DISCONNECTORS (ISOLATORS) FOR OUTDOOR USE 12 – 420 kV

Introductions
This English text is to be regarded as a translation of the Swedish guideline edition. The Swedish text and the interpretation thereof shall govern the contract and the legal relations between parties.

These guidelines are mainly based on Swedish Standard SS-EN 62271-102. The guidelines specify alternative in the case of more possibilities and also include additions and elucidations to the standard. The guidelines can be made binding by the Purchaser and will then specify the requirements which together with the applicable standard are valid for the design and testing of manual or motor operated disconnectors and earthing switches for outdoor use and rated voltages 12 - 420 kV. The text about disconnectors is also in applicable parts valid for earthing switches. The requirements for the disconnector shall, when applicable, also be valid for the movable part of a circuit-breaker (where the breaker truck has the function as disconnector) and for the disconnecting function of the disconnecting circuit-breaker (see also TR01-08E “Circuit-Breaker”).
<table>
<thead>
<tr>
<th>Notes</th>
<th>Change notes</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Changed test voltage for 82.5 kV from 325kV to 380kV in section 4 ratings</td>
<td>2010-03-03</td>
</tr>
<tr>
<td>3</td>
<td>New template. Collaboration with Vattenfall removed. Table with creepage</td>
<td>2013-02-25</td>
</tr>
<tr>
<td></td>
<td>distances have been updated, all creepage distances for both ceramic and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>non-ceramic insulators are now identical.</td>
<td></td>
</tr>
</tbody>
</table>
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1 GENERAL

1.1 Applicable standards.
Applicable Swedish Standards are valid. When there is no Swedish Standard, European Standard (EN) and IEC Publication shall apply. The latest edition shall apply.

Where voltage transformers offered do not in every way fulfil the stipulated standards and the additions of the guidelines, deviations shall be specified.

Applicable standards and guidelines:

- **SS 40103 10** Switchgear, controlgear and fuses - Vocabulary.
- **SS-EN 60694** Common specifications for high-voltage switchgear and controlgear standards.
- **SS-EN 62271-102** High-voltage switchgear and controlgear - Part 102: - AC disconnectors and earthing switches.
- **SS-EN 60529** Degrees of protection provided by enclosures (IP code).
- **SS-EN ISO 1461** Hot dip galvanized coatings on fabricated iron and steel articles.
- **SS 3192** Hot dip galvanized threaded pieces of steel.
- **SS 14 23 03** Stainless steel – SS steel 2303.
- **SS 4210167** Design of outdoor substations - Wind and ice loads.
- **SS-IEC 60168** Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1000 V.
- **SS-IEC 273** Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000 V.
- **SS-EN 60437** Radio interference test on H.V. insulators.
- **SS-EN 60507** Artificial pollution tests on H.V. insulators to be used on a.c. systems.
2 SERVICE CONDITIONS

2.1 Ambient temperature.
The lowest ambient temperature shall be -50° C.

2.2 Installation.
At installation in dirty and/or salty environment reinforced requirements for corrosion protection, wash ability and creep distance of insulators will be specified. See also item 5.2 and 5.4.

2.3 Ice thickness.
Ice thickness class 20 mm shall apply.

2.4 Wind pressure.
For normal applications the wind pressure 700 Pa against a plane surface shall apply. For equipment in exposed locations, e.g. coastal or mountain areas, a higher wind pressure might be necessary. Dimensioning shall then be done with a wind pressure in accordance with SS 42101 67.

3 DEFINITIONS

Definitions are specified in applicable standards.

Rated voltage
The rated voltage indicates the upper limit of the highest voltage of systems for which the disconnector/earthing switch is intended. (same voltage as the highest voltage for equipment)

Rated value
A quantity value assigned, generally by the manufacturer, for a specified operating condition of a component, device or equipment. (IEV 151-04-03)
Nominal voltage of a system
A suitable approximate value of voltage used to designate or identify a system.

(IEV 601-01-21)

Highest voltage of equipment
The highest r.m.s phase-to-phase voltage for which the equipment is designed in respect of its insulation as well as other characteristics which relate to this voltage in the relevant equipment standards. (IEV 604-03-01).

4 RATING

4.1 Rated insulation level
The following values of insulation level should be used:

<table>
<thead>
<tr>
<th>Nominal voltage</th>
<th>Rated voltage kV (rms)</th>
<th>Rated lightning impulse withstand voltage kV (peak)</th>
<th>Rated 1 min power frequency withstand voltage kV (r.m.s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To earth and between poles</td>
<td>Across the insulating distance</td>
<td>To earth and between poles</td>
</tr>
<tr>
<td>10</td>
<td>12</td>
<td>75</td>
<td>85</td>
</tr>
<tr>
<td>20</td>
<td>24</td>
<td>125</td>
<td>145</td>
</tr>
<tr>
<td>30</td>
<td>36</td>
<td>170</td>
<td>195</td>
</tr>
<tr>
<td>45</td>
<td>52</td>
<td>250</td>
<td>290</td>
</tr>
<tr>
<td>70</td>
<td>82.5</td>
<td>380</td>
<td>440</td>
</tr>
<tr>
<td>132</td>
<td>145</td>
<td>650</td>
<td>750</td>
</tr>
<tr>
<td>150</td>
<td>170</td>
<td>650</td>
<td>750</td>
</tr>
<tr>
<td>220</td>
<td>245</td>
<td>950</td>
<td>1050</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nominal Voltage Voltage</th>
<th>Rated withstand voltage phase to earth kV (peak)</th>
<th>Rated withstand voltage across isolating distance kV (peak)</th>
<th>Rated withstand voltage phase to earth kV (peak)</th>
<th>Rated withstand voltage across isolating distance kV (peak)</th>
</tr>
</thead>
<tbody>
<tr>
<td>380</td>
<td>420</td>
<td>1425</td>
<td>1425 (+240)</td>
<td>1050</td>
</tr>
</tbody>
</table>
Values in brackets are the peak values of power frequency voltage applied to the opposite terminal. (combined voltage).

4.2 Rated frequency.
The rated frequency shall be 50 Hz.

4.3 Rated current
Disconnectors with rated voltage 245 kV and 420 kV shall have a rated current of 3150 A if not other is specified in inquiry.

4.4 Mechanical strain.

4.4.1 Mechanical reliability
The disconnector shall operate correctly for the actions of the stresses described below in the most unfavourable direction.

a. Ice load in accordance with item 2.3.

b. Wind pressure in accordance with item 2.4.

c. Tensile forces in the connections in accordance with SS-EN 62271-102.

d. Short circuit forces calculated for the stipulated impulse current with the minimum phase separation permissible for the disconnector, and with a dynamic stress from connected conductors of at least 3000 N for each terminal.

Disconnector with a rated voltage ≥ 82.5 kV shall be equipped with insulators of a designation of minimum C8.

4.4.2 Mechanical endurance of disconnector
Earthing switches shall be of endurance class M0, if not other has been specified in the inquiry.

There are three endurance classes for disconnectors:

<table>
<thead>
<tr>
<th>Class</th>
<th>Installation</th>
<th>Operating cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>M0</td>
<td>Normal</td>
<td>1000</td>
</tr>
<tr>
<td>M1</td>
<td>In combination with a circuit breaker of same class</td>
<td>2000</td>
</tr>
<tr>
<td>M2</td>
<td>In combination with a circuit breaker of same class</td>
<td>10 000</td>
</tr>
</tbody>
</table>

Silver coating on contacts shall remain after mechanical endurance test.
4.4.3 Electrical endurance of earthing switch
Earthing switches shall be of endurance class E0, if not other has been specified in the inquiry.

There are three endurance classes for earthing switches:

<table>
<thead>
<tr>
<th>Class</th>
<th>Type</th>
<th>Closing against short-circuit</th>
</tr>
</thead>
<tbody>
<tr>
<td>E0</td>
<td>No closing capability</td>
<td>0</td>
</tr>
<tr>
<td>E1</td>
<td>Closing capability</td>
<td>2</td>
</tr>
<tr>
<td>E2</td>
<td>Closing capability</td>
<td>5</td>
</tr>
</tbody>
</table>

4.5 Inductive and capacitive breaking capacity
In the enquiry it shall be specified if the disconnector shall be used for sections. SS-EN 62271-102 is applicable.

If earthing switches for voltage \( \geq 52 \) kV shall be used for earthing the end of parallel lines, the class shall be specified in the inquiry. There are two classes, class A and B, where class A is used for relatively short lines or where the parallelism is short and class B is used for long lines and where the parallelism is long.

SS-EN 62271-102 is applicable.

4.6 Performance to break commuting currents
In the enquiry it shall be specified if the disconnector shall switch commuting current. SS-EN 62271-102 is applicable.

5 DESIGN OF DISCONNECTOR.

5.1 General
Type of disconnector shall be specified in the inquiry. Disconnectors for rated voltages above 170 kV shall have fixed terminals. In the delivery shall be included all parts necessary for erection of the fully operational disconnector on the structures provided by the purchaser, fulfilling the ratings for a new apparatus in accordance to the instructions for condition control. Products necessary for the erection shall be included in the delivery, such as lubricants, contact grease.

Type of operation mode, manual or motor, shall be specified by the purchaser. The supplier shall specify all possible locations for the operating mechanism. In addition it shall be specified whether it is optional to which side disconnector with lateral movement can be opened. Free space needed around the disconnector and operating mech-
anism for locking, manual operation and service shall be clearly marked at the dimension drawing.

Disconnectors shall be designed so as to prevent the ingress of water which can cause damage or jamming owing to freezing.

### 5.2 Corrosion protection

External parts shall be made of corrosion-resistant material. Steel shall be corrosion free or protected by hot-dip galvanizing (SS-EN ISO 1461). Worked surfaces may be protected in an other permanent way.

When disconnectors are placed in corrosive atmosphere a reinforced corrosion protection may be applied. This will then be specified in the inquiry.

### 5.3 Bearing

Bearings shall preferably be so designed that lubrication is not necessary. Where such bearing-designs cannot be applied, the bearings shall be designed for greasing and provided with hydraulic grease nipples. Grease nipples located on earthed parts should be accessible when the disconnector is in service.

### 5.4 Insulators

Insulators can be of porcelain or composit type. Insulators shall be in accordance with IEC 60815 and other applicable standards.

In polluted atmosphere insulators shall have increased creep distance. Increased creep distance if required shall be specified in the inquiry. The normal and extended creepage distances are specified in Table § 5.4.1.

Disconnectors can be washable or non washable. Washability shall be specified in the inquiry. If the disconnector is washable with limitation the supplier shall specify the limitation in the tender.

#### 5.4.1 Creepage distance

The requirements for insulator creepage distances are summarised in the table below:

<table>
<thead>
<tr>
<th>Highest voltage for equipment, $U_n$ [kV]</th>
<th>Ceramic and composite</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Polluted atmosphere (class d)</td>
</tr>
<tr>
<td>12</td>
<td>300</td>
</tr>
</tbody>
</table>
5.5 Current carrying parts
The current carrying parts shall be designed in a way that condition analysis by ther-
movision is possible.

Enclosed moveable connections and similar current carrying joints shall be avoided. Maintenance lubrication shall be possible without dismantling.

All contacts at disconnector with voltage over 170 kV shall be in open air and main-
tainence free for 25 years. Contacts demanding silver plate shall have massive silver content.

5.6 H.V. Terminals
The H.V. terminal can be either a plate or a bolt. Additional part added to the H.V. terminal to fulfill the required dimensions is not allowed. Dimensions of the terminals are shown in Appendix 1.

Terminals of copper or copper alloy shall be tin-plated with a layer of minimum 50 µm or alternatively silver-plated with a layer of minimum 20 µm. A copper alloy sensitive to stress corrosion shall not be used.

Terminals made of aluminium or aluminium alloy shall not be surface treated. An aluminium alloy sensitive to stress corrosion, layer corrosion or intercrystalline corro-
sion shall not be used. Terminal plate of aluminium or aluminium alloy shall have a hardness of min HB 75. Terminal plates are selected on the basis of rated current for the disconnector: as follows:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>600</td>
<td>380</td>
</tr>
<tr>
<td>36</td>
<td>900</td>
<td>570</td>
</tr>
<tr>
<td>52</td>
<td>1300</td>
<td>830</td>
</tr>
<tr>
<td>82.5</td>
<td>2060</td>
<td>1320</td>
</tr>
<tr>
<td>145</td>
<td>3620</td>
<td>2320</td>
</tr>
<tr>
<td>170</td>
<td>4250</td>
<td>2720</td>
</tr>
<tr>
<td>245</td>
<td>6120</td>
<td>3920</td>
</tr>
<tr>
<td>420</td>
<td>10500</td>
<td>6720</td>
</tr>
</tbody>
</table>

1 According to IEC 60815-1.
Size | Rated current of disconnector (A) |
--- | ---|
2 – 40 *) | 400 |
4 - 75 | 630 - 1250 |
9 - 125 | 1600 - 3150 |
12 – 165 **) | 4000 |

*) Only for disconnectors with rated voltage ≤ 52 kV.

**) Terminal plate 9 – 125 can be chosen if the manufacturer by temperature rise test can prove that the permitted rise of temperature will not be exceeded at loads up to 4000 A.

Terminal bolts are selected on the basis of rated current for the disconnector as follows:

<table>
<thead>
<tr>
<th>Size</th>
<th>Rated current of disconnector (A)</th>
<th>Bolt of aluminium</th>
<th>Bolt of copper</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>800 - 1250</td>
<td>800 - 1600</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>1600</td>
<td>2000 - 2500</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>2000 - 2500</td>
<td>3150 - 4000</td>
<td></td>
</tr>
</tbody>
</table>

5.7 Arrangement

Unless otherwise specified the following pole distance shall be used:

<table>
<thead>
<tr>
<th>Rated voltage kV</th>
<th>Distance mm c/c Pantographs in diagonal</th>
<th>Distance mm c/c Pantographs in parallel</th>
<th>Distance mm c/c Two pillar</th>
</tr>
</thead>
<tbody>
<tr>
<td>82.5</td>
<td>1500 x √2</td>
<td>1500</td>
<td>1500</td>
</tr>
<tr>
<td>145 – 170</td>
<td>2500 x √2</td>
<td>2500</td>
<td>2500</td>
</tr>
<tr>
<td>245</td>
<td>3500 x √2</td>
<td>3500</td>
<td>4000</td>
</tr>
<tr>
<td>420</td>
<td>5500 x √2</td>
<td>5500</td>
<td>6500</td>
</tr>
</tbody>
</table>

5.8 Special requirements for earthing switches

When particularly specified, disconnectors shall be provided with earthing switches. These shall normally be manually operated. Earthing switches in combination with disconnecting circuit-breaker shall be provided with motor operating mechanism.

The main circuit of earthing switches shall be provided along their entire length with warning markings consisting of alternate yellow and black bands about 200 mm thick. Markings under clamps, which can slide, may be removed.
5.8.1 Installation
Earthing switches shall be possible to erect in one of the following alternatives:

> At the disconnector or at other apparatus.
> At existing post insulator. It is preferred that the installation can be performed without dismantling of the existing equipment.
> At insulator belonging to earthing switch.

5.8.2 Equipment for indication and interlocking
When particularly specified, earthing switches shall be provided with

> Auxiliary contacts.
> Interlocking devices.
> Mechanical interlocks towards disconnector.

If operation of the disconnector when its earthing switch is closed causes damage to the disconnector, the motor operation of the disconnector shall be blocked by electrical interlocks controlled by the earthing switch.

5.9 Earthing
The earthing terminal shall be designed for cable lugs with two holes.

Flexible earthing connections shall be arranged to exclude corrosion, wear damage or burning due to contact to other material.

5.10 Nameplates
Nameplates shall be on Swedish.

Disconnectors consisting of independent or separate delivered poles or with removable operating mechanism shall be equipped with nameplates marking unique serial numbers for every pole and operating mechanism. Current carrying parts shall be durable marked to be related to nameplate of respective pole.
6  GENERAL REQUIREMENTS FOR DESIGN OF MANUAL OPERATED MECHANISMS, MOTOR OPERATED MECHANISMS AND LINKAGE SYSTEM.

6.1  Mechanical design

6.1.1  Operation
It shall be possible to operate single-pole or multi-pole disconnectors with the operating mechanism.

The motor operated mechanism shall be provided with a manual operating device. The device for manual operation (handle, hand crank etc.) shall be on suitable height above ground, roughly 1.2 m.

The operating mechanism shall be provided with a device for choice between manual or motor operation. This device shall be lockable in the required position. Regarding locking device, see point 9.

Motor-driven operating mechanisms, linkage system and current carrying parts shall mechanically be capable of withstanding the operating forces necessary to safely complete an operation with a disconnector stressed with forces in accordance with clause 4.4.1. The torque developed by the operating mechanism shall either be limited to this level, or else tests shall show that both disconnector and linkage system can withstand the maximum torque of the operating mechanism. Safety margins and tolerances of the torque-limiting device shall be taken into consideration.

Absent function from end-position contacts may not result in damage to the disconnector or end-stop.

Current curves for opening and closing a new disconnector shall be provided.

6.1.2  Device for blocking and interlocking
Of safety reasons the operating mechanism and disconnector shall be possible to block from leaving the closed or open position. With blocking means labeling and locking of a direct-acting mechanical and electrical blocking device. Regards blocking see clause 9.
When specified in the order, the operating mechanism shall be provided with an inter-
lock device, see clause 8.

### 6.1.3 Indication
The open and closed positions of the disconnector shall be indicated mechanically on
the operating mechanism, linkage system or pole.

### 6.1.4 Degrees of protection
The operating mechanism shall be enclosed in a case with at least protective class
IP 54 in accordance to SS-EN 60529. When a washable design is required the protec-
tive class shall be at least IP 55.

An enclosure for operating mechanism, auxiliary contacts or interlock device shall be
ventilated and the ventilation openings shall be covered with fine-mesh wire netting or
similar.

### 6.2 Electrical design

#### 6.2.1 General
Control and motor circuits shall be designed for DC, 110 V or 220 V.
Heating circuits shall be designed for 230 V, 50 Hz.

The DC equipment shall be designed for 2-pole control of control and motor circuits.

Auxiliary contacts shall be easily accessible for connection, inspection and adjustment.

Components shall be provided with special markings for identification on electrical
circuit diagrams.

Terminals shall be clearly and durable marked.

Connecting cables inside the operating mechanism shall be clearly and durably
marked at both ends.

Contact parts and screws shall be corrosion-resistant.

#### 6.2.2 Auxiliary equipment for manual operating mechanisms
On request manual operating mechanism for disconnector or earthing switch for rated
voltage \( \leq 82.5 \text{ kV} \) shall be provided or afterwards be possible to complete with 6 sin-
gle-pole auxiliary contacts. Manual operating mechanism for disconnector or earthing
switch > 82.5 kV shall be provided with 6 single-pole auxiliary contacts. The auxiliary
contacts shall have the functions defined below:
For indication of the disconnector or earthing switch state:

> 1 closed contact for open disconnector.
> 1 closed contact for closed disconnector.

For interlock, etc:

> 1 closed contact for open disconnector.
> 1 closed contact for closed disconnector.
> 1 open contact for open disconnector.
> 1 open contact for closed disconnector.

The changeover of auxiliary contacts from one position to the other shall occur, with a margin, between the point where the end-position fixation comes into play and the end position.

Breaking and making current for auxiliary contacts shall in accordance with SS-EN 60694 be at least 2 A at 220 V d.c. with a current-time constant of at least 20 ms.

Contact-movement diagrams for disconnecter and auxiliary contacts shall be given. From the diagram the safety margins in operational force of the auxiliary contacts shall be evident.

6.2.3 Interlock device

On request, the operating mechanism shall be provided and afterwards be possible to complete with an interlock device designed to interlock the disconnector in both open and closed position. If the disconnector is supplied with both auxiliary contacts in accordance to clause 6.2.2 and an interlock device in accordance to clause 6.2.3, these can preferable be placed in the same casing.

Interlock devices shall without sustaining damage be able to withstand the stresses arising when attempting to operate the disconnecter with forces in accordance with clause 6.1.1.
Interlock-coil with its mechanism shall have service reliability always with correct function. Safety margins in operational force and path of travel shall be specified.

The interlock shall be removed when the coil of the interlock device is connected, e.g. the disconnector shall be possible to operate by the manual operating mechanism. When the coil of the interlock device is disconnected and the disconnector is in a position between end-positions, the interlock shall not be activated before the disconnector has reached an end-position.

It shall be possible to cancel the interlock manually. Device for canceling shall only be possible to operate after removal of a protective hood by tool or that the device is locked without hindering the electrical function.

The interlock device shall be fitted with an auxiliary contact, made for closing optionally in interlocked or in not interlocked position. The contact should be mechanically operated (forced motion) by the interlock coil.

The interlock device shall correctly operate between 85 % and 110 % of rated voltage. The device shall be dimensioned for constant connection and manage this at 110 % of the rated voltage. The power consumption shall be given by the manufacturer.

6.2.4 Equipment for motor operated mechanisms

6.2.4.1 Function
The electrical connections shall be so arranged, that started operations are completed irrespective of the duration of the operating impulse. Operation shall start after an impulse ≥ 50 ms.

A no-voltage relay shall break the self-holding action of the operating circuit if the motor voltage is lost.

6.2.4.2 Motor
The motor may be dimensioned for intermittent operation.

Motors shall be protected against switching over-voltages caused by operating mechanism auxiliaries. The voltage amplitude must not exceed 50 % of the r.m.s. value of the insulation level.

6.2.4.3 Motor-protective circuit-breaker
Motor-protective circuit-breakers shall have two-pole contact function and manual make and break ought to be possible.
When manual breaking is not possible, a two-pole switch shall be used. This shall have the necessary making and breaking capacities for the fully braked motor.

The manufacturer shall specify the minimum useful and the maximum allowed fuse size for the feeder.

**6.2.4.4 Fuse**
Short-circuit protection in the operating mechanism is not required.

**6.2.4.5 End-position contacts**
The end-position function shall bring about two-pole switching in and out the motor.

Data for the end-position contacts shall be chosen taking into consideration whether the motor is controlled directly or via contactors. For direct control, the end-position contact shall be capable of making and breaking a fully braked motor.

Contact-movement diagrams and safety margins in operational force and path of travel shall be presented.

**6.2.4.6 Contactor**
Contactors shall be dimensioned for switching in and out a fully braked motor.

**6.2.4.7 Auxiliary contacts**
Operating mechanisms shall be provided with 8 single-pole auxiliary contacts with the functions specified below. The changeover of auxiliary contacts from one position to the other shall occur, with a margin, between the point where the end-position fixation comes into play and the end position.

For indication of the disconnector state:

- 2 closed contacts for open disconnector, open for intermediate and closed position.
- 2 closed contacts for closed disconnector, open for intermediate and open position

For interlocking, indications etc.:

- 2 open contacts for open disconnector, closed for intermediate and closed position.
- 2 open contacts for closed disconnector, closed for intermediate and open position.

Breaking and making current for auxiliary contacts shall in accordance with SS-EN 60694 be at least 2 A at 220 V d.c. with a current-time constant of at least 20 ms.

Contact-movement diagrams and safety margins in operational path of travel shall be provided.
6.2.4.8 Interlock coils

Coils for interlock devices in accordance with clause 8.

If interlock coils, with regard to the function of the operating mechanism, require auxiliary contacts, these shall have data in accordance with clause 6.2.4.7.

6.2.4.9 No-voltage relay

Instantaneous non-measuring relay with trip setting at max. 65% of rated voltage for constantly connection and max. ambient temperature.

6.2.4.10 Switch for operating voltage

The switch shall have the positions TILL (ON) and FRÅN (OFF) and have contacts for two-pole breaking of control and holding circuits.

The switch may be combined with the selection device for selection between manual and motor operation in accordance with clause 6.1.1 and/or with the device for locking the disconnector in accordance with clause 6.1.2.

6.2.4.11 Auxiliary contact for locking device etc.

See point 9. Contact data, see clause 6.2.4.7.

6.2.4.12 Heating equipment

Operating mechanisms shall be provided with constant basic heating to achieve ventilation.

If additional heating is needed for guaranteed function within the specified temperature range, this shall be controlled by a thermostat. A low heat power rating is considered an advantage. Additional heating shall be supervised by a device having contact function for signal.

There shall be a switch provided with contacts for two-pole breaking of the heating circuits.

Any heaters shall be touch-protected and easily exchangeable.

6.2.4.13 Terminal blocks

The number of terminal blocks shall be chosen so that at least all external control circuits and contacts in accordance with 6.2.2, 6.2.3 and 6.2.4 can be connected to terminal blocks. Incoming wires shall be connected to one side of the row of terminal blocks and internal wires to the other. A maximum of two wires shall be connected to each block terminal.

Terminal blocks shall be easily accessible. The blocks shall be provided with provision for disconnection, but this shall only be possible with tools. The terminal blocks shall be designed for the connection of wires with area of 1-10 mm² and be provided with terminals suitable for connection with test plugs with Ø 4 mm.
Terminal blocks for motor feeding shall be designed for the connection of wires with area up to 16 mm$^2$. The terminal blocks shall be connected in series with 10 mm$^2$ terminal blocks if they are not disconnectable.

Terminal blocks for internal circuits may be chosen by the manufacturer.

7 LABELING

7.1 Indications
Position indication in accordance to point 6.1.3 shall have the following wording and colours:

- Symbol for Open position (O) in white on green background.
- Symbol for Closed position (I) in black on yellow background.

7.2 Device for selection of operation mode and blocking
The device for selection of operation mode in the motor operating mechanism and the position of locking in open or closed positions shall be labeled with the following wording:

<table>
<thead>
<tr>
<th>Label</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HANDMANÖVER</td>
<td>(i.e. locking position manual operation)</td>
</tr>
<tr>
<td>MOTORMANÖVER</td>
<td>(i.e. locking position motor operation)</td>
</tr>
<tr>
<td>ÖPPEN</td>
<td>(i.e. locking position open)</td>
</tr>
<tr>
<td>SLUTEN</td>
<td>(i.e. locking position closed)</td>
</tr>
</tbody>
</table>

7.3 Device for manual cancellation of interlocks
The device for manual cancellation of interlocks shall be labeled in accordance with clause 7.7.

7.4 Motor-protective circuit-breaker
The motor-protective circuit-breaker in accordance with clause 6.2.4.3 shall be provided with the symbols O and I and a label with the word: MOTOR.

7.5 Switch for operating circuits
The switch for operating voltage in accordance with clause 6.2.4.10 shall be provided with the symbols O and I and a label with the word: MANÖVERSPÄNNING.
7.6  Switch for heating circuits
The switch for heating in accordance with clause 6.2.4.12 shall be provided with the symbols O and I and a label with the word: VÄRME.

7.7  Interlock device.
Where an interlock device in accordance with clause 8 is provided, it shall be supplied with the following labels:

One label adjacent to the device for manual cancellation of interlocks with the wording: MANUELL UPPHÄVNING AV FÖRREGLING (i.e. manual cancellation of interlock).

One label for the interlocked position with the word: FÖRREGLING (i.e. interlock).

7.8  Manual operating device.
Labels for indication of operating direction shall have symbols showing the direction.

8  INTERLOCKING OF MOTOR-OPERATED MECHANISM, DESIGN AND FUNCTION

On request the operating mechanism shall be provided with an interlock mechanism.

The interlock mechanisms shall without sustaining damage be able to withstand the stresses arising when attempting to operate the disconnector with forces in accordance with point 6.1.1. The interlock mechanism must not block due to external forces from wind, ice, short-circuit, or any influence other than from the operating equipment.

Safety margins in operational force and path of travel shall be specified.

The interlock mechanism shall be electrically controlled and switched in only during the operating cycle. When under voltage the interlock shall be cancelled, and in the dead state the interlock shall be engaged.

An electrical or manual operation started shall always be completed, even if the interlock mechanism looses its voltage during the operating cycle.

It shall be possible to cancel the interlock manually, although only with a special device which shall be lockable in the position FÖRREGLING (interlock), without hindering
the electrical function. This locking requirement is fulfilled if the device is placed under a separate lockable cover.

The interlock device shall automatically return to the position FÖRREGLING. The device or its cover shall be labeled with words in accordance with point 7.7.

9 BLOCKING AND LOCKING

9.1 Blocking
It shall be possible to block the disconnector. With blocking means that all operating (electrically and manually) of and external influence to the disconnector shall be hindered to bring the disconnector out of open or closed positions and that:

- A separate padlock can be used to lock the position.
- A separate label can be attached to the padlock.

The primary obstruction shall work as a direct mechanical obstruction. The safety of the obstruction may not be influenced by the dimension of the padlock. The motor and operation circuits shall be opened in both poles.

Locking shall be carried out with padlocks in accordance with appendix 2. The locking device shall be easily accessible and placed or protected for easy handling during the winter.

The locking position shall be labeled in accordance with point 7.2.

9.2 Switch for operating circuits
The operating mechanism shall be provided with a lockable switch for selecting manual or motor operation. In locked position only the selected function shall be possible. When selecting the manual operating position, motor and operating circuits shall be automatically opened in both poles.

9.3 Interlocking device
Locking of interlock device, see clause 6.1.2
10 TESTS

10.1 Type tests

10.1.1 General
The disconnector, linkage system and operating mechanism shall be tested connected
together as a unit. Type tests shall have been performed on disconnector, linkage sys-
tem and operating mechanism of the same design as those included in the delivery.

10.1.2 Scope of tests
Besides compulsory tests in accordance with SS-EN 62271-102 the following tests shall
be done:

> Operation under severe ice conditions. (20 mm).
> Operation at minimum and maximum ambient temperature.
> Verification of the proper function of the position indicating device.
> Prove the short-circuit making performance of earthing switches type E1 and E2
(if applicable).
> Bus-transfer current switching test on disconnector (if applicable).
> Induced current switching test (on earthing switches used at parallel lines, if ap-
licable).

10.1.2.1 Temperature-rise tests of the main circuit.
In order to provide the best possible base for condition analysis with a thermo-vision
camera, the temperature rise should be specified for load currents corresponding to
30, 60 and 100 % of the rated current. The measuring points shall be selected and
performed regards thermo-graphing. Tolerances in temperature rise with respect to
normal ageing should be provided. Values for 30 and 60 % of rated current may be
calculated.

10.1.2.2 Measurement of the resistance of the main circuit.
Partial resistances and the distribution between parallel current paths shall be meas-
ured.

10.1.2.3 Operation under severe ice conditions.
Testing with 20 mm ice layer is required. During the tests the motor current shall be
registered.
11  DOCUMENTATION

11.1  General
Final instructions, dimension drawings and electrical circuit and schematic diagrams shall be written in Swedish.

11.2  Documentation with tender
With the tender the following documents shall be provided:

> List of data, dimension drawings, electrical circuit and schematic diagrams, instructions for erection, operation and maintenance, type test certificates and also other documents needed for the technical evaluation.

> Bases for evaluation of the need and costs for maintenance, such as:
  
  • The interval for condition control and other measures of maintenance and the time necessary for these works.
  
  • Necessary spares, special tools and accessories and the costs for these.

> Environmental information as below (see also TR 13-01):
  
  • The interval for condition control and other measures of maintenance and the time necessary for these works.
  
  • Information about the main content of the equipment (type of material in percentage of weight) Information about the content of dangerous substances (for example heavy metals, carcinogenic compounds and compounds hard to biodegrade, xenobiotic substances).
  
  • Handling and treating of the equipment when it has served its time.

11.3  Documentation together with apparatus delivery
In connection with the apparatus delivery the following documents shall be delivered electronically and in one paper copy, if not others have been agreed:

A list (disconnector chart) including:

> Purchasing and order number.
> Manufacturer.
> Type.
> Serial number.
> Rated data.
Type test certificates.

Verification (title and number) of the following documents which shall be delivered together with the list:

- Assembly drawings and drawing lists.
- Instructions for transport, storing, erection, service, testing, condition control and adjustment.
- Lubrication chart.
- List of lubrication and contact grease.
- List of other chemical products for erection and maintenance.
- List of products and protective information for all listed chemical products.
- List of special tools and accessories for erection and maintenance.
- List of equipment for testing and condition control.
- List of spares.
- List of material for repair.
- 9 copies of final dimension drawings.
- 9 copies of final electrical circuit and schematic diagrams.
- Routine test certificates.
- Filled in Component data list according to Appendix 5.

To the actual delivery exactly defined bases for the purchaser's maintenance work shall be delivered. The technical documentation shall make it possible to organize own spare and service organisation. The documentation shall also be possible to use for education of organizers and workmen in store and for maintenance. The documentation shall include instructions for condition control and make valuating, preparing and realizing of necessary maintenance work possible, taking into account the purchaser's own aim and judging of the risk. In the list (disconnector chart) assembly drawings or bases valid for actual disconnector shall be specified. Details and valid bases for a specified disconnector or series of disconnectors of the same type shall be possible to identify through the list (disconnector chart). This means that valid edition of documents shall be clearly marked in the list.

It shall be possible to identify standard mechanical elements for purchase in Swedish commercial outlets. See also SS-EN 60694.
At the first delivery all documents specified in the list (disconnector chart) and possible to copy, shall be delivered put together in one file as base for the purchaser’s maintenance handbook. For succeeding deliveries changed drawings and instructions possible to copy shall be delivered.

11.4 Documentation and spares after delivery
The manufacturer shall at request provide the purchaser with necessary service bulletins and during at least ten years after delivery with for the maintenance necessary spares. Improvements in design, or instructions which can be applied to the equipment as supplied, shall be notified after delivery, preferably in the form of service bulletins. See also SS-EN 60694.

11.5 Documentation and spares after delivery
The manufacturer shall at request provide the purchaser with necessary service bulletins and during at least ten years after delivery with for the maintenance necessary spares. Improvements in design, or instructions which can be applied to the equipment as supplied, shall be notified after delivery, preferably in the form of service bulletins. See also SS-EN 60694.
12 Appendix

12.1 Appendix 1  Terminal Plate och Bolt, dimensions.
**Bolt**  
Length 125 mm : Diameter: 30, 40, 60 mm

<table>
<thead>
<tr>
<th>Plate</th>
<th>Figur</th>
<th>Measure (mm):</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 - 75</td>
<td>1</td>
<td>2-hål</td>
<td>75</td>
<td>17,5</td>
<td>40</td>
<td>14</td>
<td>10</td>
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<tr>
<td>4 - 75</td>
<td>2</td>
<td>4-hål</td>
<td>75</td>
<td>17,5</td>
<td>40</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>9 - 125</td>
<td>3</td>
<td>9-hål</td>
<td>125</td>
<td>22,5</td>
<td>40</td>
<td>14</td>
<td>35</td>
</tr>
<tr>
<td>12 - 165</td>
<td>4</td>
<td>12-hål</td>
<td>125</td>
<td>22,5</td>
<td>40</td>
<td>14</td>
<td>35</td>
</tr>
</tbody>
</table>
12.2 Appendix 2  Padlock
12.3 Appendix 3  Design and guarantee data

Mode:
- Pantograph in diagonal erection.
- Pantograph in parallel erection.
- Centre-brake disconnector.
- Three-pillar type.

Earthing switches:
- Built on: 0, 1 or 2.
- Free erected earthing switches: Yes or No.
- Interlock device.
- Mechanical interlock towards disconnector.

Operating mechanisms
- Per 3 poles: 1 or 3 S.

Type of operating mechanism:
- Motor operating mechanism.
- Manual operating mechanism with 6 auxiliary contacts.
- Manual operating mechanism without auxiliary contacts.

Counter contact for pantograph:
- Material of busbar tube: Al (or Cu).
- Outer diameter of tube: 100, 150 or 250 mm.

Service condition:
- Air pollution: normal or salt or industry.
- Corrosion protection: normal or increased (requirement shall be specified).
> Washability: washable or not washable.
> Creep distance: normal (28 mm/kV) or increased (44 mm/kV).
> Protective class: IP54 or IP55.

Rated voltage: 12, 24, 36, 52, 82.5, 145, 170, 245, 420 kV

Insulation level: Values in clause 4.1.
> 1 min., 50Hz to earth, between poles and across open pole.
> Lightning impulse to earth, between poles and across open pole.
> Switching impulse to earth and across open pole.

Rated frequency: 50 Hz.

Rated current: 630, 800, 1250, 1600, 2000, 2500, 3150, 4000 A.
Rated short time current: 12.5, 16, 20, 25, 31.5, 40, 50 kA.
Rated peak withstand current: 32, 40, 50, 63, 80, 100, 125 kA peak.
Rated time for short-circuit: 1 s (0.5 s).

Voltage for motor and control circuits: 110 or 220 V dc.

Rated voltage for heating: 230 V, 50 Hz.

Inductive breaking capacity: If other values than 1A for rated voltage ≤ 170 kV, 0.5 A > 170 kV.

Capacitive breaking capacity: If other values than 1A for rated voltage ≤ 170 kV, 0.5 A > 170 kV.

Breaking of commuting current: Yes or No.

Mechanical endurance: If other than Class M0.

Electrical endurance (earthing switches): If other than Class E0.
12.4 Appendix 4 Main terminal movements
### Appendix 5 Component Datalist

Indatablad för frånskiljare och jordningskopplare

<table>
<thead>
<tr>
<th>Beskrivning</th>
<th>Värde</th>
<th>Enhet</th>
<th>Not</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Allmänt</strong></td>
<td></td>
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</tr>
<tr>
<td>Station</td>
<td>*</td>
<td></td>
<td>Ifylls av ställverksbyggaren EX Hagby</td>
</tr>
<tr>
<td>Objekt id/Littera</td>
<td>*</td>
<td></td>
<td>Ifylls av ställverksbyggaren EX CL6 S5-F1</td>
</tr>
<tr>
<td><strong>Beskrivning</strong></td>
<td>*</td>
<td></td>
<td>Frånskiljare/Jordningskopplare</td>
</tr>
<tr>
<td>Inköpsnummer</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leverantörens ordernummer</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tillverkare</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typbeteckning</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Levererad</td>
<td>*</td>
<td>ååmm</td>
<td></td>
</tr>
<tr>
<td>Utförandeform</td>
<td>*</td>
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</tr>
<tr>
<td>Märkspänning</td>
<td>kV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Märkström</td>
<td>A</td>
<td></td>
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</tr>
<tr>
<td>Märkkorttidsström</td>
<td>kA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tid</td>
<td>s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stötström</td>
<td>kA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolationsnivå till jord - kort stöt</td>
<td>kV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolationsnivå till jord - lång stöt</td>
<td>kV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolationsnivå till jord - 50Hz</td>
<td>kV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolationsnivå över pol - kort stöt</td>
<td>kV</td>
<td></td>
<td></td>
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<tr>
<td>Isolationsnivå över pol - lång stöt</td>
<td>kV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolationsnivå över pol - 50Hz</td>
<td>kV</td>
<td></td>
<td></td>
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<tr>
<td>Spolbarhet</td>
<td>*</td>
<td>Ja/Nej/Begränsad</td>
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</tr>
<tr>
<td>Brytförmåga kap</td>
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<td></td>
</tr>
<tr>
<td>Brytförmåga ind</td>
<td>A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slutningstid</td>
<td>s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Öppningstid</td>
<td>s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minsta polavstånd</td>
<td>mm</td>
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</tr>
<tr>
<td>Vikt per trepolid apparat</td>
<td>kg</td>
<td></td>
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</tr>
<tr>
<td>Pris per trepolid apparat</td>
<td>SEK</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Svenska Kraftnät**
Norm, Riktlinje * TR1-09, rev B
Standard * SS-EN 62271-102
Ombynadsdatum * ååmm
Senaste driftningsdatum * ååmm
Sammanställningsritning *
Måttskiss *
Montage och skötselanvisning *
Kretsschema *
Poler
Tillverkningsnr pol L1 *
Tillverkningsnr pol L2 *
Tillverkningsnr pol L3 *
Max tillåten statisk kraft - horisontalt N
Max tillåten statisk kraft - vertikalt N
Storlek uttagsplatta * Ex 9-125
Diameter tapp mm
Längd tapp mm Ex 125
Material tapp *
Motkontakt för Al-rör, diameter mm 250
Krypsträcka stödisolator mm
Krypsträcka vridisolator *
Tillverkare stödisolatorer *
Ritningsnr stödisolator *
Tillverkare vridisolatorer *
Ritningsnr vridisolator *
Manöverdon
Typ av manöverdon * Hand/Motor
Antal manöverdon per trepolig st 1 eller 3
Typheteckning manöverdon *
Tillverkningsnr don L1 *
Tillverkningsnr don L2 *
Tillverkningsnr don L3 *
Motorspänning V 110/220 V DC
Manöverspänning V 110/220 V DC
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Värmespänning</td>
<td>V</td>
<td>230 V AC</td>
</tr>
<tr>
<td>Motorström, max vid start</td>
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<td></td>
</tr>
<tr>
<td>Motorström under manöver</td>
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<td></td>
</tr>
<tr>
<td>Total effekt magneter</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>Total effekt värmeelement</td>
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<td></td>
</tr>
<tr>
<td>Kapslingsklass</td>
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