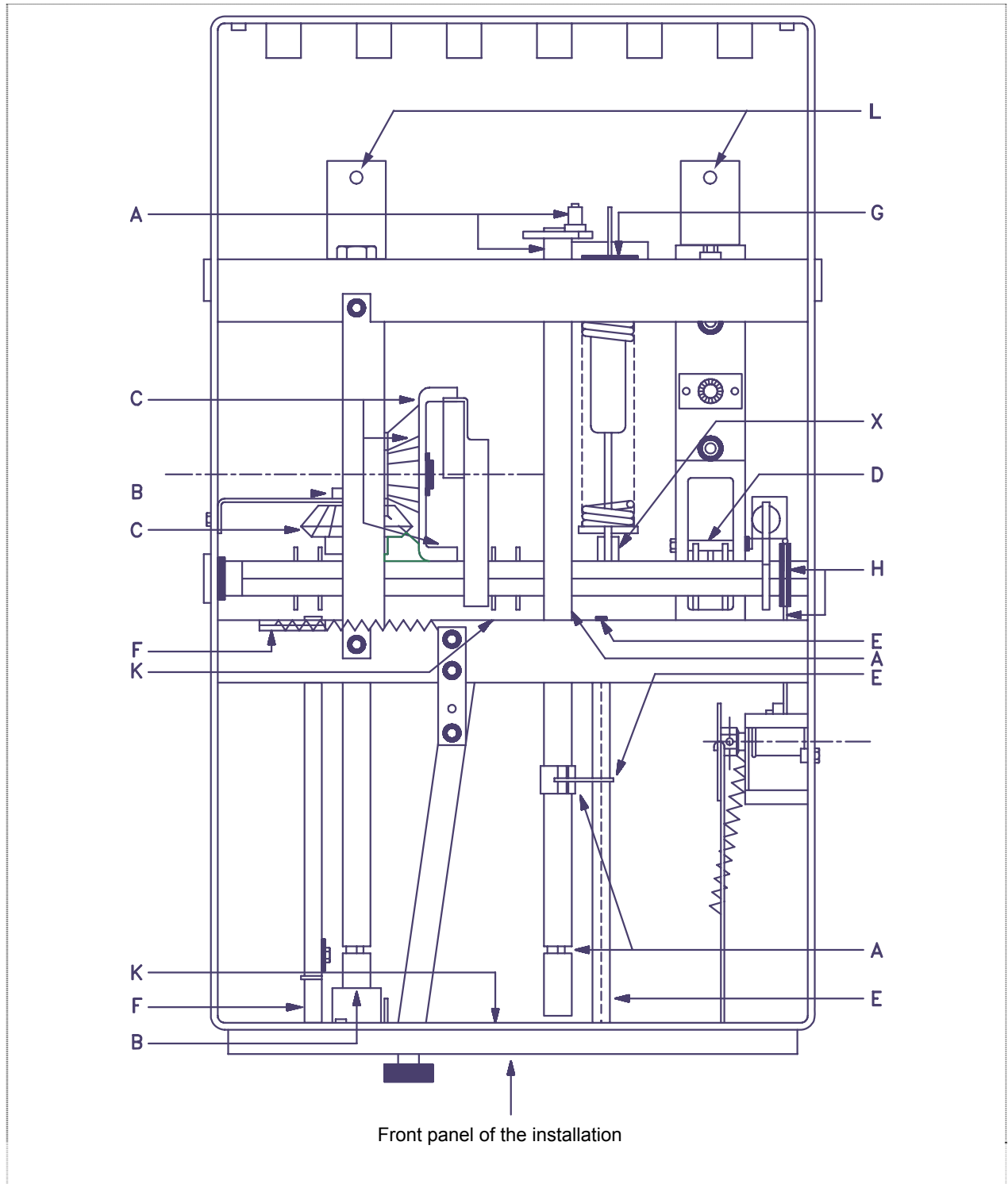
1. Ensure a safe working situation:
 - to this end, switch the relevant switch off and put the disconnecter in earthing position (see chapter 4 - System operation)
2. Remove the upper cover:
 - slightly undo the 2 bolts at the rear of the installation using a spanner (width across flats: 8)
 - lift the cover at the rear and slide it forward
3. If there is an instrument compartment:
 - open the door by giving the locks a quarter turn in anticlockwise direction
 - lift the mounting board (if fitted) as far as possible
 - Take off the cover plate.
4. Slightly lubricate the pivot and sliding points of the parts in question using Molycote paste BR2. These points are indicated in figure 1.

NOTE

It is advisable to use a brush with a long handle to lubricate the various points. This will facilitate lubrication and prevent injury.

TIP

Use as little lubricant as possible.



1. Top view of the mechanism compartment

- | | |
|--|---|
| A. The shaft driving the disconnecter. | F. The shaft driving the load-break switch or circuit breaker position indicator. |
| B. The shaft driving the load-break switch or the circuit breaker. | G. The strip of the main spring. |
| C. The right-angled transmission gear. | H. The strip for switching-off. |
| D. The catch in the three levers. | K. The two locking plates. |
| E. The shaft driving the disconnecter position indicator. | L. Guide shaft driving the change-over switch. |
| | X. The pin for the main spring |

6.1.3 REPLENISHING THE GREASE-FILLED CABLE BOXES

Accessories supplied with the system

- Filling device

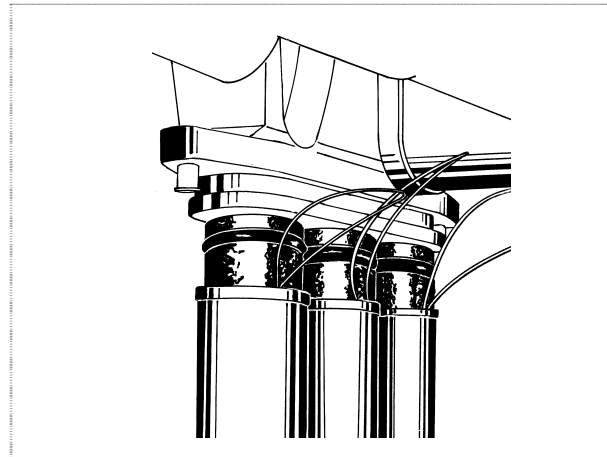
LIFE HAZARD

When performing operations on the cable box, make sure that the cable(s) in question is (are) always earthed.

1. Check the level of the cable grease (using a lamp, if necessary).
 - The cable box needs refilling when the grease level has dropped to a level below the cable core clamps, the grease having been absorbed by the cable.
 - In this case fill up the hose of the filling device with grease, before pushing it into the cable box, so as to prevent the intrusion of air.
 - For filling up the cable box, see chapter 3.3.8.
2. Undo the hose clamp and slide the cable box so far down that the nylon vent threads can be fitted (see figure 1).
 - When sliding down is not so easy because the grease has become too viscous, you may heat the cable box a little, using a hair-drier, for instance.

WARNING

Never heat the cable box with a naked flame.



1

6.1.4 CLEANING THE INSTALLATION

Cleaning will not be necessary if the switchgear is installed in accordance with the guidelines described in chapter 3.1.

If the switchgear is soiled, take the following measures:

LIFE HAZARD

Make the installation dead.

- Clean the soiled parts using a damp cloth.
- Dry the installation and apply a little silicone grease, type DC-4 or MAC 05. Polish the layer of grease until a shiny, non-sticky surface is obtained.

Remark:

MAC 05 is an Eaton-developed cleaning and conditioning agent, which removes surface pollution and restores the moisture-repellent silicone layer covering the cast resin.

6.1.5 REPLACING THE BASE CONTACTS IN THE 24-kV FUSE HOLDER OF A FUSED LOAD-BREAK SWITCH PANEL

General

The 24-kV fuse holders of a fused load-break switch panel are suitable for receiving 20/24-kV fuses (figure 1) as per DIN 43625.

When the switchgear delivered is used with an operating voltage of 10/12 kV, these fuse holders can be provided with 10/12-kV base contacts with spacing tube (figure 2).

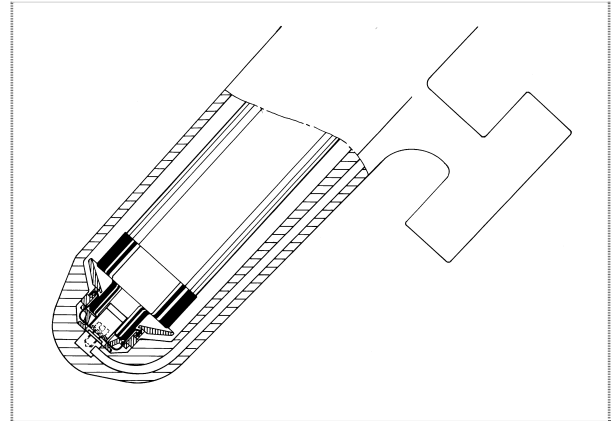
If the switchgear is initially commissioned for a specific operating voltage and the company switches to another operating voltage later on, the base contacts will need replacement.

Required accessories

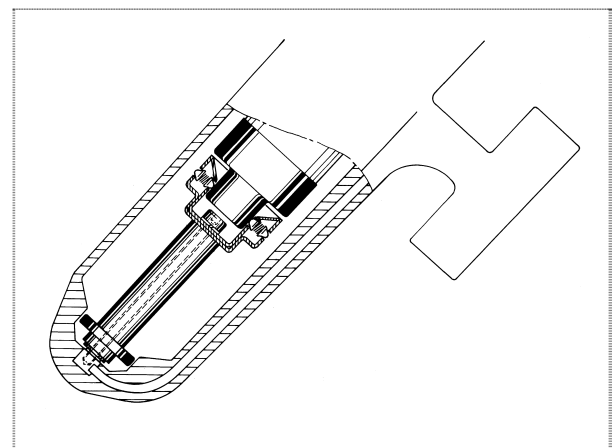
- One 20/24-kV (base contact (figure 1) or
- One 10/12-kV base contact with spacing tube (figure 2)
- One wrench (figure 3)

Remark:

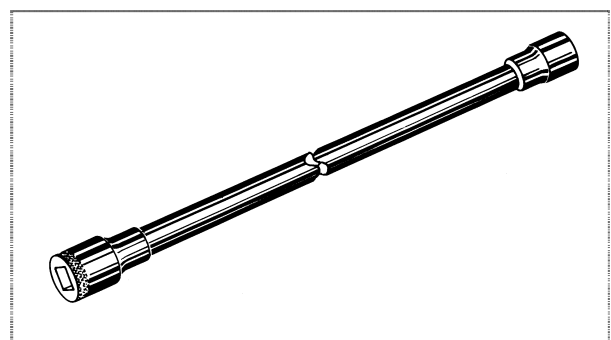
17.5-kV fuses are available in a short (10/12 kV) and a long (20/24 kV) version.



1. 20/24-kV base contact (DIN 43625)



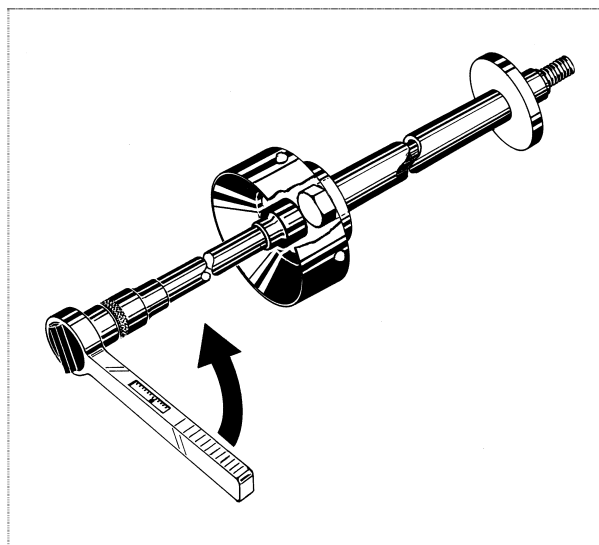
2. 10/12-kV base contact with spacing tube (DIN 43625)



3. Wrench, for use in combination with a torque wrench, which is set to 20 Nm

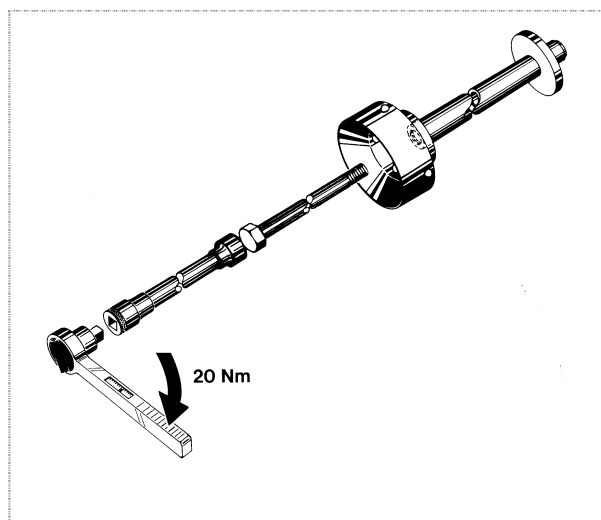
Replacing a 10/12-kV base contact with spacing tube by a 20/24-kV base contact

1. Remove the high-voltage fuses, following the procedure described in chapter 4.2.13.
In this situation the disconnecter is in earthing position and the load-break switch cannot be switched on.
2. Switch off the low-voltage side of the transformer and check - prior to removing the base contact with spacing tube - that the outgoing cables are dead.
3. Remove the 10/12-kV base contacts and spacing tubes using the special wrench.
4. Clean the contact faces of the 20/24-kV base contacts using a Scotch-brite scouring pad, for instance.
5. Fit the preassembled 20/24 kV-base contact using the special wrench and a torque of 20 Nm as follows:
Place the preassembled 20/24-kV base contact on the wrench.
Rest the contact against the side of the fuse holder and slowly lower the whole.
6. Fit the 20/24-kV fuses and switch the load-break switch on (see chapter 4.2.10).

**3. Removing a 10/12-kV base contact with spacing tube**

Replacing a 20/24-kV base contact by a 10/12-kV base contact with spacing tube

1. Remove the high-voltage fuses, following the procedures described in chapter 4.2.13.
In this situation the disconnecter is in earthing position and the load-break switch cannot be switched on.
2. Switch off the low-voltage side of the transformer and check - prior to removing the base contact - that the outgoing cables are dead.
3. Remove the 20/24-kV base contacts using the special wrench.
4. Clean the contact faces of the 10/12-kV base contacts with spacing tubes using a Scotch-brite scouring pad, for instance.
5. Fit the preassembled 10/12-kV contact with the spacing tube using the special wrench and a torque of 20 Nm as follows:
Place the preassembled 10/12-kV base contact with spacing tube on the wrench.
Rest the contact against the side of the fuse holder and slowly lower the whole.
Rest the contact against the side of the fuse holder and slowly lower the whole.
6. Fit the 10/12-kV fuses and switch the load-break switch on (see chapter 4.2.10).



5. Fitting a 10/12-kV base contact with spacing tube

6.2 REPAIR

Contact Eaton in case of faults and repair work.

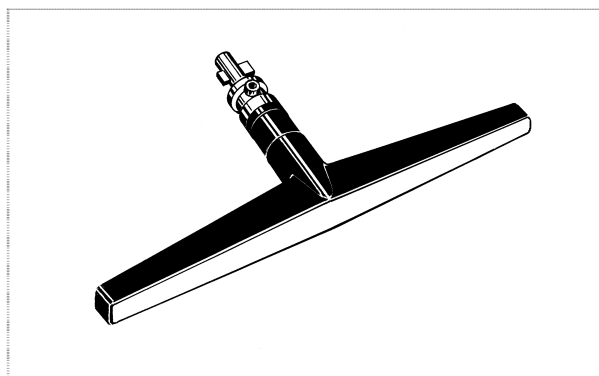
Eaton Electrical Systems Pty Ltd
10 Kent Road,
Mascot, NSW 2020
Locked bag 1006
Rosebery, NSW 1445
Phone: 02 9693 9333
Fax: 02 9693 5127
www.eatonelectric.com.au

Customer service: 1300 3 Eaton
CustomerServiceAusNZ@eaton.com

7. ACCESSOIRES

7.1 SUMMARY OF AVAILABLE ACCESSORIES

1. Operating handle
(106.311)



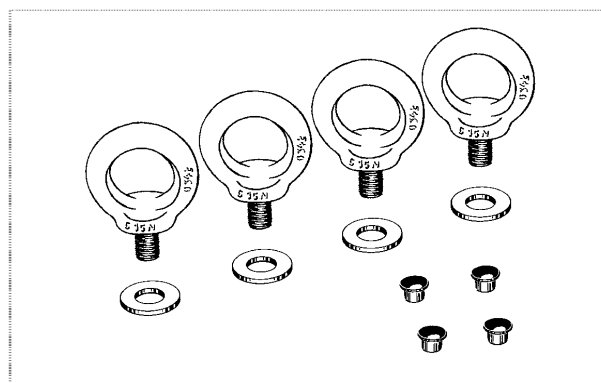
1.

2. Key for protection cover
(106.363)



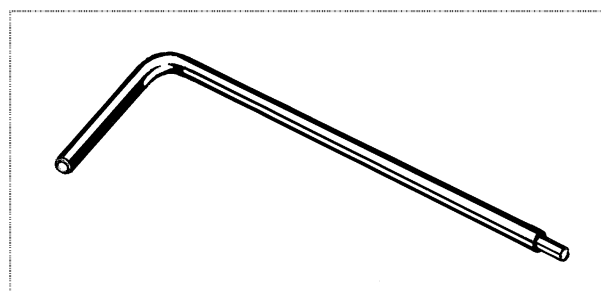
2.

3. Lifting eyes, sealing plugs and nylon filler rings



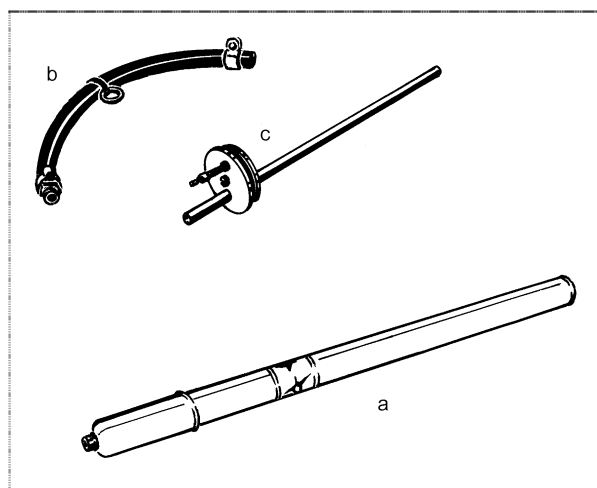
3.

4. Spanner for cable core clamps

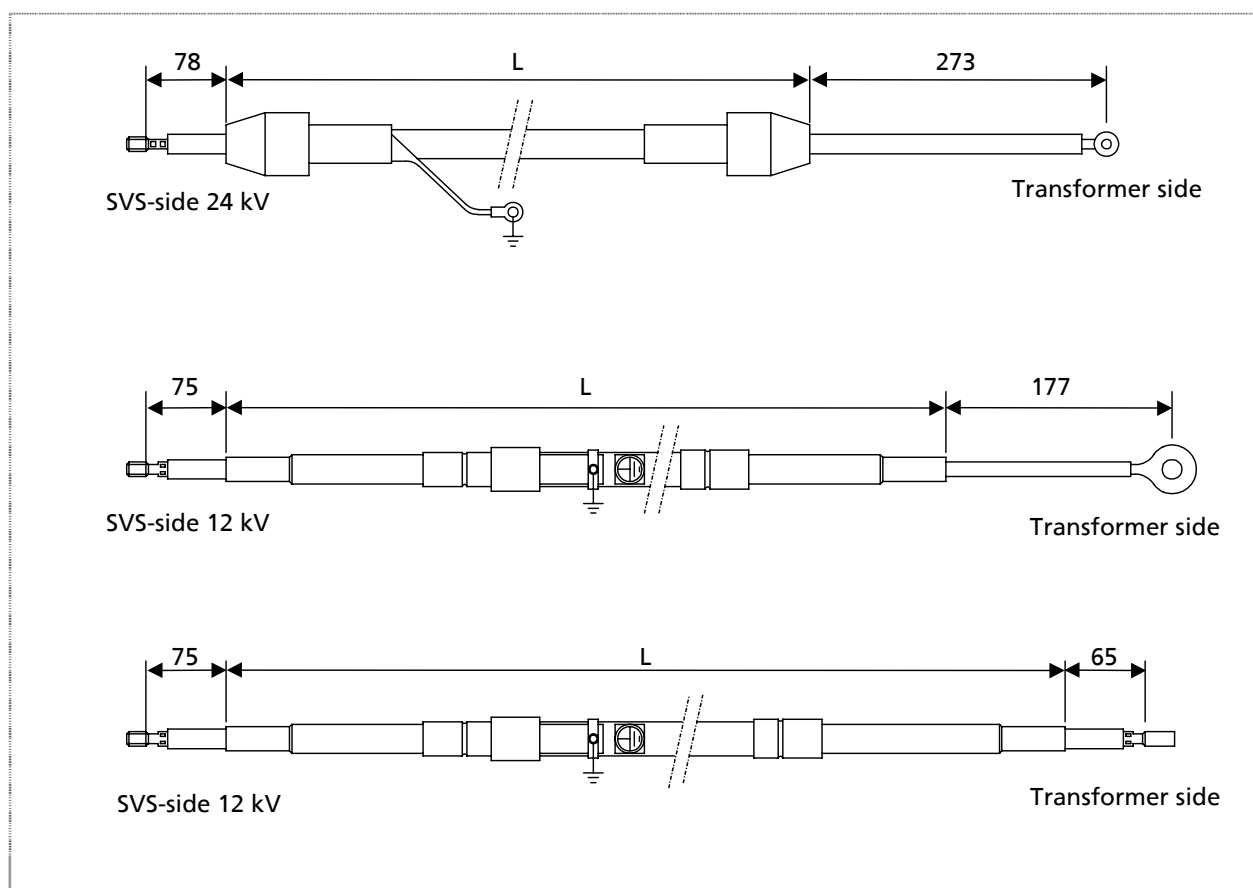


4.

5. Filling device with:
 - Hand-operated pump (a)
 - Filling hose with hose clip, shut-off ring and connector nipple (b)
 - Filling device with filling tube (c)
(684.016)
6. Eaton one-core plastic-insulated transformer cable;
please state length and type when ordering



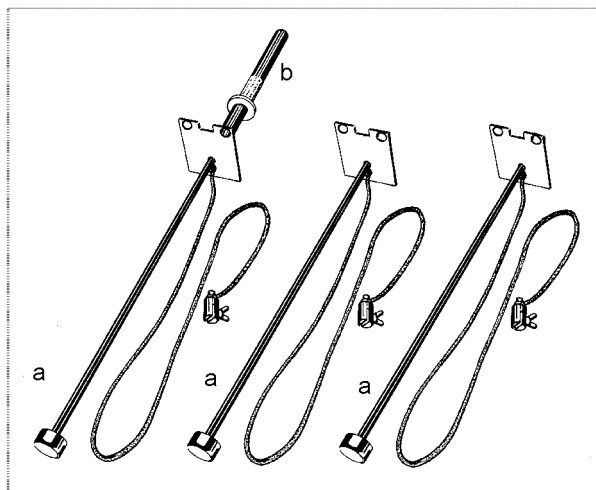
5.



6.

7. Earthing equipment for earthing the cable of a 12 - 24-kV fused load-break switch panel:

- three earthing pins (a) with earth contact and earth cable with terminals
- one insulated handle (b)
(12 kV: 106.107)
(24 kV: 106.132)



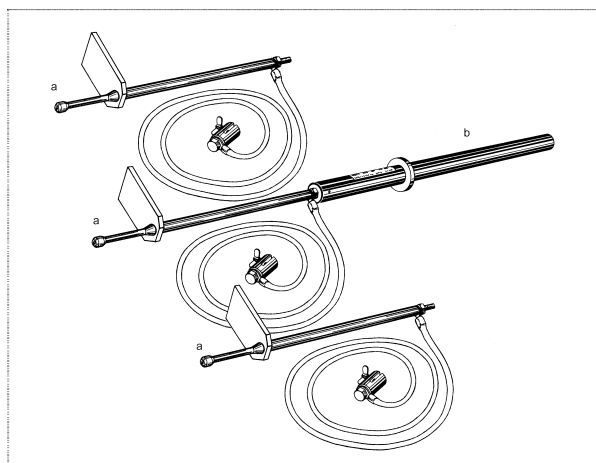
7.

Technical data

Rated voltage (IEC)	(kV)	12	17.5	24
Rated short-time withstand current 1 s	(kA)	3	3	3
Rated peak withstand current	(kA)	7	7	7
Length of earthing pin (without insulated handle)	(mm)	530	530	680
Cross-sectional area of earthing cable	(mm ²)	25	25	25

8. Earthing equipment for earthing the cable of a 12-kV fused load-break switch panel:

- Three earthing pins (a) with earth contact and earth cable with terminals
- One insulated handle (b)
(612.891)



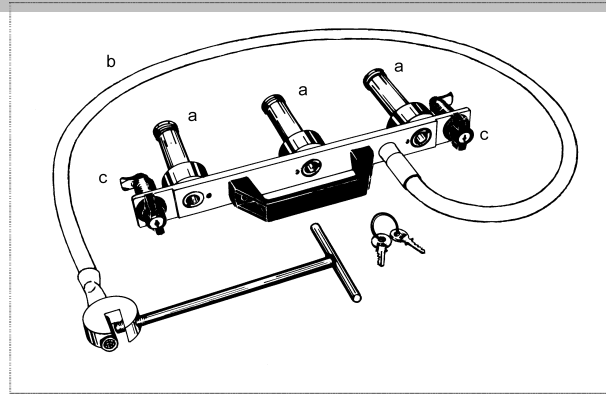
8.

Technical data

Rated voltage (IEC)	(kV)	12
Rated short-time withstand current 1 s	(kA)	3
Rated peak withstand current	(kA)	7
Length of earthing pin (without insulated handle)	(mm)	530
Cross-sectional area of earth cable	(mm ²)	25

9. Three-pole short-circuit proof external back-up earth for application to the 12 - 17.5-kV cable access port of a load-break switch or circuit breaker panel, consisting of:

- A three-phase star point with:
 - Three earthing contacts (a)
 - One earth cable (b)
 - Two built-in interlocks (c) with keys (612.191)



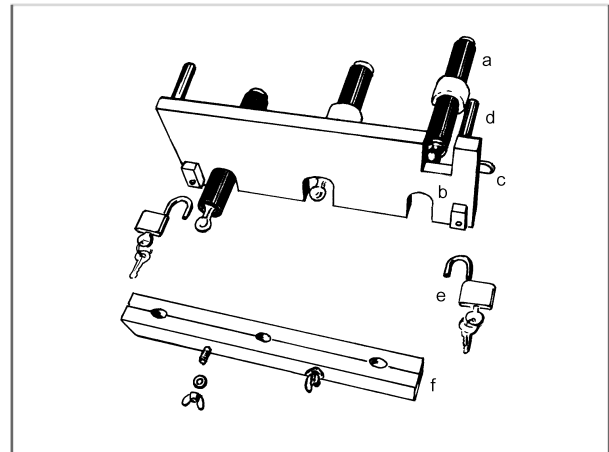
9.

Technical data

Rated voltage (IEC)	(kV)	12	17.5
Rated short-time withstand current 1 s	(kA)	20	20
Rated peak withstand current	(kA)	50	50
Cross-sectional area of earth cable	(mm ²)	70	70

10. Single-pole short-circuit proof external back-up earth for application to the 12 - 17.5-kV cable access port of a load-break switch or circuit breaker panel, consisting of:

- Three earthing pins (a)
- One insulated locking plate (b) with:
 - two hooked latches (c)
 - two guide pins (d)
- Two padlocks (e)
- One cable clamping bar (f) (107.924)

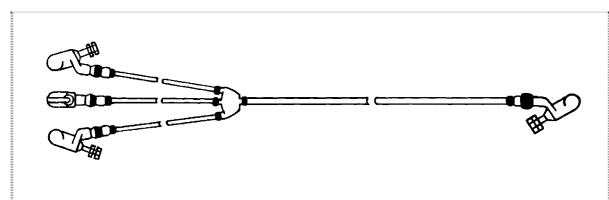


10.

Technical data

Rated voltage (IEC)	(kV)	12	17.5
Rated short-time withstand current 1 s	(kA)	20	20
Rated peak withstand current	(kA)	50	50

- 11.1 Earth cable with ball-head bolt connector for single-pole short-circuit proof external back-up earth. (107.197)



11.1

- 11.2 Mounting rod for earth cables.
(684.420)



11.2

Technical data

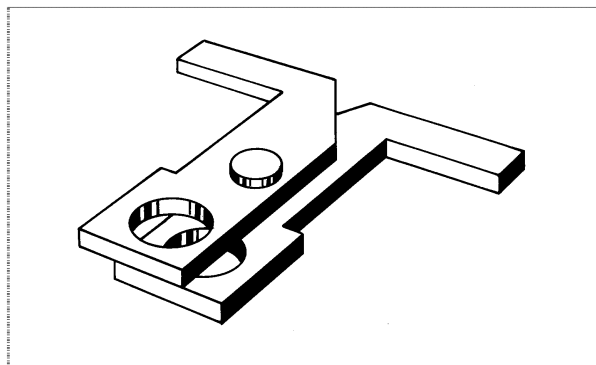
Rated voltage (IEC)	(kV)	12	17.5
Rated short-time withstand current 1 s	(kA)	20	20
Rated peak withstand current	(kA)	50	50
Cross-sectional area of earth cable	(mm ²)	50	50

12. Padlock with warning sign; it is used when locking against switching-off, when a panel is earthed through the load-break switch or circuit breaker.
(569.463)
(107.079)

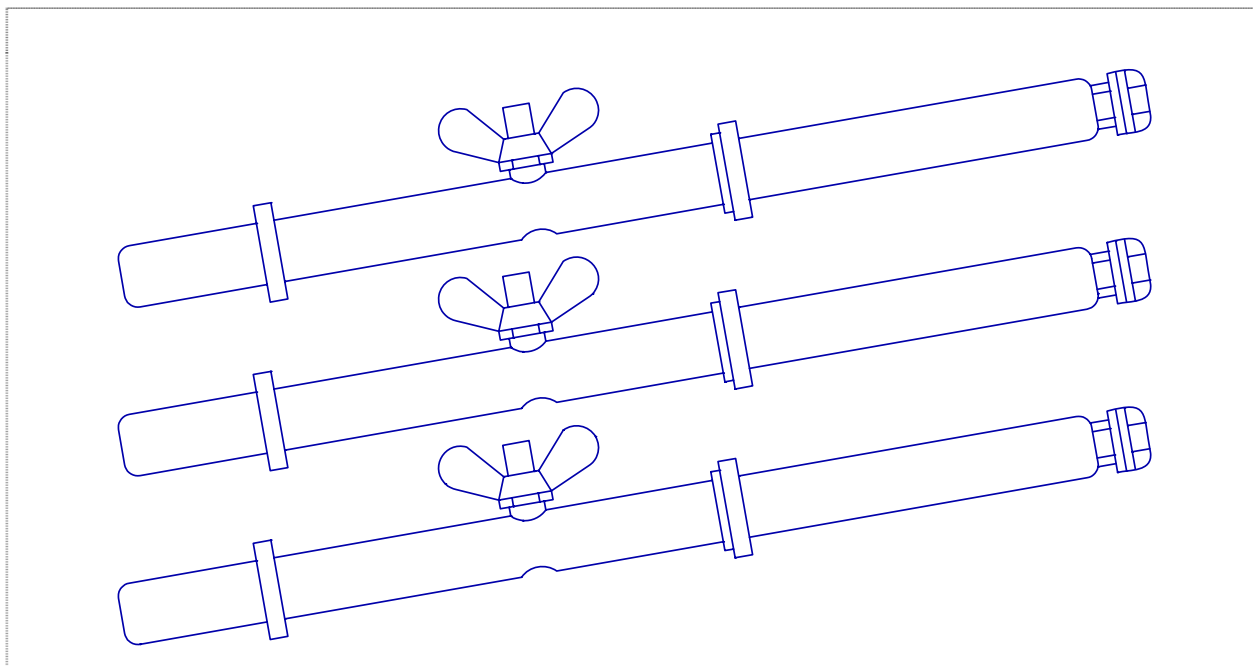


12.

13. Scissors-type interlock for locking a load-break switch or circuit breaker when in intermediate position.
(106.348)



13.



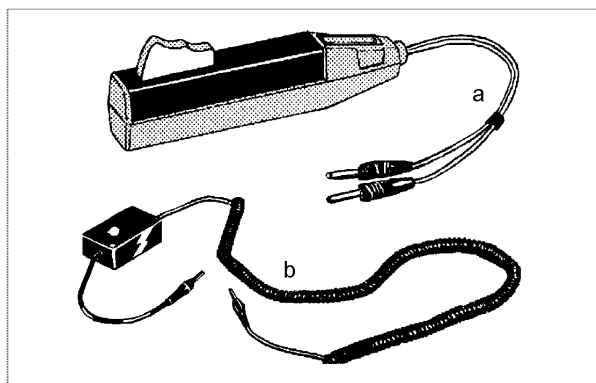
14.

14. Metering and testing pins for 12 - 17.5-kV cable terminal block.

(106.340)

15. Test equipment:

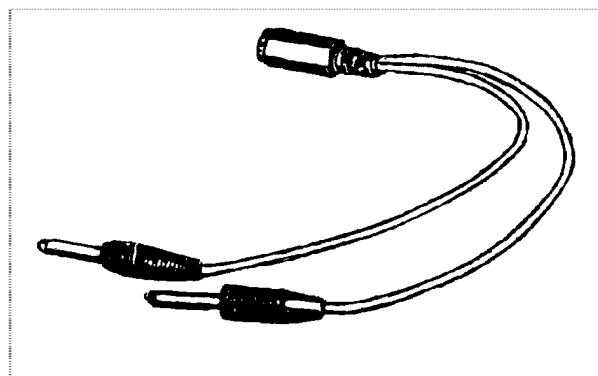
- Voltage indication tester (piezo tester) (a)
(612.441)
- Phase coincidence tester (b)
(612.492)



15.

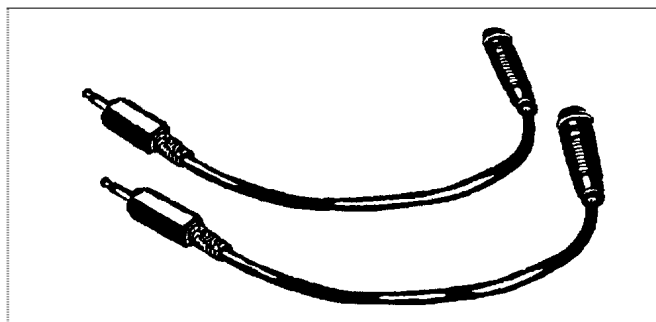
16. Miscellaneous adapter leads for test equipment

16.1 Adapter lead to enable the old voltage indication tester to be used for the new LED voltage indicator.



16.1

- 16.2 Adapter lead to enable the new phase sequence tester to be used for the new LED voltage indicator.



15.2

17. Type UNL single-pole voltage tester:

- measuring probe (a)
- handle (b)

The single-pole voltage tester is made up of two parts:

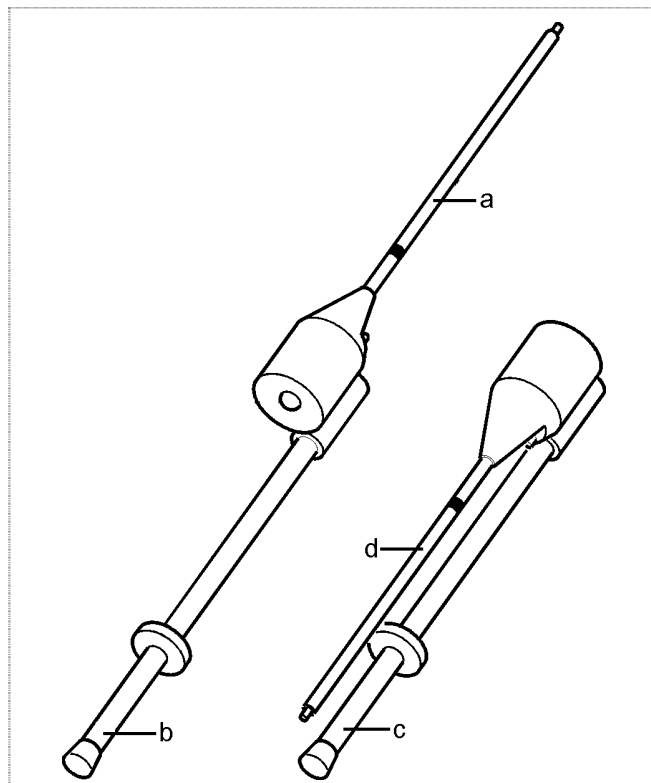
- measuring probe (antenna) with a renewable test point (a)
- handle (b)

Before being used, the measuring probe is screwed onto the handle. When the tester is transported, the measuring probe may also be fitted upside down on the handle.

The measuring probe is fitted with a red ring, which is clearly visible.

An indicator lamp (c) and push button (d) are fitted on the thick end of the measuring probe (which is screwed onto the handle). The indicator lamp lights up when the test point of the measuring probe is live. The push button can be used to test the measuring probe.

The rated voltage of the measuring probe must match the operating voltage of the installation to be tested. The rated voltage is stated on the thick part of the measuring probe.



17.

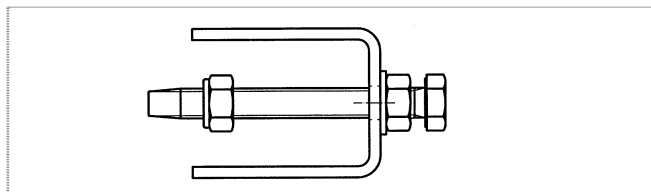
18. Puller for removing the end caps of voltage transformers.

CAUTION

- Before carrying out any measurements, clean and dry the voltage tester properly.
- Do not insert the voltage tester beyond the red ring into live installation parts.
- Hold the voltage tester behind the ring on the handle.

NOTE

Read the instructions for use supplied with the voltage tester.



18.

8. GLOSSARY

8.1 SAFETY AND QUALIFICATION OF PERSONNEL

European standard applicable

Standard applicable: 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**

The following requirements apply to operating personnel:

1. Operating personnel shall 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 WORK OPERATIONS MANAGER (this person must be designated in accordance with EN 50110-1 as the person responsible for *control* of 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 be made between the INSTALLATION MANAGERS.

- The responsibility that 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 agree with national legislation.

- Before operations are begun, while they are being carried out and prior to commissioning of the installation, the WORK 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 must have been instructed (using these operating instructions) concerning the safety requirements, safety rules and operating instructions applicable to operating the installation.

- **Clothing**

Personnel must wear suitable clothing, which fits the body closely.

- **Local rules and regulations**

Of course, local rules and regulations (including operating instructions) must be followed.

8.2 ABNORMAL OPERATING 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.

8.3 EQUIPMENT AND THE AREA AROUND 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 area in which the switchgear is set up.

- **Working area:**

A clearly indicated part of the operating area in which work on the installation can be carried out safely.

- **Switch:**

An apparatus designed to switch electrical currents on and off.

- **Load-break switch:**

A switch capable of safely switching on a short-circuit current and switching off a nominal current.

- **Circuit-breaker:**

A switch capable of switching a short-circuit current on and off safely.

- **Fuse:**

An electrical appliance which 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 (melting) conductor.

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