SG15_MILE / SG25_MILE

MEDIUM VOLTAGE SWITCHGEAR

TECHNICAL MANUAL

ISO 9001:2015 certification
ISO 14001:2015 certification

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SAFETY FIRST

Make sure that during installation, commissioning and operation, the respective legal regulations (such as IEC) and appropriate national safety regulations are adhered to.

Make sure that the installation, commissioning and the operation are carried out by electrical specialists.

Only install the switchgear in closed rooms designated for electrical equipment.

Make sure that the specified data are not exceeded under the switchgear operation.

Make sure that this manual is available to all persons concerned with installation, commissioning and operation.

Pay special attention to the hazard statements throughout this manual:

Useful Features: Useful and helpful information

TIPS: Examples of calculations, hints

Technical stuff: Indicates important information about installation and maintenance

WARNING: Indicates a potentially hazardous situation that, if not avoided, could result in personal injury or equipment damage

DANGER! Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury

Always follow the instruction manual and respect the rules of good engineering practice!
Hazardous voltage can cause electrical shocks and burns. Disconnect power, then earth and short-circuit before proceeding with any work on this equipment.

Low voltage devices (recloser controller all types) meet the requirements of the EMC Directive 2014/30/EC, the Low Voltage Directive 2014/35/EU

TABLE OF CONTENTS

ABBREVIATION

AC	Alternating current
BC	Bus Coupler
BR	Bus Riser
BRES	Bus Riser with Earth Switch
BRM	Bus Riser with Metering Transformer
BT	Bus-Tie
CB	Circuit breaker
CC	Cable compartment
CM	Control module
CT	Current transformer
CO	Close-open (operation)
DC	Direct current
DIN	German institute for standardization
DOU	Draw-out unit
EMC	Electromagnetic compatibility
ES	Earthing switch
GOST	State standard of the Russian Federation
HCD	Handheld closing generator
HD	Heavy duty switching module
IAC	Internal arc classification
IEC	International Electrotechnical Commission
IF	Incoming Panel
IP	International protection
IP	Ingress protection
ISM	Indoor switching module
KD	Knocked down (panel)
LBS	Load break switch
LBSF	Load-Break Switch with Fuses
LD	Low duty switching module
LED	Light-emitting diode
LSC	Loss of service continuity (class)
LV	Low voltage
M	Metering panel
ManGen	Manual generator
MES	Metering panel with Earth Switch
MV	Medium voltage
OF	Outgoing Panel
PB	Power block
PCD	Pole-to-center distance
PD	Partial discharge
PM	Metallic partitions (class)
R&D	Research and development
SA	Surge arrester
SCADA	Supervisory control and data acquisition
SG_Mile	Medium-Voltage switchgear Mile series
Shell	Shell type switching module
SP	Switchgear panel
STP	Service Transformer Panel
VCB	Vacuum circuit breaker
VT	Voltage transformer

TECHNICAL MANUAL

This manual provides general information, technical options and specification, intended for the selection of the switchgear.

1.GENERAL

1.1 Presentation

The SG_Mile series switchgear is designed for primary distribution networks with rated voltages of 12kV, 17.5kV and 24kV 50/60Hz intended for indoor installation. The SG_Mile series switchgear is air insulated LSC2B-PM class, with single busbar design. The switchgear concept meets today's owner requirements such as reliability, personnel and operational safety, economy and efficiency in an optimal way.
The SG_Mile switchgear panels are successfully installed and commissioned for wide range of applications: distribution networks, industry, mining, Oil&Gas etc.
The switchgear is modular and is built by placing standardized units side by side in a coordinated way. The switchgear is easy to configure and selection of the apparatus and instruments does not imply dedicated solutions.
The functional units of the switchgear are guaranteed arc proof AFLR 31.5kA 1s in accordance with the IEC 62271-200 standard, appendix AA, class A accessibility, criteria 1 to 5. All start-up, maintenance and service operations can be carried out from the front. The switchgear and earthing switches are operated from the front with the door closed. The SG_Mile series switchgear can be configured with front access or with both front and rear access.

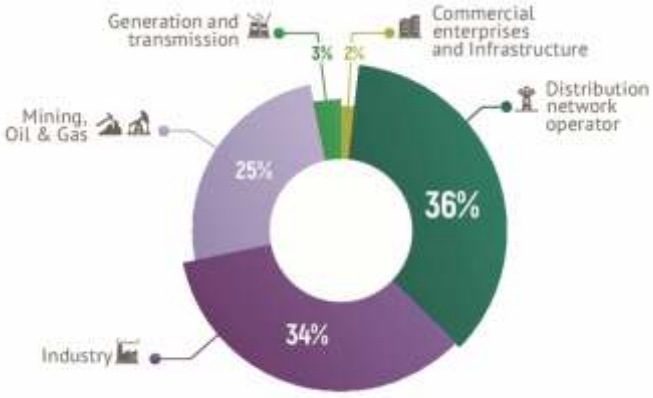


Fig.1.1. Installed switchgears by industry

1.2 Applicable standards

The switchgear and its main apparatus comply with the following standards:

Table 1.1. Applicable standards

Description	Standard
High-voltage switchgear and control gear – Part 1: Common specifications	IEC 62271-1
High-voltage switchgear and controlgear – Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV	IEC 62271-200
High-voltage switchgear and control gear – Part 200: High-voltage alternating current disconnectors and earthing switches	IEC 62271-102
Insulation co-ordination – Part 2: Application guide	IEC 60071-2
High-voltage switchgear and control gear – Part 100: High-voltage alternating current circuit-breakers	IEC 62271-100
Instrument transformers - Part 2: Additional requirements for current transformers	IEC 61869-2
Instrument transformers - Part 3: Additional requirements for inductive voltage transformers	IEC 61869-3
High-voltage switchgear and control gear - Part 103: Switches for rated voltages above 1 kV up to and including 52 kV	IEC 62271-103
Unsealed metal-enclosed switchgear and controlgear for voltages up to 10 kV. General specifications	GOST 14693-90
Factory-assembled metal-enclosed switchgear for rated voltages up to and including 35 kV. General specifications	GOST R 55190-2012
Alternating-current circuit-breakers for voltages from 3 to 750kV. General specifications	GOST R 52565-2006

1.3 Degrees of protection

The degrees of protection of the switchgear conforms with IEC 60529 standard. The SG_Mile series switchgear is normally supplied with the following standard degrees of protection:
- IP4X on the external housing.
- IP3X with the doors open.

Note: IP41 on request

1.4 Normal service conditions

The rated characteristics of the switchgear are guaranteed under the following ambient conditions:

Table 1.2.

Parameter	Parameter value
Minimum ambient temperature	-25°C*
Maximum ambient temperature	+55°C**
Maximum altitude above sea level	1000 m***
Relative humidity	95%
Ambient atmosphere in accordance with IEC 60721-2-1- "Wda": non-explosive, uncontaminated and non-corrosive. Atmosphere type II according to GOST 15150-69.	

* - The value is limited by instrument transformers
** - IEC 62271-200 limits the upper level of ambient temperature at +40°C
*** - For installations in altitudes above 1000 m, the external insulation is calculated as multiplication of rated insulation with Ka in accordance with IEC 62271-1

Table 1.3.

Altitude above sea level, m	Air dielectric strength factor Ka
1000	1,00
1200	0,98
1500	0,95
1800	0,92
2000	0,90
2500	0,85
3000	0,80

1.5 Type testing

The SG_Mile switchgear has successfully passed all the tests specified by relevant IEC (International Standard) and GOST (state standard of the Russian Federation) standards. As noted within the regulations of these standards, the tests were carried out on the switchgear units considered to be the most sensitive to stresses applied within the tests and, therefore, assigned to be valid through the whole range.

Table 1.4. Type tests

Test
1) Dielectric test on main and auxiliary circuits
2) Temperature rise and main circuit impedance measurement
3) Peak and rated short-time withstand currents test on primary and earthing circuits, including draw-out unit and earthing switch
4) Making and breaking capacity of the switching devices and apparatus
5) Mechanical operations of the switching devices and draw-out units
6) Verification of the IP protection code
7) Verification of auxiliary and control circuits
8) Internal arc test (IAC classification: AFLR, 31.5(25)kA,1s)

1.6 Routine tests

Routine tests are performed by the assembly factory as specified in the standard IEC 62271-200 to ensure the superior quality of each product delivered to a customer site:

Table 1.5. Routine tests

Test
Dielectric test on the main circuits
Tests on auxiliary and control circuits, and verification of conformity to the circuit diagrams
Functional tests
Verification of protection against electrical shock
Dielectric tests on the auxiliary circuits
Measurement of the resistance of the main circuit
Design and visual checks
Mechanical operation tests
Tests of auxiliary electrical devices (interlock)
Voltage and current transformers ratios, polarity check
Primary current injection test (CT-Protection-VCB check)
Voltage injection test for protection and metering

1.7 Internal arc proof

The personnel safety factor was a primary goal when SG_Mile switchgear was designed. Thus, the SG_Mile switchgear has been designed and tested to withstand an internal arc due to a short-circuit current of the same levels as the panel rated breaking currents. These tests ensure that the metal construction of the SG_Mile switchgear is able to protect personnel operating near the switchgear subjected to an internal arc fault. The internal arc is treated to be the most unlikely event from all type of faults, however, a small percentage of occurrence still exists due to many factors including improper connection of incoming cables and tightening contact connections, intrusion of animals, deterioration of insulation over time, severe atmospheric conditions and human factors. The proven characteristics of the SG_Mile switchgear drastically reduce the incidence of these causes in generation of faults, but not all can be fully eliminated.

An internal arc event produces a large amount of energy which instantly transforms into phenomena such as rapid increase of internal pressure and temperature, visual and sound effects, which consequently result in high mechanical stresses on the switchgear structure, and/or in melting and evaporation of the materials.

Such significant stresses, unless properly controlled, may cause a serious threat to the service personnel due to harmful effects (shock-wave, flying parts, doors opening, emission of hot gases, open flame).

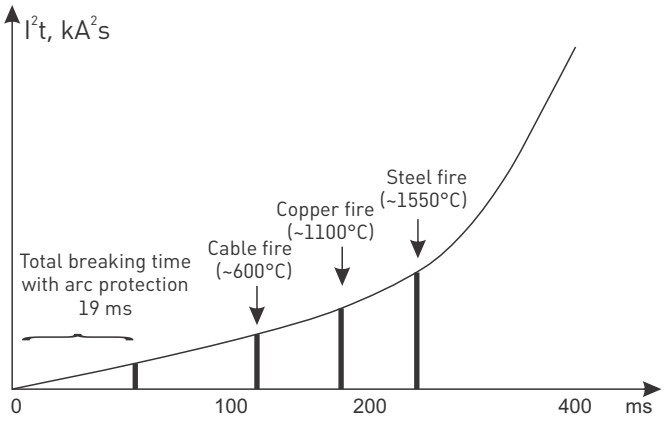
The IEC 62271-200 standard describes the test-methods required. The SG_Mile switchgear conforms to all criteria stated in Annex A of the standard:

- The doors of the switchgear must remain closed and no opening of the cover panels must occur.
- No part of the switchgear, which may be hazardous for personnel, may be ejected.
- Arcing does not cause holes in the accessible sides up to a height of 2 m.
- Vertically and horizontally arranged fabric indicators placed outside the switchgear may not get burnt.
- All the switchgear earthing connections must remain effective.

The SG_Mile switchgear is IAC classified: AFLR 31.5kA, 1s. For the installation of the SG_Mile switchgear the following factors are obligatory to be considered:

- Level of the fault current (16...31.5 kA).
- Duration of the fault current (0.1...1s).
- Hot gases evacuation routes.
- Dimensions of the switchboard room, with special attention to the height.

TE Energy has developed various solutions providing effective control and protection over the arc initiation at earlier stages as well as passive type protection based on construction.



Arcing time minimization

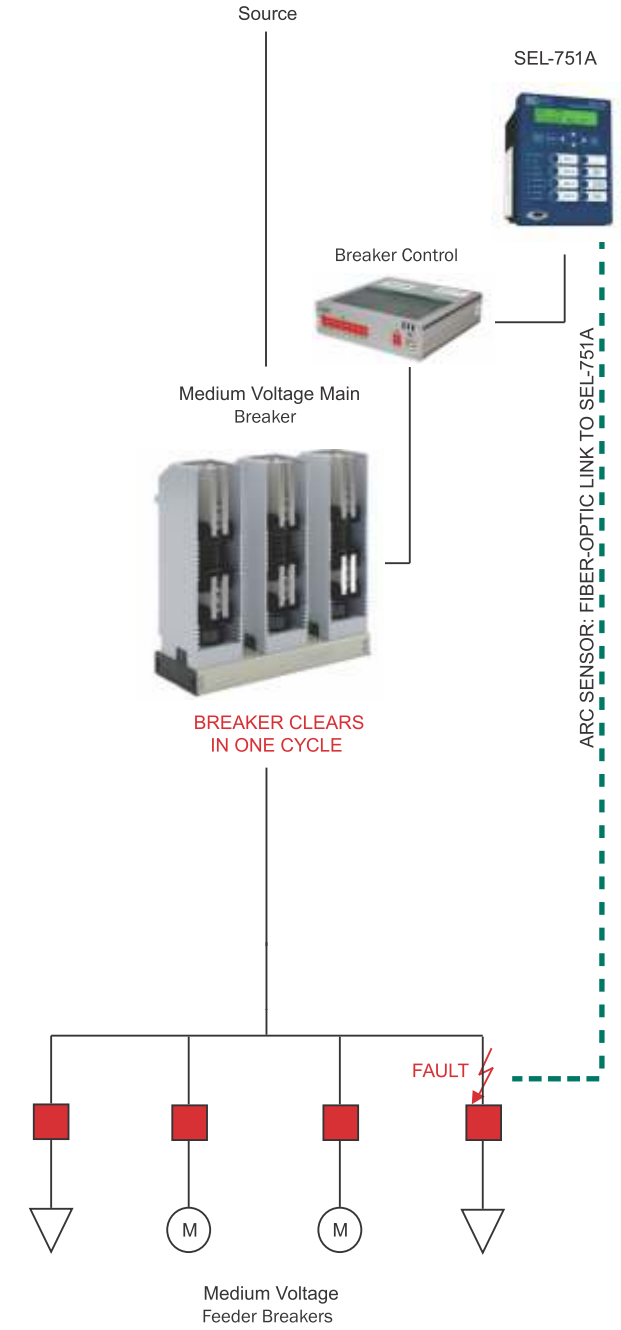
The energy released in an arc flash is directly proportional to the arcing time (V x I x t), where V is voltage, I - current, t - time. As V x I are given by the service conditions, only the arcing time (t) is changeable. The less arcing time, the less destruction can result from the arc flash. The circuit breaker operation time consist of:
1. Arc Flash relay operation time. Normally - 7ms.
2. Circuit breaker breaking time (opening time of circuit breaker and arcing time). Normally 100ms for motor spring charged drive circuit breakers.

The application of modern Arc Flash Relays with optical sensors makes it possible to minimize relay response times up to 2ms.

Vacuum circuit breakers are designed with this concept in mind – optimizing the vacuum interrupter, insulation, magnetic actuator and control modules. This has resulted in the fastest circuit breaker, the one cycle interrupter - a breakthrough for fast switching and arc flash protection technology. The reaction time of the CM16 control module series is minimized to 4ms (special version) . The opening time of the fastest circuit breaker - 7ms (special version), the average arcing time - 8ms, which results in ultra-fast arc flash interruption of 20ms, that is equal to a period with frequency 50Hz, while other manufacturers advertise 5 cycles.

Table 1.6. Arc flash mitigation with vacuum circuit breaker

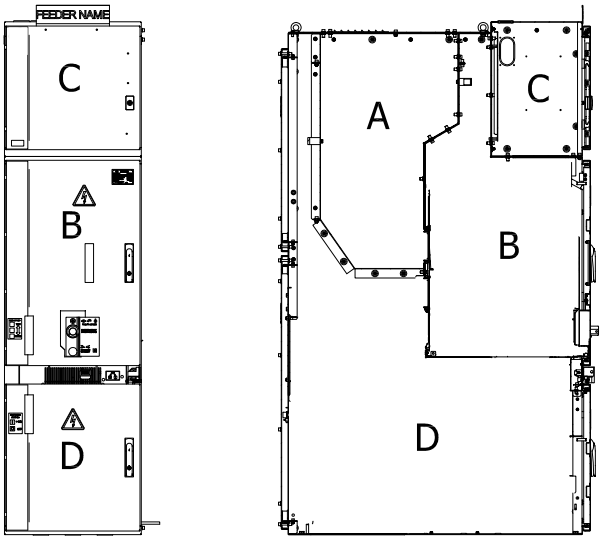
Arc flash relay reaction time	2ms
CM 16 reaction time	4ms
Shell FT type VCB opening time	7ms
Arcing time	7ms
Totally:	**20ms**



2. DESIGN

2.1 Compartments

The SG_Mile switchgear panel is assembled with standard, pre-fabricated, hot-dip zinc galvanized sheet steel units forming a rigid, free standing structure. The switchgear consists of four compartments which are separated from each other by means of earthed metal partitions. The switchgear is supplied with cassette type draw-out unit. Within the aspects of IEC 62271-200 related to the definition of Loss of Service Continuity, the design category of SG_Mile series switchgear is defined as LSC2B-PM. Compartments of the SG_Mile series switchgear are presented below.



A - Busbar compartment
B - Circuit Breaker compartment
C - Low-voltage compartment
D - Cable compartment

Fig.2.1. SG_Mile cassette type

2.1.1 Busbar compartment

The busbar compartment houses the main busbar system connected to the fixed upper isolating contacts of the circuit breaker by means of branch connections. The main busbars are made of electrolytic copper. The busbar compartment of each panel is segregated from the busbar compartments of the neighboring panels with bushing insulators. The bushing insulators were tested with electrodynamic forces load withstand during the flow of fault current.
Optionally the busbars can be covered with heat shrinkable insulation sleeves. It is possible for maintenance personnel to access the busbar compartment from the front (through the circuit breaker compartment), as well as from the rear (removable partition of busbar compartment) of the switchgear.

2.1.2 Cable compartment

The cable compartment houses the branch connections, earthing busbar, earthing switch, power cables, surge arresters, instrument transformers (current transformers, voltage transformers, zero-current transformers). The cable compartment design allows up to 4 cables per phase connections (in case of the withdrawable voltage transformer truck present) or 7 cables per phase (in case of the voltage transformer truck absent). Cable fixing plate is suitable for any kind of cable. Optionally, insulation partitions can be situated in the cable compartment between phases. Insulation partitions are made from non-flammable material. Panel openings for control cables can be made in the bottom of the switchgear if they enter from the cable tunnel.

2.1.3 Circuit breaker compartment

The circuit breaker compartment houses the circuit breaker, bushing insulators and contains fixed contacts for connection of the circuit breaker to the busbars, to the cable compartment and the shutter mechanism. The metallic shutters operate automatically during movement of the circuit breaker from the test position to the service position or vice versa. The position of the circuit breaker can be seen from the front of the panel through an inspection window. All necessary interlocks for safety operation according to IEC 62271-200 and others can be added on request. The bushings are single-pole type and are made of cast resin. Access to live parts is prevented with movable metal shutters.

2.1.4 Low voltage compartment

The low-voltage compartment is designed to mount all secondary circuit connections within the single panel as well as interconnections between adjacent panels and transit connections. Special holes are provided for transit cables. The spacious compartment allows the installation of multi-functional microprocessor protection relay, energy meters, lighting, heating and many other devices. The sensors, indicators, microprocessor protection relay management blocks, mimic diagram, and control buttons are placed on the front panel.

2.2 Draw-out units

The following types of draw-out units are available:

- Draw-out unit with Vacuum Circuit Breaker cassette type.
- Draw-out unit with Isolating truck cassette type.
- Draw-out unit with Voltage Transformers cassette type (for CB/CC).
- Draw-out unit for Cable Service cassette type.
- Draw-out unit for Cable Testing cassette type.

Draw-out unit with VACUUM CIRCUIT BREAKER (cassette type)

The main purpose of a draw-out unit with circuit breaker:
- switching of load and short-circuit currents;
- to make a visible break between the busbar and the cable compartment. It is needed for maintenance purposes in the cable compartment to guarantee personal safety. The Draw- out unit is equipped with all necessary interlocks for safe operation with the panel in any condition.

Draw-out unit with ISOLATING TRUCK (cassette type)

Draw-out unit with Isolation truck is used for:
- conducting rated load currents;
- making a visible break between sections of switchboard during maintenance procedures.

Draw-out unit with VOLTAGE TRANSFORMERS

A draw-out unit with voltage transformers is used for:
- voltage metering for protection or/and commercial energy metering.

It can be placed in the circuit breaker or in the cable compartment. All voltage transformers are equipped with fuses to protect transformers against fault current. Blown fuse indication is available as an optional feature.

CABLE SERVICE draw-out unit cassette type

Cable Service draw-out unit is used for safe cable insulation testing, without disconnecting the power cables.

CABLE TESTING draw-out unit cassette type

Cable Testing draw-out unit is used for safe and convenient cable insulation testing as well as primary current injection test on power cables without disconnecting them.

Fig.2.2. Draw-out unit with VCB, cassette type

Fig.2.3. Draw-out unit with Isolating truck, cassette type

Fig.2.4. Draw-out unit with VT, cassette type (cable compartment)

Fig.2.5. Draw-out unit with VT, cassette type (circuit breaker compartment)

Fig.2.6. CABLE SERVICE draw-out unit cassette type

Fig.2.7. CABLE TESTING draw-out unit cassette type

2.3 Main busbars

The busbar compartment contains the main busbar system connected to the fixed upper contacts of the circuit breaker compartment by means of branch connections. The main busbars are made of electrolytic copper. The maximum rating of busbar system with natural cooling is 3150A. With compulsory cooling the busbar's nominal rating can exceed 4000A. The busbars are normally covered with heat shrinkable sleeves for voltage ratings exceeding 12kV. Each busbar compartment within the panel is segregated from the others by means of partitions and supported by pass through insulators. The through insulators have been tested for their capability to withstand stresses due to electro-dynamic forces at the rated breaking currents.

2.4 Branch connections

The cable compartment contains the branch system for connecting power cables to the fixed, lower contacts of the circuit breaker compartment. The branch connections are made of electrolytic copper.

2.4.1 Branch insulation

SG15_Mile switchboard with rated voltage up to 12kV - only central upper and lower branch busbars L2 are covered with heat-shrink insulation. Also, side isolating barriers are fixed to segregate L1 and L3 busbars from earthed metal parts in cable compartment. A complete heat-shrink insulation (including joints covers) can be offered under a customer request.
SG15_Mile and SG25_Mile switchboards with rated voltages 17.5kV and 24kV are delivered with fully insulated busbars.
The L, T, I type joint insulation covers are used for insulation of corresponding busbar connections.

The normal load / cross-section dependency of main and branch busbars are presented in the table.

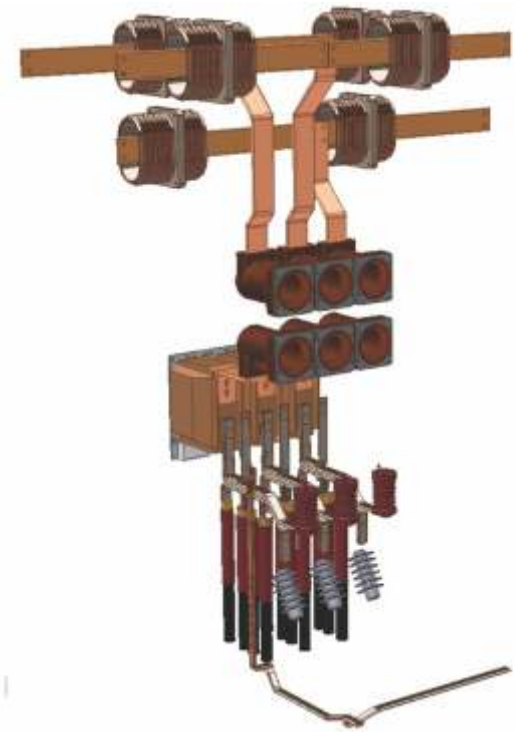


Table 2.1. Main busbars

Main busbars rated current, A	Busbar, mm x mm
1250	1x10x80
1600	2x10x60
2000	2x10x80
2500	3x10x80
3150	3x10x100

Table 2.2. Branch busbars

Branch busbars rated current, A	Busbar, mm x mm
630	1x10x40
1250	1x10x80; 2x10x40
1600	2x10x60
2000	2x10x80
2500	3x10x80
3150	3x10x100

2.5 Earthing busbar

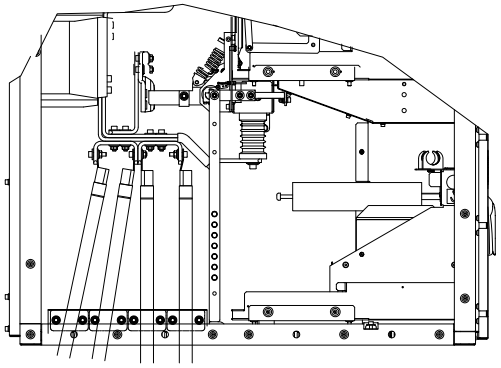
The earthing busbar is made of electrolytic copper. It runs along all adjacent panels and connects to a main substation earthing bar. All current carrying parts are interconnected with each other to equipotential bonding to guarantee personal safety against electric shock. The earthing busbars are capable of peak withstand current 31.5kA and peak value 82kA for 3 seconds.

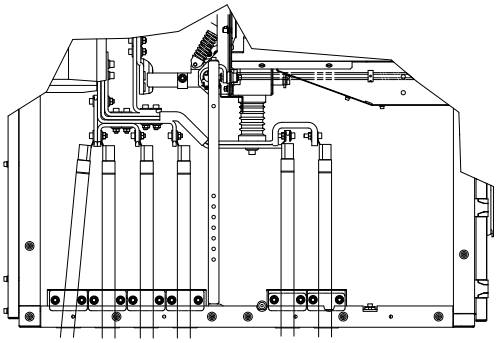
2.6 Bushing insulators and shutters

The bushing insulators are located in the circuit breaker compartment to hold fixed contacts. They are also used for connection of the withdrawable unit to the busbar compartment and the cable compartment respectively. The bushing insulators are single-pole type and are made of cast resin. The shutters are made of metal and activated automatically during movement of the withdrawable unit from the test position to the service position or vice versa.

2.7 Cables

Single and three-core cables (up to a maximum of 6 per phase or up to 4 cables with voltage transformers) can be used. The construction of SG_Mile provides simple access to the cable from the front side of the switchgear and gives the opportunity of placing SG_Mile close to the wall.





2.8 Auxiliary wiring

Electrical wiring diagrams are the part of switchgear documentation delivered with each order.
A complete set of wiring diagrams developed by TEE for a typical substation is available with Protection Relays from other manufacturers.
The following options are available:

- Auxiliary supply voltage: 24 .. 240V DC/AC.
- Any type of a microprocessor protection relay can be adopted.
- Solenoid and electromagnet interlocks for earthing switch, draw-out units, sectional earthing switch.
- Heating for every compartment, lighting.
- SCADA different options.
- Arc protection variety selection.
- Commercial metering.
- Motor-driven draw-out unit and earthing switch.

2.9 Pressure relief flaps and gas exhaust duct

Pressure relief flaps allow hot gases to be released from the compartment in the event of internal arc. A pressure relief flap is mounted at the top of each power compartment of a panel.
TE Energy has designed different versions of the flaps depending on required IP level, nominal currents and rated breaking currents.

The gas exhaust duct is presumed to evacuate hot gases into dedicated areas. The evacuation of hot gases and other harmful particles can be diverted to:

- Neighboring rooms.
- Outside to restricted areas.
- Dedicated panel with extinguishing compartment equipped with special filters.
- Upstream (special attention to the ceiling height).

The gas exhaust duct is fitted to SG_Mile at the top of each panel and runs along the entire length of the switchboard. The pressure generated by the internal arc opens pressure relief flaps thus allowing hot gases to be evacuated to dedicated areas. A complete solution for every installation is to be specified

Pressure relief flaps design samples

≤ 1250 A rated current
Flat single sheet

>1250 A rated current
Louvre + mesh

2.10 Doors

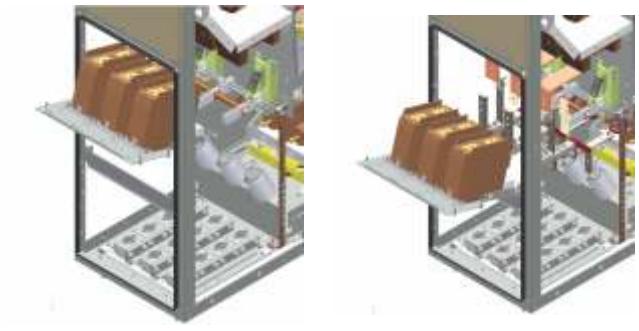
The SG_Mile powder coated doors are made of galvanized steel sheets, it provides a rigid structure and is resistant to mechanical stresses. Robust hinges and handles provide for convenient and safe closing.
Inspection windows are made of explosion-proof glass, providing maximum safety for personal.

2.11 Natural ventilation circuit

There is a natural ventilation circuit arranged around the circuit breaker to provide dissipation of heat due to circuit breaker operating at high currents or at high ambient temperatures. The cool air is sucked into the circuit, passing underneath the circuit breaker and primary contacts and withdrawn from the panel through the gas exhaust channel. In case of internal arc blast, the reverse air current boosted by a high pressure instantly closes the special valve inside the intermediate plate, thus preventing personnel injuries due to the escape of hot gases. If the pressure relief flaps type - louvres applied, it is used as part of ventilation circuit.

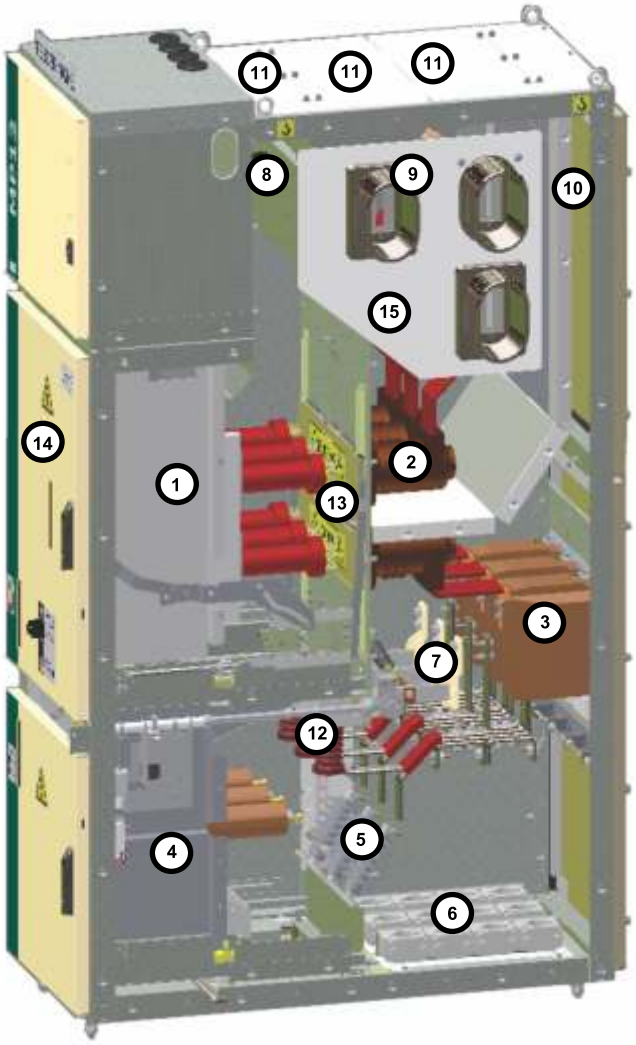
2.12 Maintenance of current transformers

For convenient access to the current transformers, inside cable compartment, a rotating CT mounting plate design is employed.
The CT mounting plate may be opened:
- using central mounting bolts in case of CT assembly;
- using lower mounting bolts in case of CT replacement.



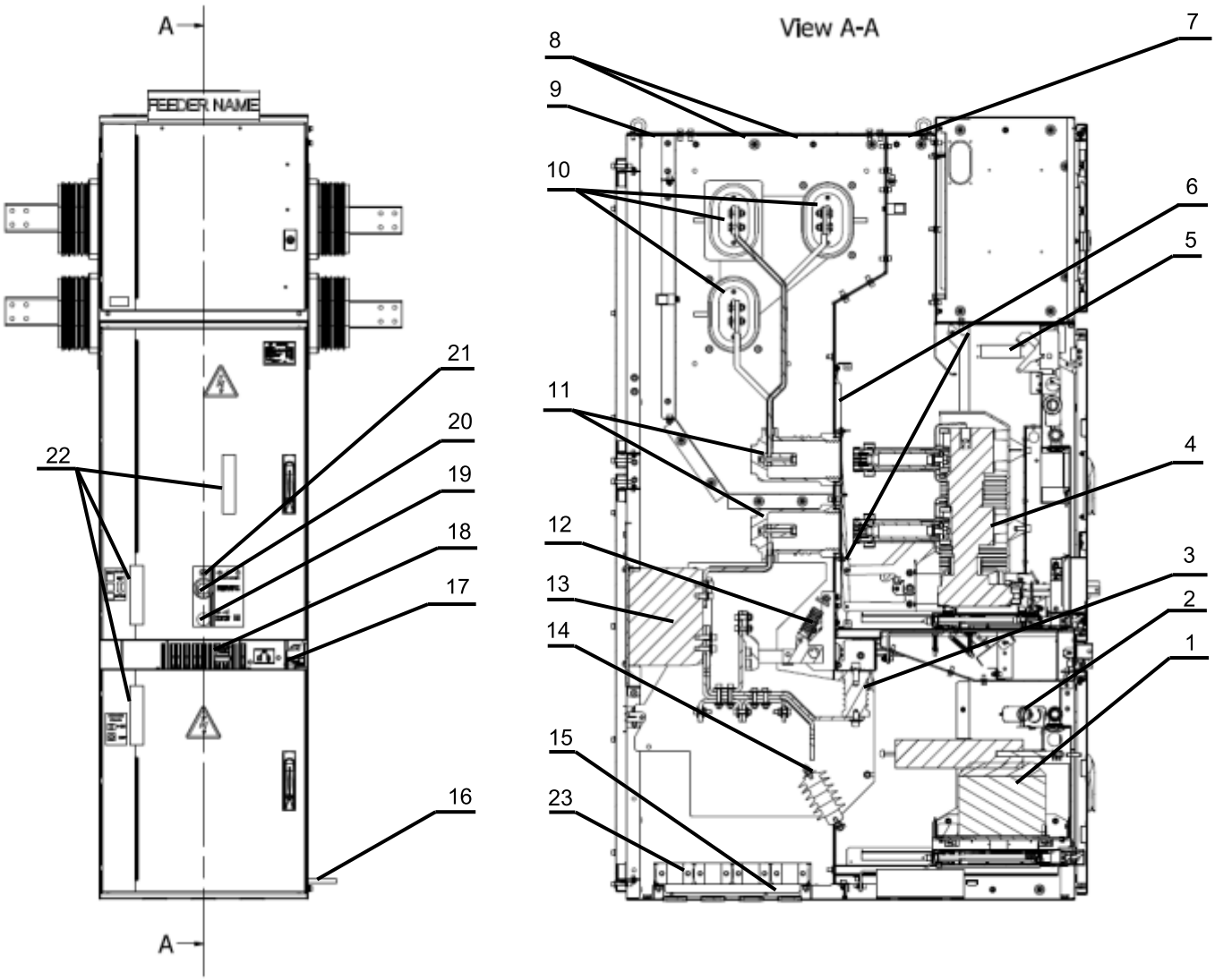
3. BASIC STRUCTURE

An indoor substation switchboard consists of different numbers and types of SG panels with switching devices, control and protection relays, signaling and metering devices and other auxiliary equipment, which are interconnected by control cabling. The base structure of the typical SG panel is given below.



1. Vacuum circuit breaker
2. Primary contacts insulators
3. Current transformers
4. Draw-out unit with voltage transformers
5. Surge arresters
6. Sealed cable entries
7. Earthing switch
8. Gas exhaust channel of the circuit breaker compartment
9. Gas exhaust channel of the busbar compartment
10. Gas exhaust channel of the cable compartment
11. Pressure relief flaps
12. Support insulators with voltage indicator
13. Shutter mechanism
14. Circuit breaker door with inspection window
15. Through insulators

Cross - section: cassette type



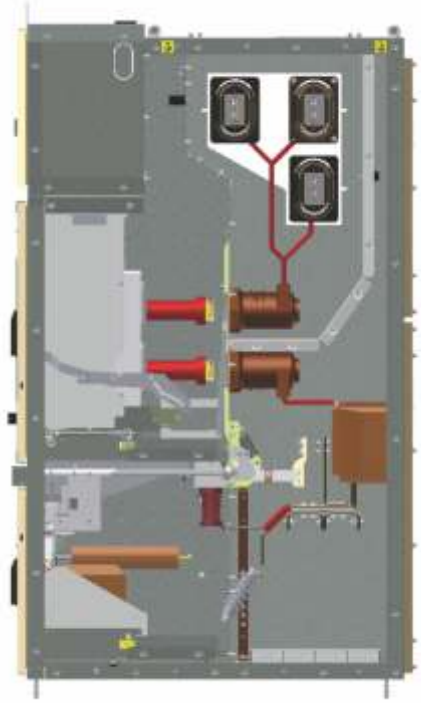
1. Voltage transformer
2. Voltage transformer auxiliary connector
3. Support insulator with capacitive sensors
4. Draw-out unit with circuit breaker
5. Circuit breaker auxiliary connector
6. Shutter mechanism
7. Circuit breaker compartment pressure relief flap
8. Busbar compartment pressure relief flap
9. Cable compartment pressure relief flap
10. Through insulators
11. Bushing insulators
12. Earthing switch (make type)
13. Current transformers
14. Surge arresters
15. Bottom with sealed cable entries
16. Main earthing bar
17. Earthing switch operation slot
18. Ventilation provision
19. Draw-out unit operation slot
20. Circuit breaker manual trip button
21. Circuit breaker / draw-out unit interlock interface
22. Inspection windows
23. Cable clamps

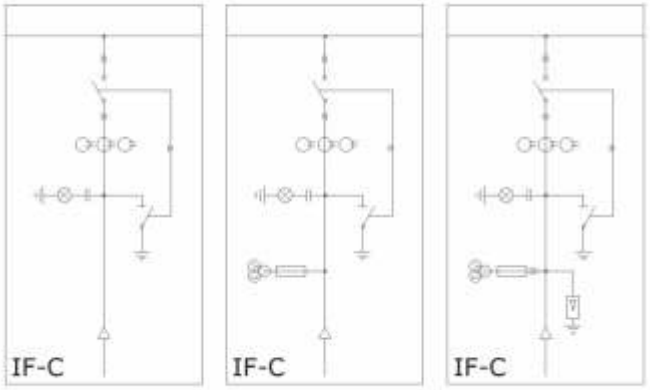
3.1 Typical panels

Typical panels arrangements are shown below. Additional equipment or accessories are available upon request.

IF - Incoming panel

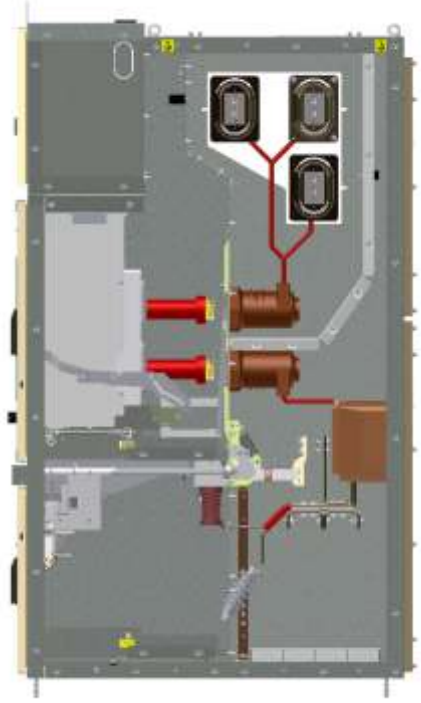
Cassette version

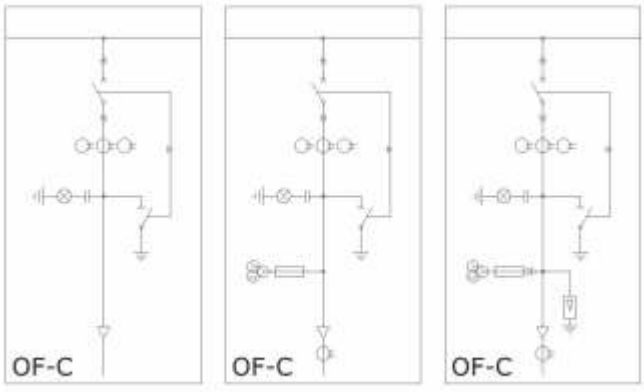




OF – Outgoing panel

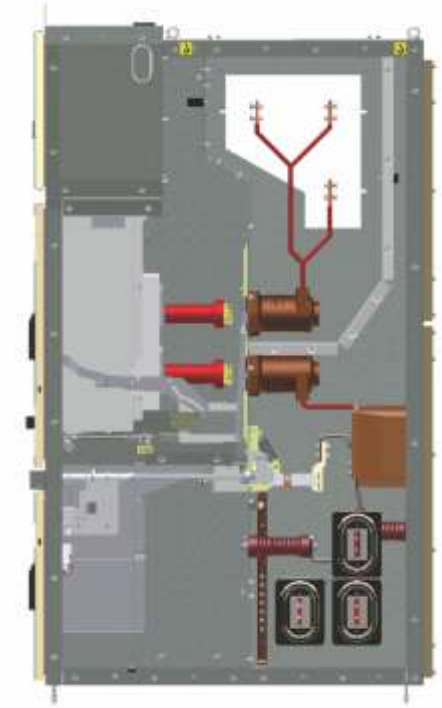
Cassette version

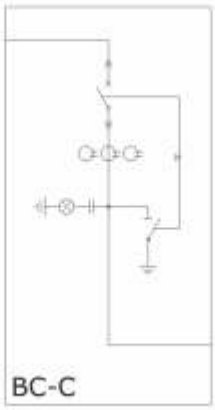




BC – Bus Coupler

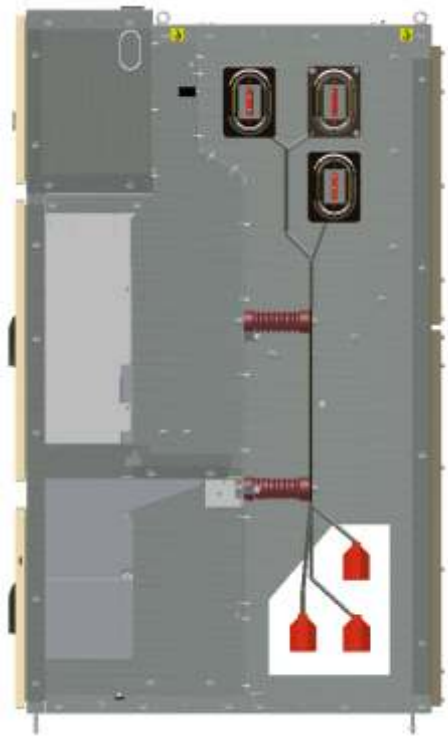
Cassette version





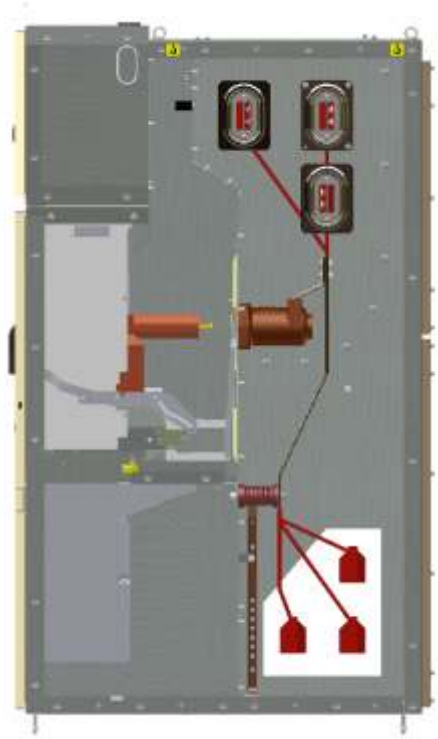
Available in left and right option.

BR – Bus Riser



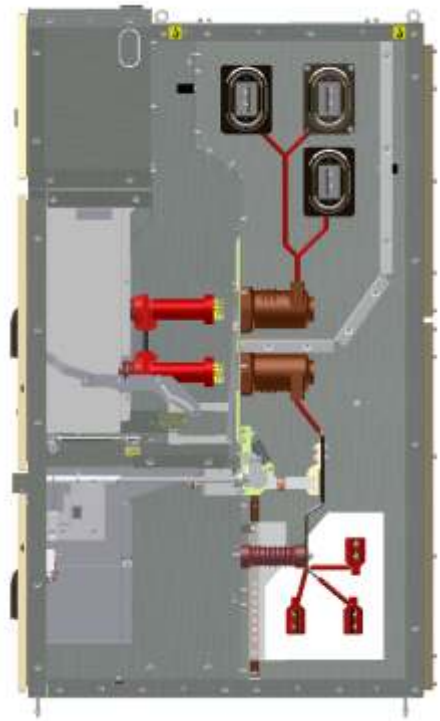
Available in left and right option.

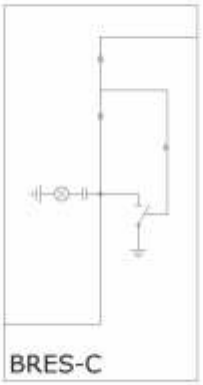
BRM – Bus riser with metering transformer



Available in left and right option.

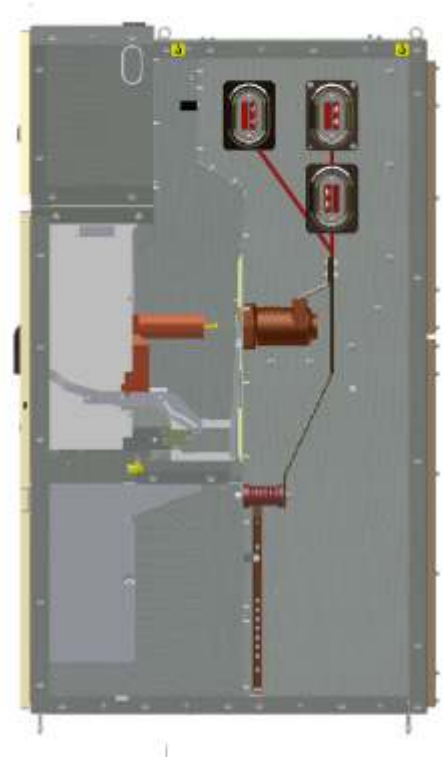
BRES – Bus riser with earth switch

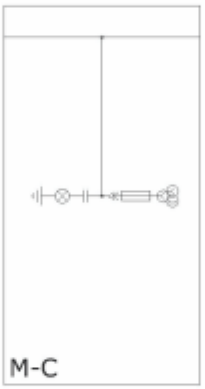




Available without installed earthing switch.
Available in left and right option.

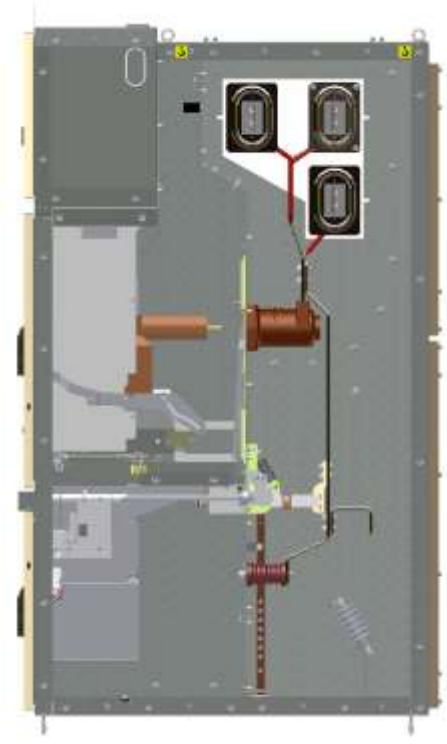
M – Metering panel

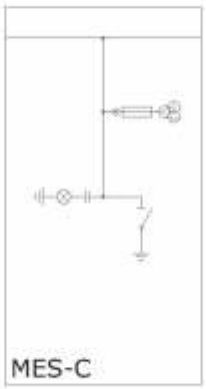




Available with installed surge arresters.

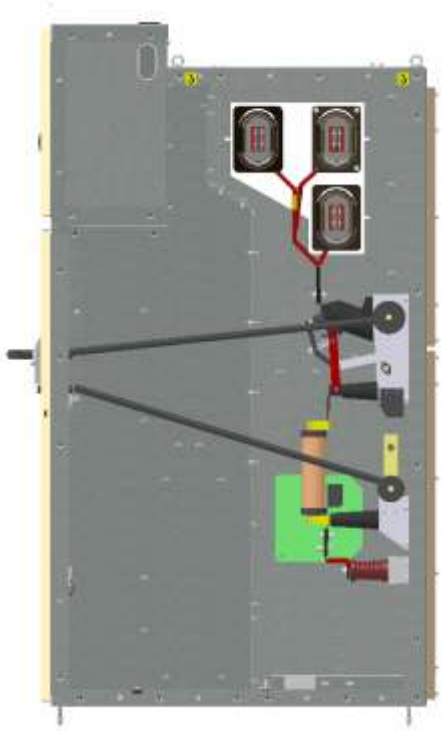
MES – Metering panel with earth switch

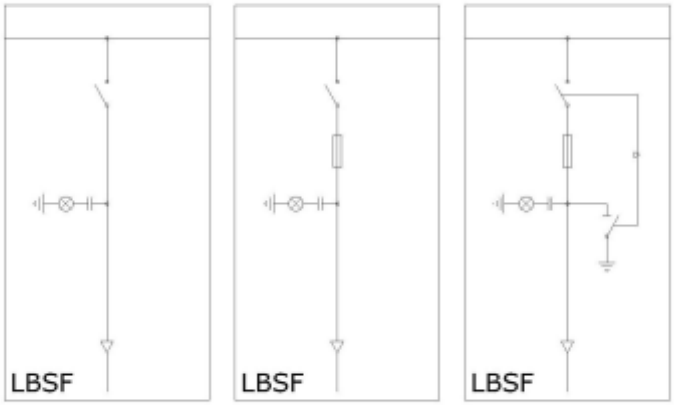




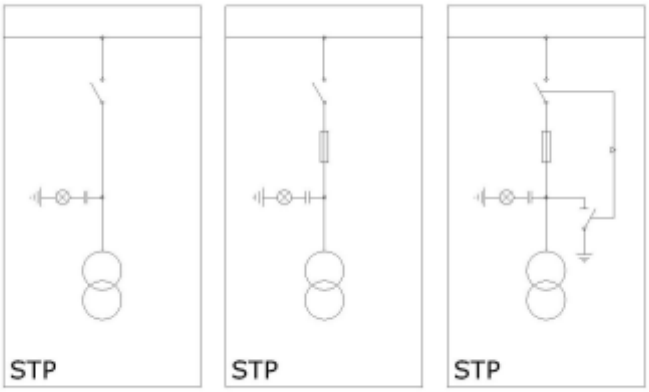
Available with installed surge arresters.

LBSF – Load-break switch with fuses panel

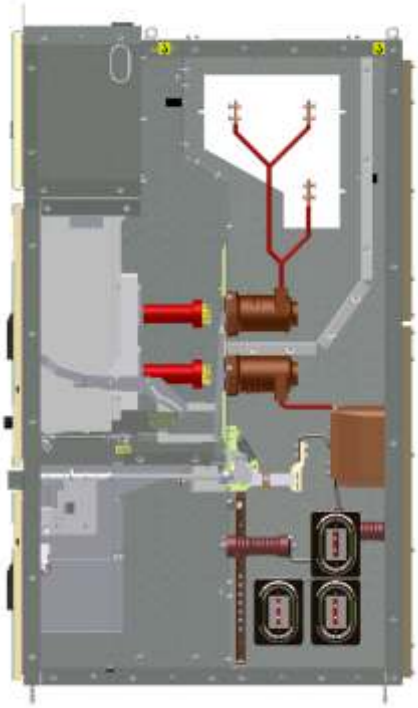


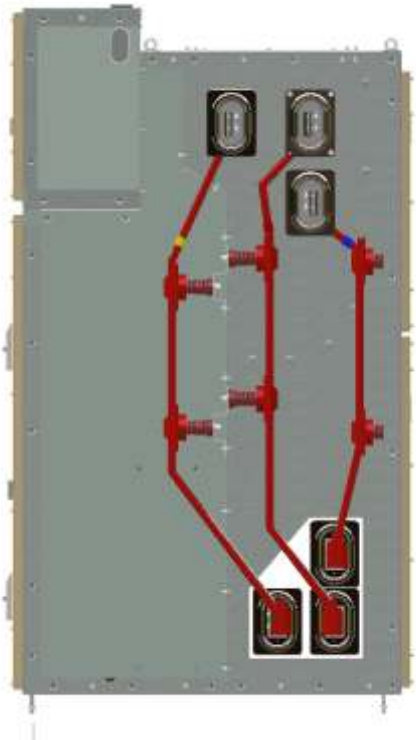


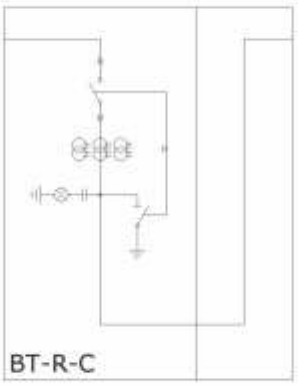
STP – Service transformer panel

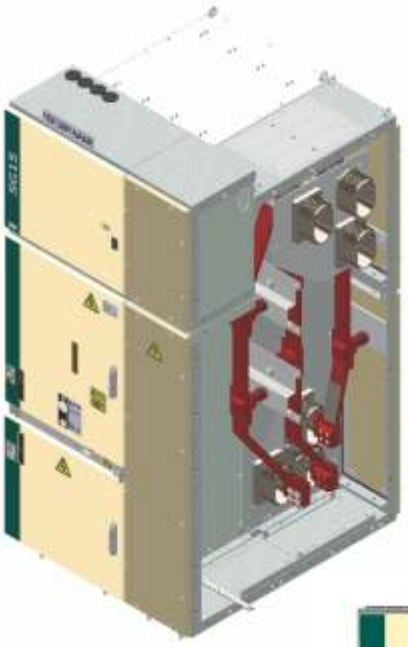


BT – Bus-Tie







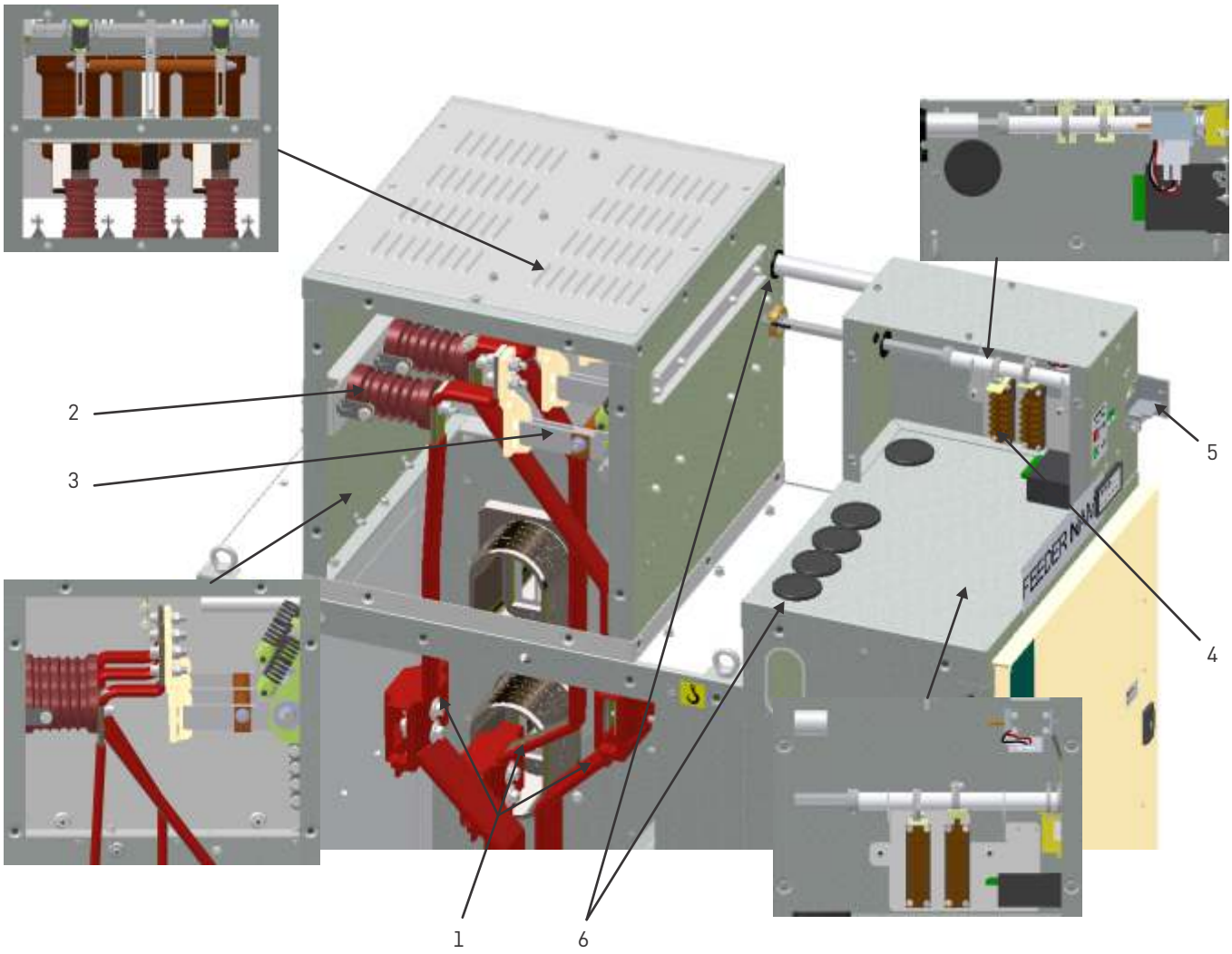


Available with left side or right side attachment.

3.2 Top Installation

Depending on panel requirements and structure, the busbar earthing switch or voltage transformers can be installed over the top of any panel.
A top installed earthing switch can be equipped with support insulators, with capacitive sensors, electromagnet for providing necessary interlocks and signalling.

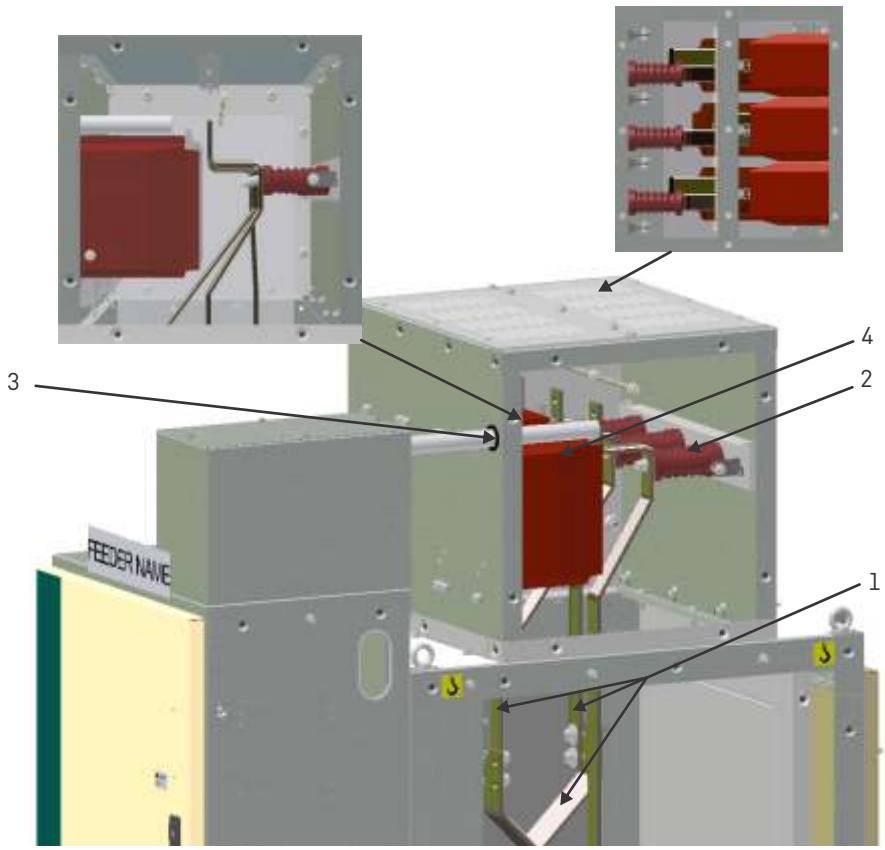
Earthing switch top installation



1	Branch busbar
2	Support insulators/capacitive sensors
3	Earthing switch
4	Earthing switch position signaling microswitches
5	Earthing switch operation slot
6	Openings for control cables

Voltage transformer top installation

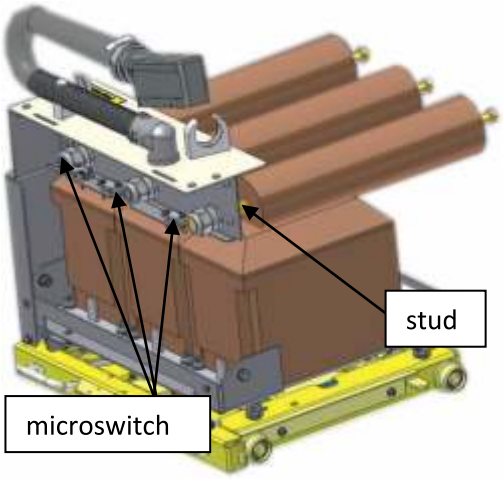
A top installed voltage transformers can be equipped with fuses.

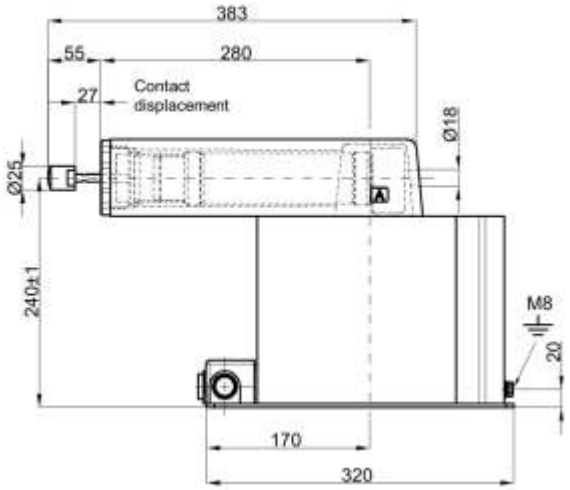


1	Branch busbar
2	Support insulators/capacitive sensors
3	Openings for control cables
4	Voltage transformers

3.3 Blown fuse indication of voltage transformer

Blown fuse indication for each phase of the voltage transformer is available. A special voltage transformer is used for this feature, which has holes in the body frame for joining the stud, made of isolating material.
In case of a blown fuse, the head strikes the stud. The stud locks microswitch the contact and a signal is displayed on SCADA.

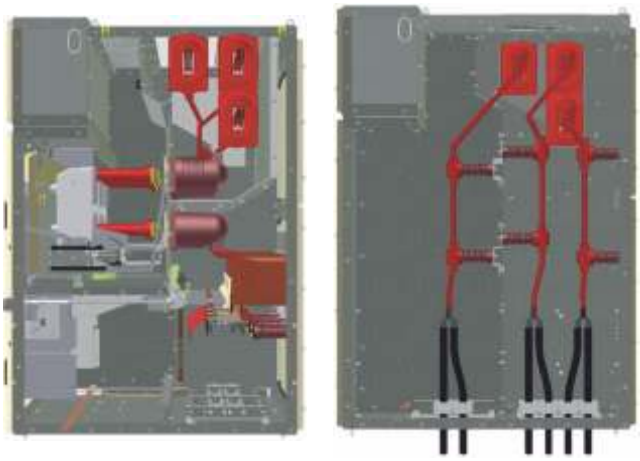


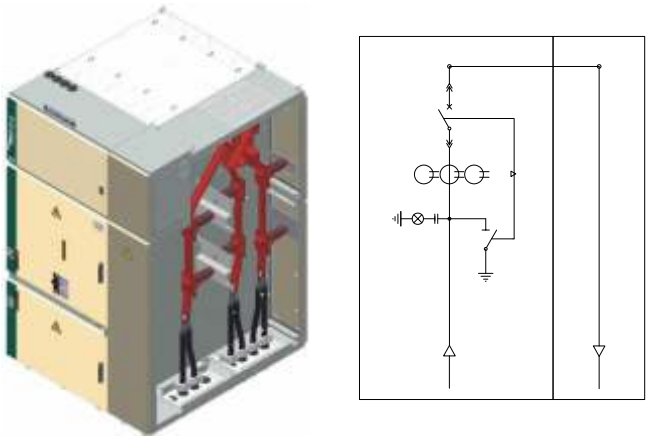


3.4 Busbar extensions and bridges

3.4.1 Panel attachments

The following solutions are available for non-standard installations such as rear or side input, cable or busbar input:
- rear attachment for cable or busbar input;
- left side attachment for cable or busbar input;
- right side attachment for cable or busbar input.

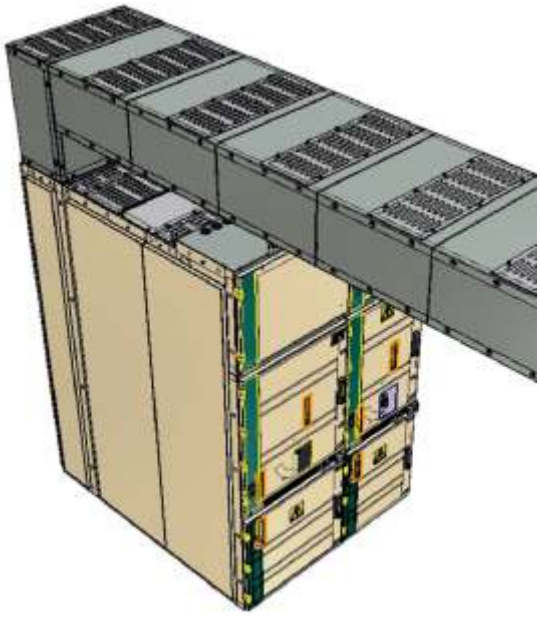


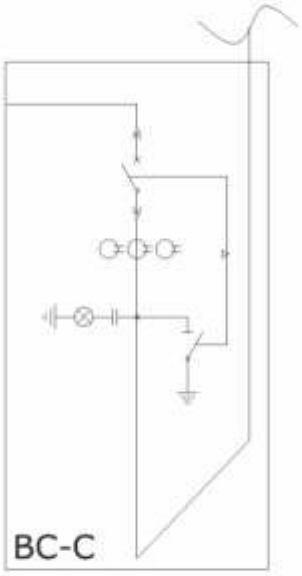


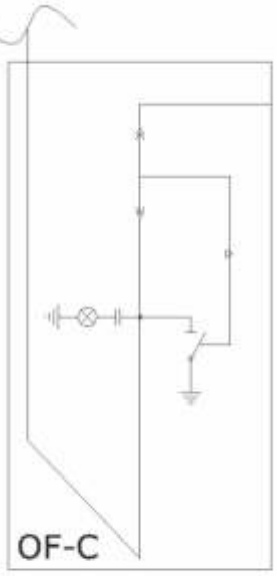
Panel with right side cable input attachment

3.4.2 Busbar bridge

Section coupling can be also done with a busbar bridge (bus duct). Normally the connection of the busbar bridge is done with the help of rear attachments of the panels at the opposite sides. The busbar bridge is designed per project requirements.







4. EQUIPMENT

4.1 Cassette platform

The following equipment can be installed onto draw-out units depending on their functionality: circuit breaker, voltage transformers, isolating truck. The equipment is fixed onto a metal support and handling cassette platform. The cassette platform is provided with a wheel system which makes racking the apparatus in and out of the switchgear possible with the door closed.

The truck platform allows efficient earthing of the apparatus by means of the sliding earth busbar contact and the metal structure of the switchgear. The apparatus cassette platform can be motor operated. The rack-in and rack-out operations can be carried out by means of electrical controls, either locally by an operator or by a remote system. Every platform has 5NO+5NC contacts for indication and control.

4.2 Cassette circuit breaker

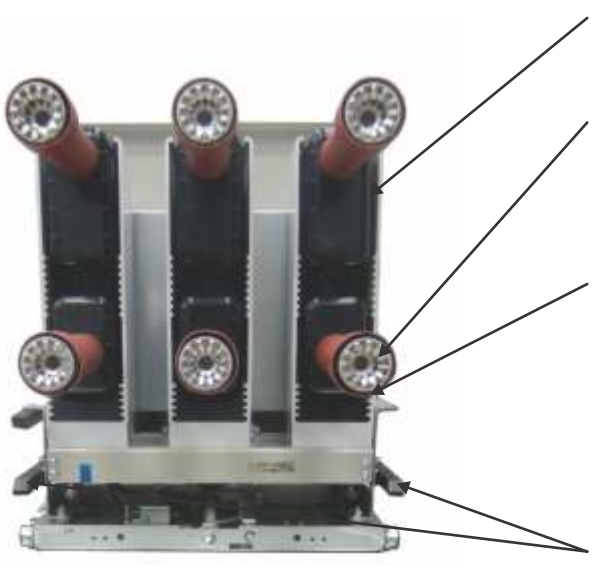
CBunit_DOU15(25)_Mile series draw-out units are designed for application in SG_Mile with rated voltages 12-24kV 50/60Hz. These draw-out units are based on ISM15(25)_LD; ISM15(25)_Shell; ISM15_HD switching modules with electromagnetic drive. Also draw-out units can be equipped with Sion VCB on request.

CBunit_DOU15(25)_Mile is completely type tested within metal-clad switchgear per standards:
- IEC 62271-100: High-voltage switchgear and controlgear – Part 100: High-voltage alternating current circuit-breakers.
- GOST 14693-90, GOST 12.2.007.0-75, GOST 12.2.007.4-75.

4.2.1 Draw-out unit with VCB (CBunit_DOU15(25))

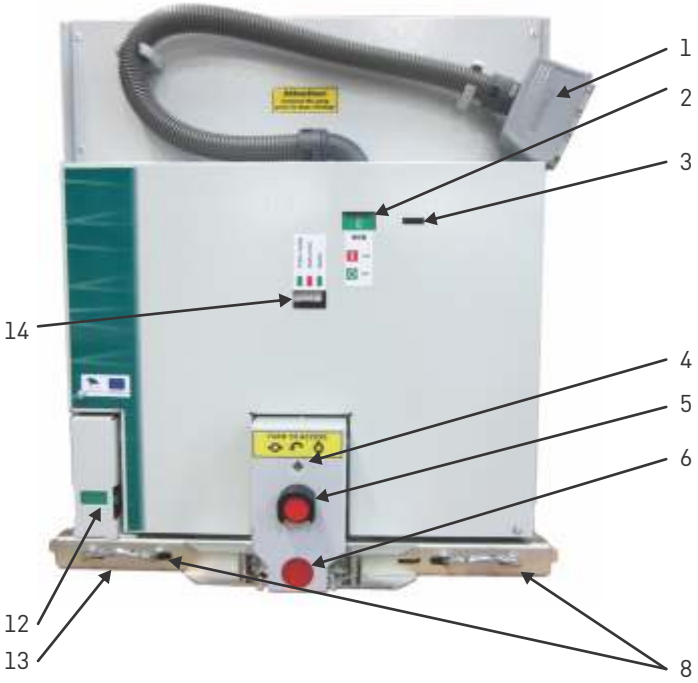
1 – Control cable with auxiliary connector
2 – Indicator of main contacts position
3 – Counter of operations
4 – Circuit breaker / draw-out unit interlock
5 – Manual trip push-button
6 – DOU operating interface
7 – Shutters actuators
8 – DOU operating handles
9 – Support insulators
10 – Movable contacts
11 – Circuit breaker
12 – Mechanical indicator of DOU position
13 – Low-body vehicle

CBunit_DOU15(25) Mile series cassette front view



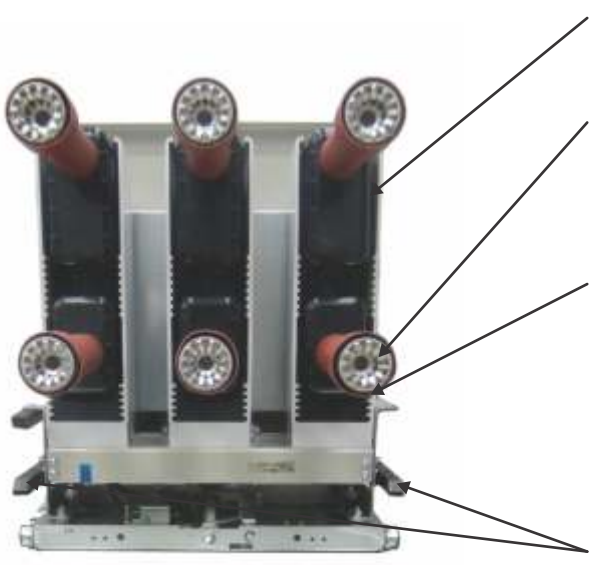
CBunit_DOU15_Shell2(Mile_210-31,5-1250_C_e220_0) rear view
CBunit - Draw-out unit with circuit breaker
DOU15 - Rated voltage up to 17.5kV
Shell2 - ISM15_Shell2 circuit breaker
Mile - Mile series switchgear
210 - Pole distance 210mm
31.5 - Rated breaking current
1250 - Rated current 1250A
C - DOU version cassette
e220 - Electromagnet, aux voltage 220VDC/AC
0 - built-in control module not included

CBunit_DOU15_LD1(Mile_210-20-1250_C_e110_0) rear view
CBunit - Draw-out unit with circuit breaker
DOU15 - Rated voltage up to 17.5kV
LD1 - ISM15_LD1 circuit breaker
Mile - Mile series switchgear
210 - Pole distance 210mm
20 - Rated breaking current
630 - Rated current 630A
C - DOU version cassette
e110 - Electromagnet, aux voltage 110VDC/AC
0 - built-in control module not included



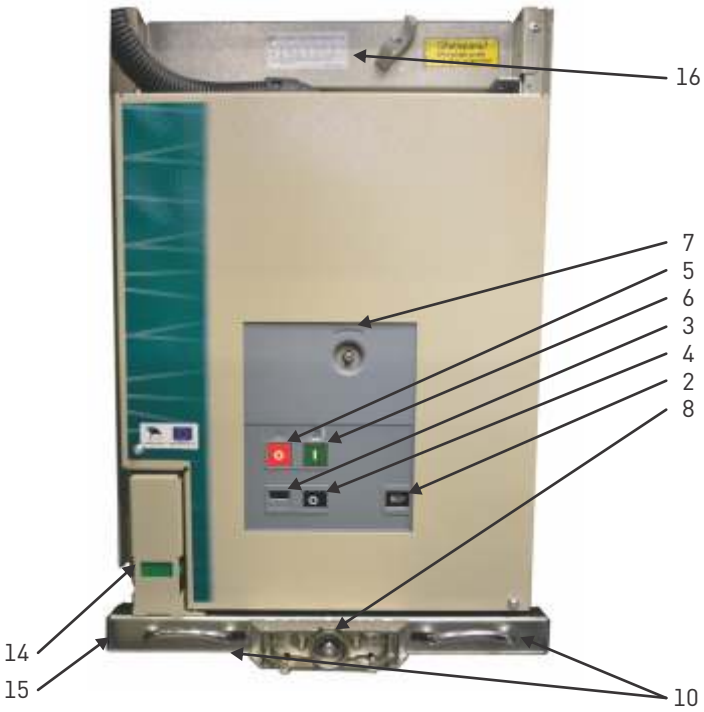
1 – Control cable with auxiliary connector
2 – Indicator of main contacts position
3 – Counter of operations
4 – Circuit breaker / draw-out unit interlock
5 – Manual trip push-button
6 – DOU operating interface
7 – Shutters actuators
8 – DOU operating handles
9 – Isolating covers
10 – Movable contacts
11 – Circuit breaker
12 – Mechanical indicator of DOU position
13 – Low-body vehicle
14 – Control module inspection window

CBunit_DOU15(25) Mile series cassette with built-in control module front view



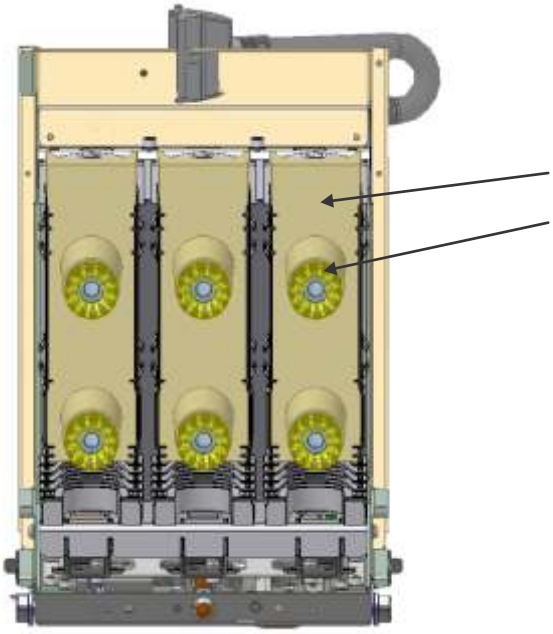
CBunit_DOU15_Shell2(Mile_210-31,5-1250_C_0_CM) rear view
CBunit - Draw-out unit with circuit breaker
DOU15 - Rated voltage up to 17.5kV
Shell2 - ISM15_Shell2 circuit breaker
Mile - Mile series switchgear
210 - Pole distance 210mm
31.5 - Rated breaking current
1250 - Rated current 1250A
C - DOU version cassette
0 - Electromagnet/motor drive not included
CM - built-in control module included

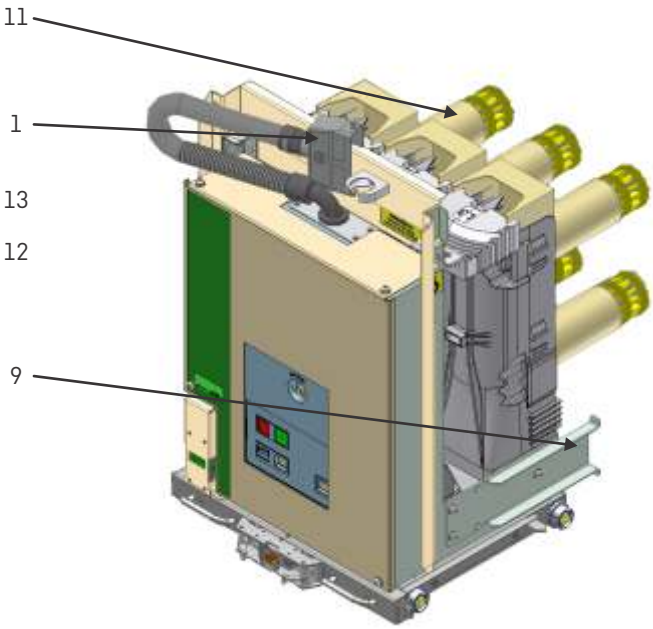
CBunit_DOU15_ LD1(Mile_150-20-630_C_0_CM) rear view
CBunit - Draw-out unit with circuit breaker
DOU15 - Rated voltage up to 17.5kV
LD1 - ISM15_LD1 circuit breaker
Mile - Mile series switchgear
150 - Pole distance 150mm
20 - Rated breaking current
630 - Rated current 630A
C - DOU version cassette
0 - Electromagnet/motor drive not included
CM - built-in control module included



1 – Control cable with auxiliary connector
2 – Indicator of main contacts position
3 – Counter of operations
4 – Closing spring charged indicator
5 – Close push-button
6 – Open push-button
7 - CB operating interface
8 – DOU operating interface
9 – Shutters actuators
10 – DOU operating handles
11 – Isolating covers
12 – Movable contacts
13 – Circuit breaker
14 – Mechanical indicator of DOU position
15 – Low-body vehicle
16 – Nameplate (DOU technical parameters)

CBunit_DOU15_Sion3AE5 cassette with Sion VCB

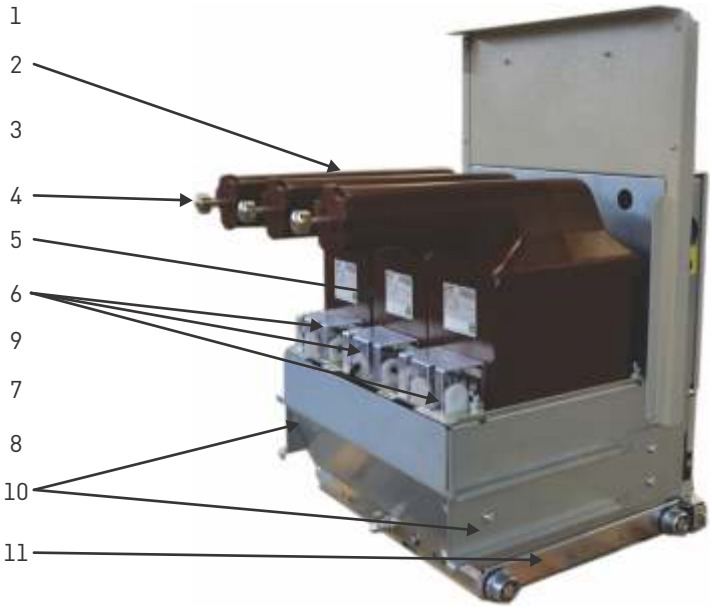




CBunit_DOU15_Sion3AE5(Mile_150-25-1250_C_e110_0) rear view
CBunit - Draw-out unit with circuit breaker
DOU15 - Rated voltage up to 17.5kV
Sion3AE5 - Sion3AE5 circuit breaker
Mile - Mile series switchgear
150 - Pole distance 210mm
25 - Rated breaking current
1250 - Rated current 1250A
C - DOU version cassette
0 - Electromagnet, aux voltage 110VDC/AC
CM - built-in control module included

4.2.2 Draw-out unit with Voltage Transformers (SGunit_DOU15(25)_VTX)

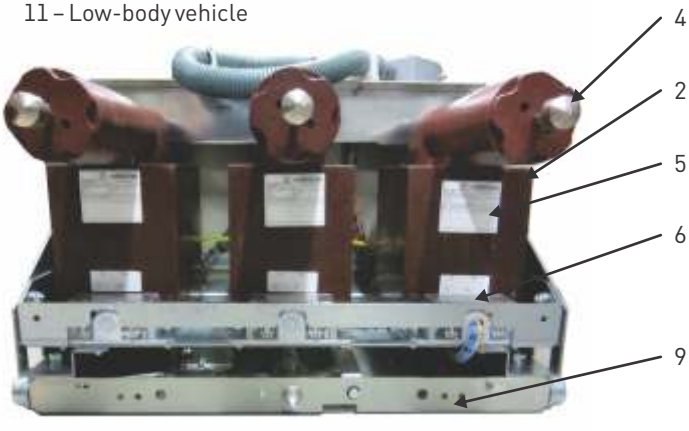
SGunit_DOU15_VTA(Mile_1_CB_150_C_0_0) front view
SGunit - Draw-out units without circuit breaker
DOU15 - Rated voltage up to 17.5 kV
VTA - Voltage transformers ALCE Elektrik
Mile - Mile series switchgear
1 - Fused VT, 3 winding, cl. 0,5
CB - Circuit breaker compartment
150 - Pole distance 150mm
C - DOU version cassette
0 - Electromagnet/motor drive not included
0 - Blown fuse indication system not included



SGunit_DOU15_VTA(Mile_1_CB_150_C_0_0) rear view

1 – Nameplate (DOU technical parameters)
2 – Voltage transformers
3 – Control cable with auxiliary connector
4 – Voltage transformer contact pin
5 – Nameplate (VT Technical parameters)
6 - VT secondary winding terminal blocks, protected with plastic cap
7 – DOU operating handles
8 – DOU operating interface
9 – Mechanical indicator of DOU position
10 – Shutters actuators
11 – Low-body vehicle

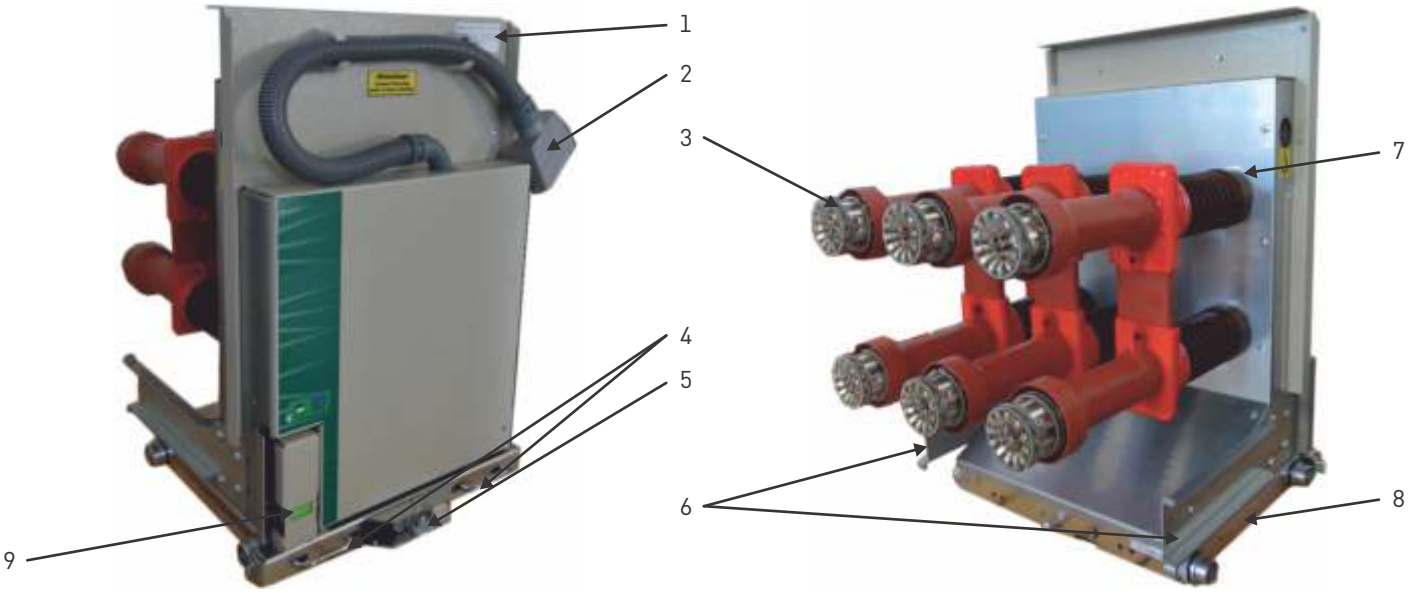
SGunit_DOU15_VTA(Mile_2_CC_150_C_0_S) front view
SGunit - Draw-out units without circuit breaker
DOU15 - Rated voltage up to 17.5 kV
VTA - Voltage transformers ALCE Elektrik
Mile - Mile series switchgear
2 - Fused VT, 3 winding, cl. 0,2
CC - Cable compartment
150 - Pole distance 150mm
C - DOU version cassette
0 - Electromagnet/motor drive not included
S - Blown fuse indication system included



SGunit_DOU15_VTA(Mile _2_CC_150_C_0_S) rear view

1 – Nameplate (DOU technical parameters)
2 – Voltage transformers with fuse
3 – Control cable with auxiliary connector
4 – Voltage transformer contact pin
5 – Nameplate (VT Technical parameters)
6 – VT secondary winding terminal blocks, protected with plastic cap
7 – DOU operating handles
8 – DOU operating interface
9 – Low-body vehicle

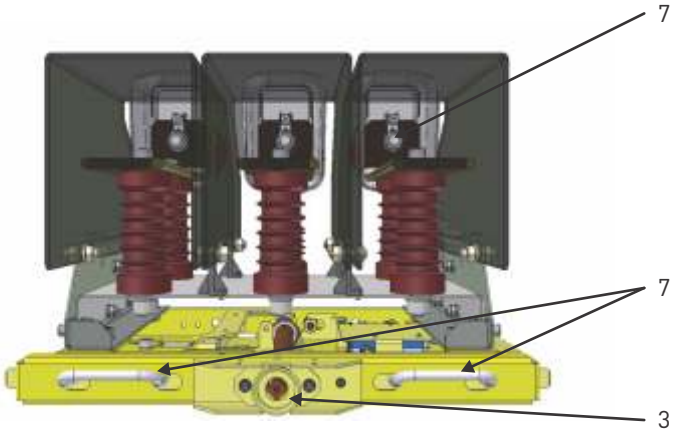
4.2.3 Draw-out unit isolating Truck (SGunit_DOU15(25)_IT)



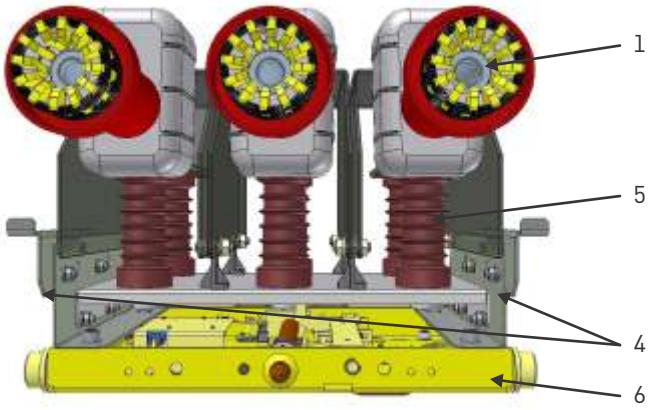
SGunit_DOU15_IT(Mile_CB_210_2000_C_0)
SGunit - Draw-out units without circuit breaker
DOU15 - Rated voltage up to 17.5 kV
IT - Isolating Truck
Mile - Mile series switchgear
CB - Circuit breaker compartment
210 - Pole distance 210mm
2000 - Rated current 2000A
C - DOU version cassette
0 - Electromagnet/motor not included

1 – Nameplate (DOU technical parameters)
2 – Control cable with auxiliary connector
3 – Movable contacts
4 – DOU operating handles
5 – DOU operating interface
6 – Shutters actuators
7 – Support insulators
8 – Low-body vehicle
9 – Mechanical indicator of DOU position

4.2.4 Cable testing trolley draw-out unit (SGunit_DOU15(25)_CTT)



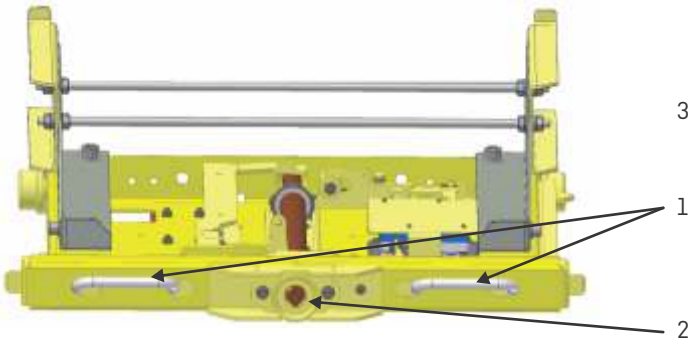
SGunit_DOU15_CTT(Mile_210_1250_C) front view
SGunit - Draw-out units without circuit breaker
DOU15 - Rated voltage up to 17,5 kV
CTT - Cable testing draw-out unit
Mile - Mile series switchgear
210 - Pole distance 210mm
1250 - Rated current 1250A
C - DOU version cassette



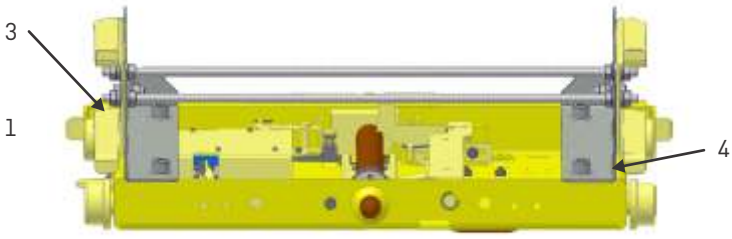
SGunit_DOU15_CTT(Mile_210_1250_C) rear view

1 – Movable contacts
2 – DOU operating handles
3 – DOU operating interface
4 – Shutters actuators
5 – Support insulators
6 – Low-body vehicle
7 – Power contacts for testing

4.2.5 Cable service trolley draw-out unit (SGunit_DOU15(25)_CST)



SGunit_DOU15_CST(Mile_150_C) front view
SGunit - Draw-out units without circuit breaker
DOU15 - Rated voltage up to 17.5kV
CST - Cable service draw-out unit
Mile - Mile series switchgear
150 - Pole distance 150mm
C - DOU version cassette



SGunit_DOU15_CST(Mile_150_C) rear view

1 – DOU operating handles
2 – DOU operating interface
3 – Shutters actuators
4 – Low-body vehicle

4.3 Circuit breaker

4.3.1 Presentation

The withdrawable circuit breaker (CBunit_DOU15 (25)) version is based on a fixed type vacuum circuit breaker and control module. These modules, developed with the latest switching and electronic control technology, can be used as the core components of medium voltage switchgear. There are two basic module types:

- Switching modules (either LD, Shell or HD types) are used to close and open primary circuits.
- Control modules (CM) are used to provide control (close and trip operations) of LD, Shell or HD modules.

Switching modules are three pole units. Each pole incorporates a vacuum interrupter and single-coil magnetic actuator encapsulated in solid insulation. Control modules are microprocessor-based electronic units, containing built-in close and trip capacitors. The close and trip capacitors can be discharged onto the actuator coil to provide appropriate operations. The ability to choose switching and control modules separately allows any type of switchgear to be easily configured with regard to its primary and auxiliary circuits.

The LD, Shell and HD circuit breakers and the CM control modules are the result of years of R&D by scientists and engineers. Their use in the SG_MILE switchgear allow users to benefit from a unique combination of features:

- No maintenance needed during its entire lifetime.
- Long mechanical and interrupting life.
- Fast autoreclosing capability.
- Low power consumption in auxiliary circuits.
- Light weight.
- Fastest arc interruption.

4.3.2 Overall design

In contrast to the majority of conventional circuit breakers, this patented design incorporates three independent magnetic actuators: one per pole. This minimizes the number of moving parts and makes all of these parts coaxial. The vacuum interrupter and the magnetic actuator are located at opposite ends of a hollow support insulator. The actuator armature is rigidly coupled to the vacuum interrupter moving contact by a linear drive insulator within the support insulator. This provides direct linear movement and eliminates the use of rotating shafts, bearings and bell cranks. The result is a maintenance free vacuum circuit breaker with a long, trouble-free mechanical life. The actuators are situated inside the frame as shown in the figure below. A synchronizing shaft connects the three poles and performs three functions:

- Opening synchronization of the poles.
- Operation of auxiliary switches.
- Link drive for mechanical interlocks on switchgear.

4.3.3 Magnetic actuator

The actuator is held in its two states without the use of mechanical latches:

- In the OPEN position the armature is held by the opening spring.
- In the CLOSED position the armature is held by the magnetic flux, produced by a ring magnet.

This actuator has only one coil. Current flows into the coil in different directions for closing and tripping the actuator.

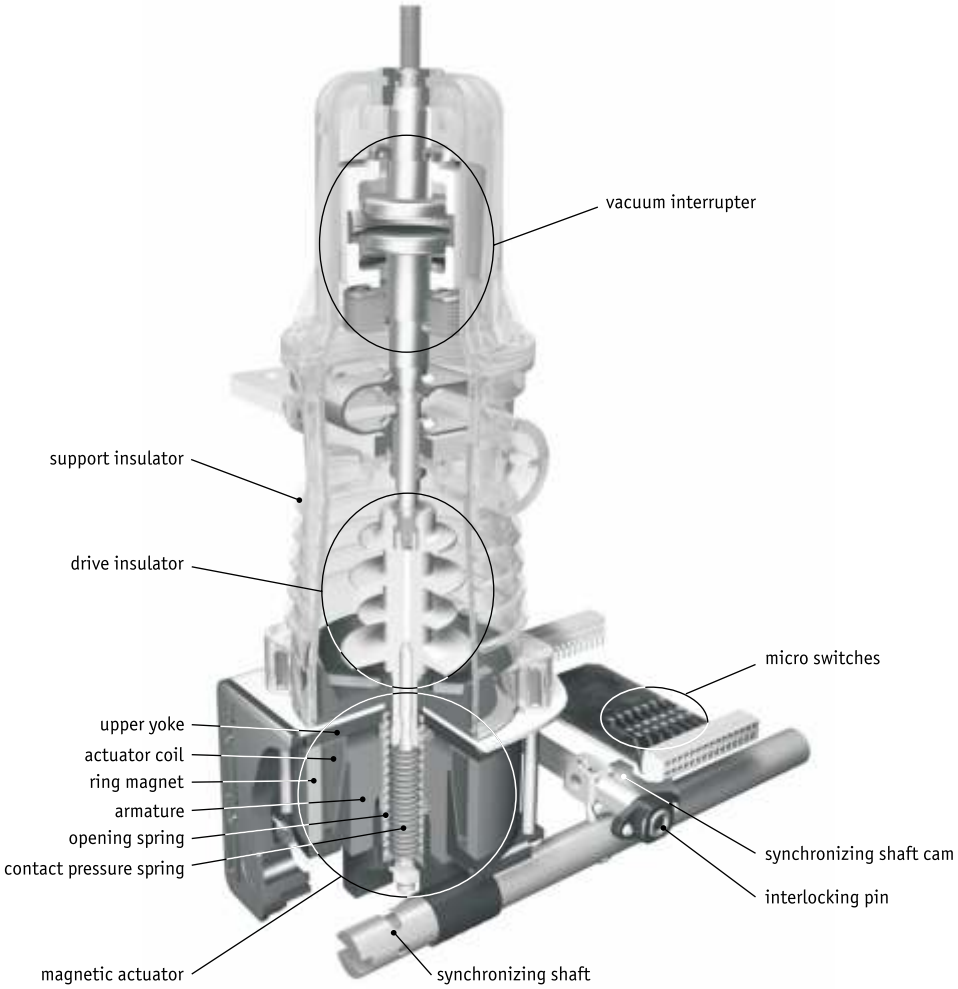


Fig.4.1. ISM15(25)_LD circuit breaker pole cross-section

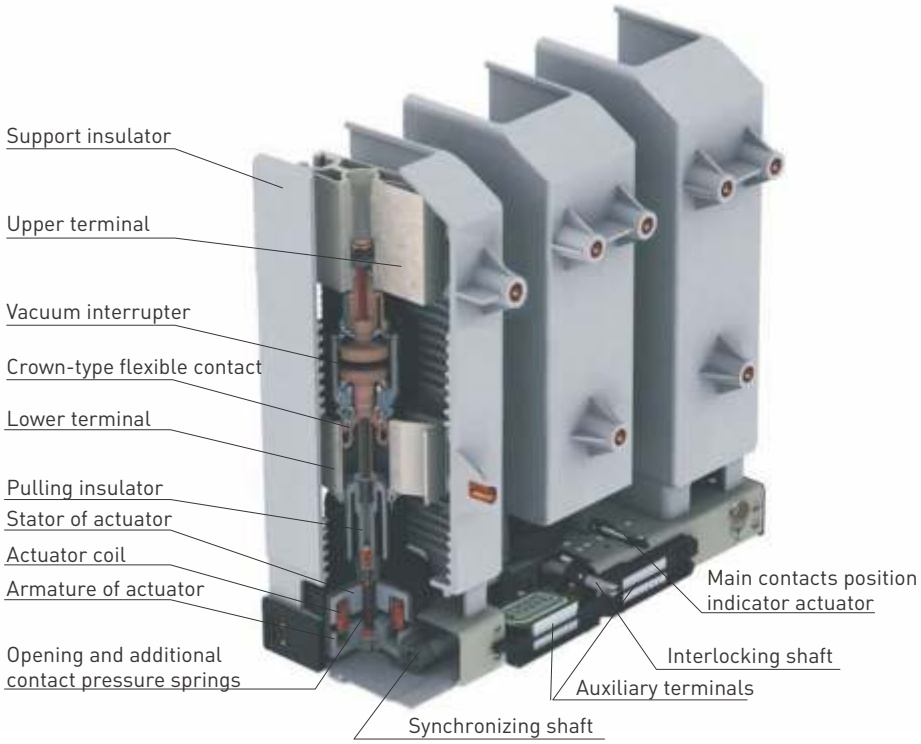
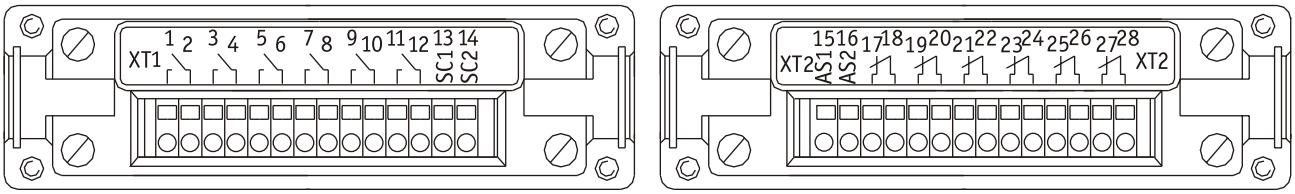


Fig.4.2. ISM15(25)_Shell circuit breaker pole cross-section

Terminal arrangement for the three-phase circuit breaker

Every circuit breaker has 6NO+7NC auxiliary contacts for indication and control.



XT1		XT2	
Terminal №	**Connection**	**Terminal №**	**Connection**
1	NO auxiliary switch 1(1)	15	NC auxiliary switch (1) (1)
2	NO auxiliary switch 1(2)	16	NC auxiliary switch (2) (2)
3	NO auxiliary switch 2(1)	17	NC auxiliary switch 7(1)
4	NO auxiliary switch 2(2)	18	NC auxiliary switch 7(2)
5	NO auxiliary switch 3(1)	19	NC auxiliary switch 8(1)
6	NO auxiliary switch 3(2)	20	NC auxiliary switch 8(2)
7	NO auxiliary switch 4(1)	21	NC auxiliary switch 9(1)
8	NO auxiliary switch 4(2)	22	NC auxiliary switch 9(2)
9	NO auxiliary switch 5(1)	23	NC auxiliary switch 10(1)
10	NO auxiliary switch 5(2)	24	NC auxiliary switch 10(2)
11	NO auxiliary switch 6(1)	25	NC auxiliary switch 11(1)
12	NO auxiliary switch 6(2)	26	NC auxiliary switch 11(2)
13	actuator coil (1) (1)	27	NC auxiliary switch 12(1)
14	actuator coil (2) (2)	28	NC auxiliary switch 12(2)

Note: NC auxiliary switch with terminals 15, 16 is used for interconnection with control module.
Normal position of the microswitches corresponds to the "open" position of the circuit breaker main contacts.

4.3.4 Vacuum interrupters

When the vacuum interrupter contacts are opened, the interrupting current initiates a so-called "vacuum arc" that burns essentially as plasma originating from evaporated contact material. The current continues to flow through this plasma until a zero current is reached. At this moment the arc is extinguished and a transient recovery voltage appears across the open gap. If the contact surface is locally overheated, it produces excessive vapor, resulting in the deterioration of the vacuum followed by an electrical breakdown. To avoid this, effective control of the vacuum arc is necessary. The most effective way to achieve this goal is to apply an axial magnetic field produced by the interrupting current itself. This method is implemented in vacuum interrupters for ISM15(25)_LD(Shell, HD) modules. Several major benefits result from this design:

- High interrupting capacity.
- Very compact dimensions.
- Low chopping current (4-5 amps) This limits inductive switching overvoltages to safe values.
- Axial magnetic field minimizes contact erosion and ensures a very long and reliable life.

Fig.4.3. Vacuum interrupters

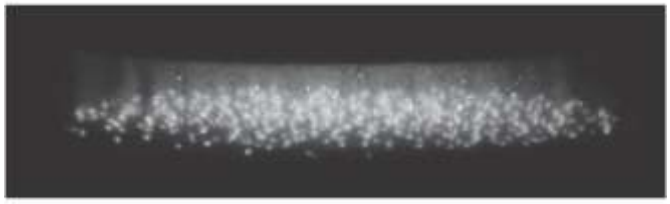


Fig.4.4. Finely dispersed vacuum arc resulting from stabilizing effect of axial magnetic field

4.4 Control modules

Control modules (CM) are used to provide control (close and trip operations) of ISM15(25)_LD, ISM15(25)_Shell, ISM15_HD vacuum circuit breakers.

Table 4.1

Description	Code	Operative voltage	Picture
Control Module	CM_16_1(220)	100/220VDC; 100-230VAC	
Control Module	CM_16_1(60)	24-60VDC	
Control Module	CM_16_2(220)	100/220VDC; 100-230VAC	

4.4.1 Emergency closing devices

The emergency closing devices are used in the case of auxiliary supply outage to perform the first or an emergency close. There are two types of the devices available: a manual closing generator and a handheld closing device.

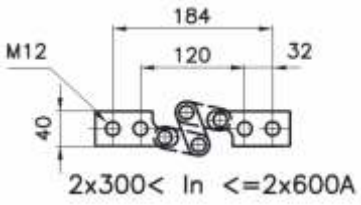
- Manual closing generator is used to charge the capacitors of Control Module to perform the first close without need of battery. ManGen can be placed directly in Low-Voltage compartment and used when needed or be a part of a kit. In this case ManGen has a plug to be connected to the socket inside the Low-Voltage compartment.
- Handheld closing device is used in the same way as ManGen but the HCD should be equipped with batteries prior to start closing operation.

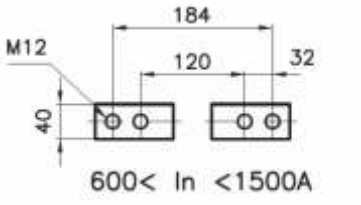
Table 4.2

Description	Code	Applicable Control Module	Picture
Manual generator	SGKit_ManGen_02-110	CM_16_1(220) CM_16_2(220)	
	SGKit_ManGen_02-30	CM_16_1(60)	
Handheld closing device	SGkit_HCD_01-220	CM_16_1(220) CM_16_2(220)	
	SGkit_HCD_01-60	CM_16_1(60)	

4.5 Current transformers

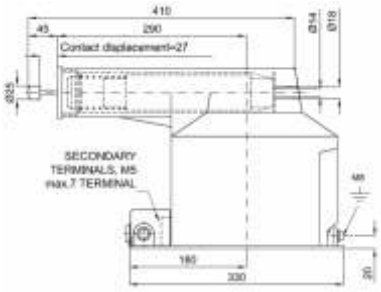
The support type current transformers are used to provide current information from the line to protection relays, control systems and power metering devices.
All active parts are solidly insulated with cast resin.
All current transformers comply with IIEC 61869-2: Instrument transformers - Part 2: Additional requirements for current transformers, GOST 7746-2015 and DIN 42600.
The SG_Mile switchgear is designed for mounting many different types of manufactures of support type current transformers.





4.6 Voltage transformers

The voltage transformers are used to provide voltage information from the line to protection relays, control systems and power metering devices. All active parts of transformer are solidly insulated with cast resin. This material performs both the electrical insulating and the mechanical functions.
Voltage transformers are designed for fixed installation or mounting on a withdrawable truck in the switchgear. Both types can be equipped with protection fuses with a striker system. This system can also send a signal of a blown fuse to SCADA.
Fuses of voltage transformer can be placed on its top side on request.
Fixed voltage transformers can be installed directly on the main busbar system on the top of switchgear.
The transformers comply with IEC 61869-3: Instrument transformers - Part 3: Additional requirements for inductive voltage transformers, GOST 1983-2015 and DIN 42600.



4.7 Zero sequence current transformer

The zero sequence current transformers are used for measuring phase currents or detect earth fault currents. They are solidly insulated with cast resin.
Transformers can be mounted inside a panel or fitted to the bottom of switchgear in a cable cellar.

4.8 Earthing switch

Each panel can be fitted with an earthing switch for cable earthing. The same device can also be used to earth the sectional busbar system in metering or bus coupler panel.The busbar earthing switch can be mounted on the top of panel into special attachment upon request.
The earthing switch has short-circuit making capacity.
The earthing switch can be operated from the front of switchgear and can be manual or motor operated.
The earthing switch position can be determined from the front of the switchgear by means of a mechanical indicator. For the applications of front and rear access panel, the position of the earthing switch can also be determined from the rear of the panel by means of mechanical position indication through an inspection window.
The earthing switch conforms with IEC 62271-102.

Earthing switch has 5NO+5NC auxiliary contacts for position indication:

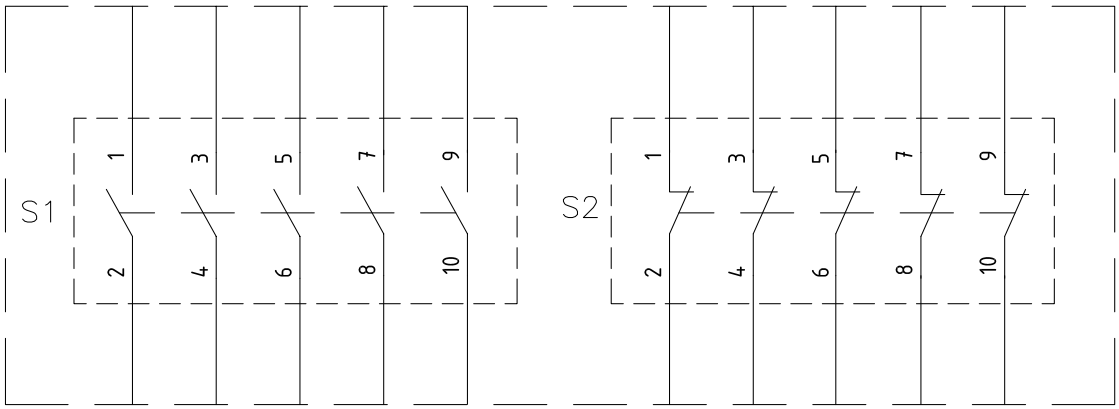


Fig.4.5. Auxiliary contacts of the earthing switch

4.9 Surge Arresters

The switchgear can be equipped with surge arresters. They are used to protect the panel against lightning and switching overvoltages and are installed in the cable compartment.
Surge arresters conform with IEC 60099-4 and GOST R 52725-2007 standards.

4.10 Accessorises

For convenient installation and maintenance, the switchgear can be equipped with the following accessorises:
1. Left side and right side switchgear covers
2. Antioxidant joint compound
3. Kit of keys, handles and hooks for operation
4. Toolboard
5. Manual generator or handheld closing device
6. Kit of spare parts on request

5. INTERLOCKS AND LOCKING DEVICES

The SG_Mile switchgear is fitted with all interlocks needed to guarantee the highest level of safety for operators. According to IEC 62271-200 the interlocking devices prevent:

- Closing of a circuit breaker in the intermediate position
- Racking-in/out of a circuit breaker in the closed position
- Opening of the circuit breaker compartment door as long as the circuit breaker is not in the test position
- Closing of the circuit breaker compartment door, unless secondary circuits plug is not connected
- Racking-in of the circuit breaker from test to service position while the compartment door is open

In addition, if a panel is equipped with an earthing switch, the interlocking devices prevent:

- Racking-in of the circuit breaker while the earthing switch is closed
- Closing of the earthing switch when the circuit breaker is closed or in the intermediate position
- Opening of the cable compartment door while the earthing switch is open
- Opening of the earthing switch while the cable compartment door is open
- Opening of the cable compartment door, unless earthing switch is not closed

All doors of SG15(25)_Mile switchgear have swing-handles equipped with the key-locks.

The earthing switch close/open operations can be prevented by applying the padlocks or castell lock to the corresponding openings or slots.

The metal shutters can be locked either together or individually in open and closed positions by means of two independent padlocks.

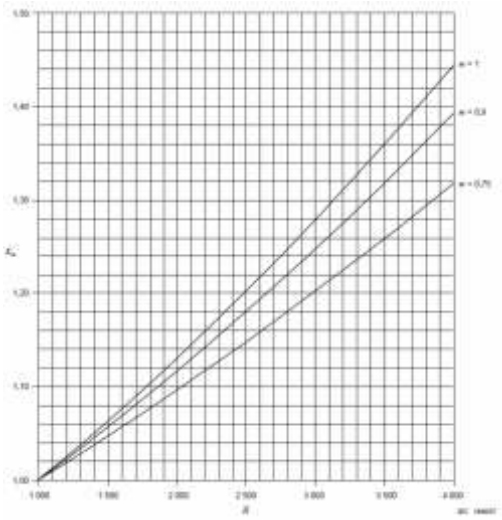
6. TECHNICAL SPECIFICATIONS

The rated characteristics of the switchgear are guaranteed under the following ambient conditions:
In accordance with 62271-1 standard.

Parameter	Parameter value
Minimum ambient temperature	-25°C*
Maximum ambient temperature	+55°C**
Maximum altitude above sea level	1000 m***
Relative humidity	95%
Ambient atmosphere in accordance with IEC 60721-2-1- "Wda": non-explosive, uncontaminated and non-corrosive. Atmosphere type II according to GOST 15150-69.	

* - The value is limited by instrument transformers
** - IEC 62271-200 limits the upper level of ambient temperature at 40°C
*** - For installations in altitudes above 1000 m, the external insulation is calculated as multiplication of rated insulation with Ka in accordance with IEC 62271-1

The panel operation environment must be free dust, particles, fumes or smoke, corrosive or flammable gases, vapors or salts.



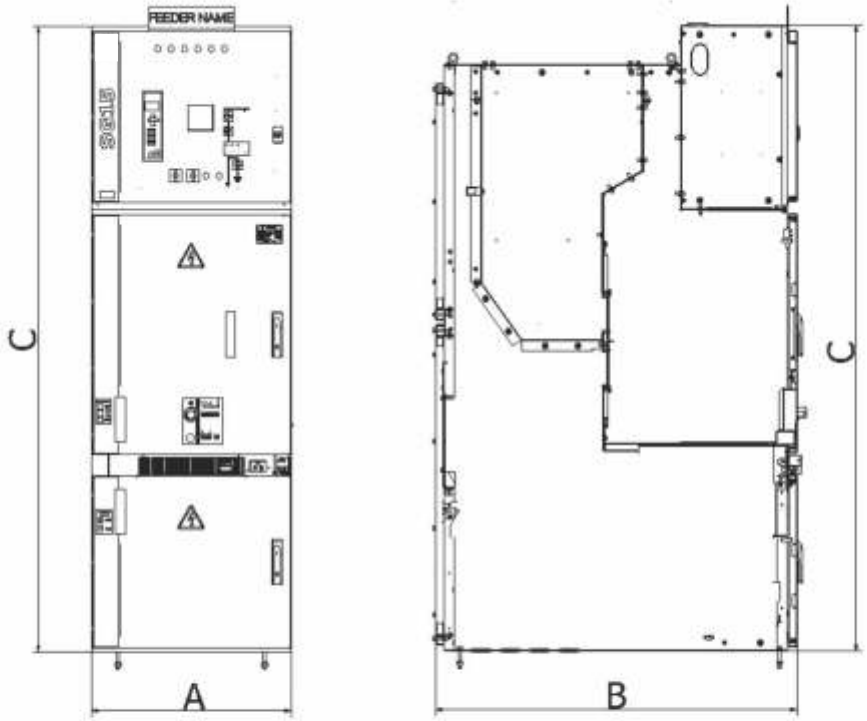
Main technical data	SG15_Mile		SG25_Mile
Rated voltage, kV	12	17.5	24
Rated insulation voltage, kV	12	17.5	24
Rated frequency, Hz	50/60	50/60	50/60
Rated power frequency withstand voltage, 1 min, kV	28(42*)	38(42*)	50
Rated lightning impulse withstand voltage, kV	75	95	125
Rated main busbar current, A	1250; 1600; 2000; 2500; 3150**	1250; 1600; 2000; 2500; 3150**	1250; 1600; 2000; 2500
Rated circuit breaker current, A	630-800 (LD) 630-2500 (Shell) 630-3150 (HD,Sion)	630-800 (LD) 630-2500 (Shell) 630-3150 (HD,Sion)	630-800 (LD) 630-2500 (Shell) 630-2500 (Sion)
Rated branch connection current, A	630; 1250; 1600; 2000; 2500; 3150	630; 1250; 1600; 2000; 2500; 3150	630; 1250; 1600; 2000; 2500
Rated breaking current, kA	20; 25; 31.5	20; 25; 31.5	16; 20; 25
Rated short-time withstand current (3 s), kA	20; 25; 31.5	20; 25; 31.5	16; 20; 25
Rated peak withstand current, kA	52; 63; 82	52; 63; 82	42; 52; 63
Rated supply voltage for auxiliary circuits, V			
DC	24; 48; 110; 125; 220	24; 48; 110; 125; 220	24; 48; 110; 125; 220
AC	100-230	100-230	100-230
Insulation level	Normal	Normal	Normal

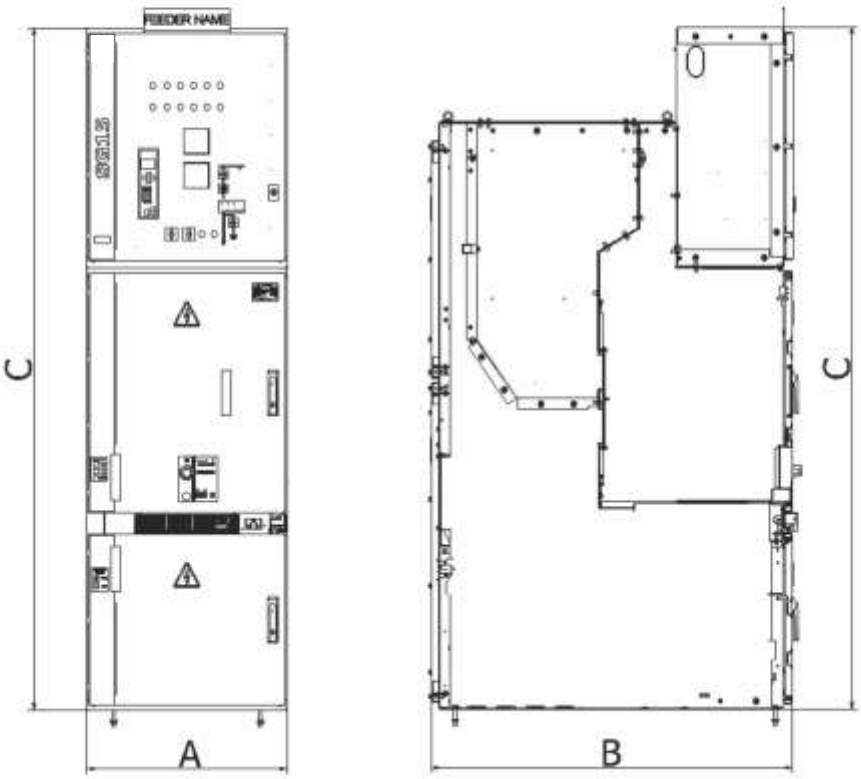
Main technical data	SG15_Mile		SG25_Mile
Insulation type	Air	Air, Heat-shrink	Air, Heat-shrink
IAC classification (IEC62271-200)	AFLR 31.5kA/1s	AFLR 31.5kA/1s	AFLR 25kA/1s
Busbar insulation	Partly-insulated	Insulated	Insulated
Maintenance version	Front; front/rear access	Front; front/rear access	Front; front/rear access
Control version	Local and RTU	Local and RTU	Local and RTU
Height	2348***	2348***	2348***
Height, mm (extended LV compartment)	2558***	2558***	2558***
Width, mm			
600	630..1250A	630..1250A	-
750	630..2000A	630..2000A	630..1250A
1000	2000..3150A	2000..3150A	630..2500A
Depth	1355	1355	1593
Class of protection	IP 4X (IP 41 on request)	IP 4X (IP 41 on request)	IP 4X (IP 41 on request)

* - In accordance with GOST
** - Forced cooling
*** - Without feeder nameplate

7. OVERALL DIMENSIONS

Cassette type





Switchboard type	Width, A mm	Depth, B mm	Height, C mm	Height, D mm (extended LV compartment)
SG15_Mile	600, 750, 1000	1355	2348*	2558*
SG25_Mile	750, 1000	1593	2348*	2558*

* - Without feeder nameplate

SG15_Mile

Depth (mm)	1355			
Height (mm)	2348			
Width (mm)	1000			
	750			
	600			
Weight (kg)	780		930	1050
Rated current (A)	630	1250	1600/ 2000	2500/ 3150
IF				
OF				
BC				
BR				
BRES				
BRM				
BT*				
M				
MES				
LBSF**				
STP**				

* - BT panel width is from 1000mm
** - STP and LBSF panels maximum ratings are 630A, available with width 750mm

SG25_Mile

Depth (mm)	1593		
Height (mm)	2348		
Width (mm)			
	750		1000
Weight (kg)	800		1100
Rated current (A)	630	1250/ 1600	2000/ 2500
IF			
OF			
BC			
BR			
BRES			
BRM			
BT*			
M			
MES			
LBSF**			
STP**			

* - BT panel width is from 1000mm
** - STP and LBSF panels maximum ratings are 630A, available with width 750mm or 1000mm

APPLICATION GUIDE

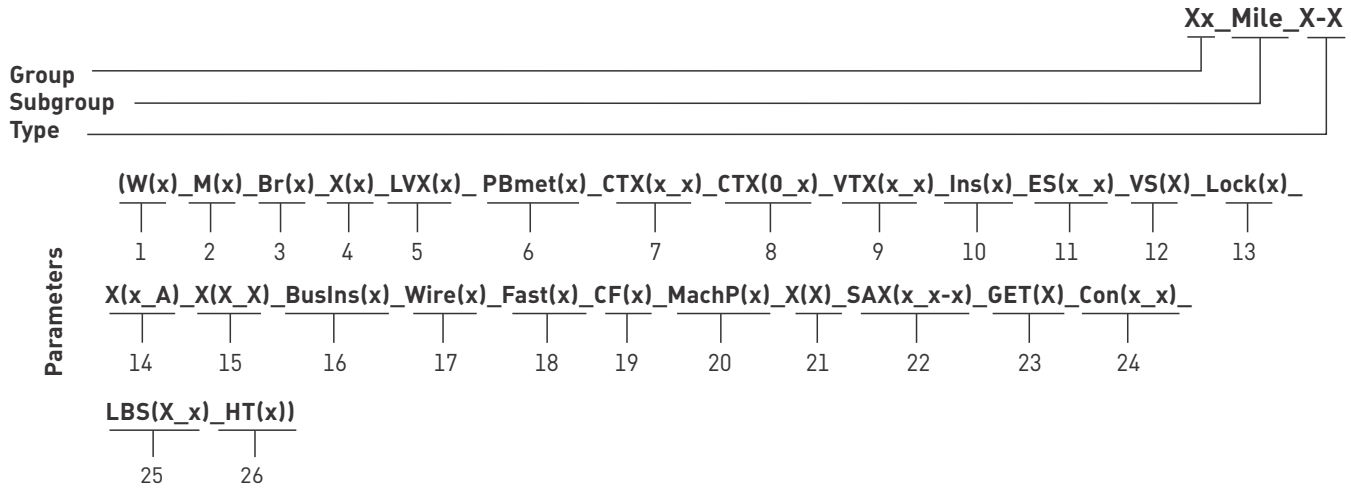
This guide provides instructions for installation and use of the switchgear.

8. SELECTION

8.1 Selection parameters for the Mile series panels

The SG_Mile Switchgear is available in three different options:
SP (Switchgear panel) – fully assembled and tested SG_Mile switchgear panels;
PB (Power block) – assembled and tested metal enclosure with fully functional mechanical interlocks;
KD (Knocked down panel) – set of kits, necessary for assembly at customer premises (valid license contract required).

All major parts, components or accessories are grouped into different kits. Each kit belongs to a certain component group, subgroup, has a type and parameter, which may vary depending on the quantities, ratings or characteristics. The combination of the kits forms the unique code of the panel, indicating what equipment is in each panel.
The basic groups, subgroups, types and parameters of the Mile series switchgear are presented below.



X – letters, x - numbers
If any of the kit is not included, the "0" is displayed.

Classifier Group	Abbreviation	Description
GROUP	SP15	Fully assembled and routine test panel up to 17.5kV
	SP25	Fully assembled and routine test panel up to 24kV
	PB15	Assembled enclosure with functional interlocks to 17.5kV
	PB25	Assembled enclosure with functional interlocks to 24kV
	KD15	Supply of loose detail kits for customer assembly up to 17.5kV
	KD25	Supply of loose detail kits for customer assembly up to 24kV
SUBGROUP	Mile	SG_Mile series switchgear
TYPE	IF-C	Incomer (Cassette)
	OF-C	Outgoing panel (Cassette)
	BC-C	Bus Coupler (Cassette)
	BR	Bus Riser
	BRM-C	Bus Riser with Metering (Cassette)
	BRES-C	Bus Riser with earthing switch and isolating truck (Cassette)
	BT-L-C	Bus Tie Left (Cassette)
	BT-R-C	Bus Tie Right (Cassette)
	M-C	Metering panel (Cassette)
	MES-C	Metering panels with earthing switch (Cassette)
	LBSF	Load break switch with fuse panel
	STP	Service transformer panel

Type Nr.	Type (Parameter)	Classifier Group_Subgroup	Description	
PARAMETERS	W(600)	(1) MileWidth_Milewidth Panel width	600mm	
	W(750)		750mm	
	W(1000)		1000mm	
	M(1250)	(2) SGkit_Busbars Main busbar kits	Rated current 1250A	
	M(1600)		Rated current 1600A	
	M(2000)		Rated current 2000A	
	M(2500)		Rated current 2500A	
	M(3150)		Rated current 3150A	
	Br(630)	(3) SGkit_Busbars Branch busbar kits	Rated current 630A	
	Br(1250)		Rated current 1250A	
	Br(1600)		Rated current 1600A	
	Br(2000)		Rated current 2000A	
	Br(2500)		Rated current 2500A	
	Br(3150)		Rated current 3150A	
	VTAt(x_x)	(4) SGkit_VTt15 VT top installation kit	Voltage Transformer Alce VT for top installation panel attachment for MILE panel up to 17.5kV Characteristics (x_x):	
			First letter 'x' - pole distance: 150 - 150mm 210 - 210mm 275 - 275mm	Second letter 'x' - option: 1 - Fused VT, 3 windings, cl. 0,5 2 - Fused VT, 3 windings, cl. 0,2 3 - VT, 3 windings, cl. 0,5 4 - VT, 3 windings, cl. 0,2
	VTAt(x_x)	(4) SGkit_VTt25 VT top installation kit	Voltage Transformer Alce VT for top installation panel attachment for MILE panel up to 24kV Characteristics (x_x):	
			First letter 'x' - pole distance: 150 - 150mm 210 - 210mm 275 - 275mm	Second letter 'x' - option: 1 - Fused VT, 3 windings, cl. 0,5 2 - Fused VT, 3 windings, cl. 0,2 3 - VT, 3 windings, cl. 0,5 4 - VT, 3 windings, cl. 0,2
	ESt(x_x)	(4) SGkit_ESt15 ES top installation kit	Earthing switch top installation panel attachment for MILE panel up to 17.5kV Characteristics (x_x):	
			First letter 'x' - pole distance: 150 - 150mm 210 - 210mm 275 - 275mm	Second letter 'x' - option: 1 - with 110VDC electromagnet 2 - with 220VDC electromagnet 3 - with 24VDC electromagnet 4 - with 48VDC electromagnet 5 - with 110VDC motor drive 6 - with 220VDC motor drive
	ESt(x_x)	(4) SGkit_ESt25 ES top installation kit	Earthing switch top installation panel attachment for MILE panel up to 24kV Characteristics (x_x):	
			First letter 'x' - pole distance: 150 - 150mm 210 - 210mm 275 - 275mm	Second letter 'x' - option: 1 - with 110VDC electromagnet 2 - with 220VDC electromagnet 3 - with 24VDC electromagnet 4 - with 48VDC electromagnet 5 - with 110VDC motor drive 6 - with 220VDC motor drive

Type Nr.	Type (Parameter)	Classifier Group_Subgroup	Description	
PARAMETERS	**LT(x)**	**(4) SGkit_Attach** Rear and side panel attachment kits	left side attachment (variable current)	
	R(x)		rear attachment (variable current)	
	RT(x)		right side attachment (variable current)	
			Characteristics: Letter 'x' - option: 1250 - 1250A current 1600 - 1600A current 2000 - 2000A current 2500 - 2500A current 3150 - 3150A current	
	LVStd(1)	**(5) SGkit_LVmet** LVmet kit	LV cabinet standard size 690mm	
	LVExt(1)		LV cabinet extended size 900mm	
	PBmet(x_x)	**(6) SGkit_PBmet** PBmet kit	Metal enclosure without LV cabinet Characteristics (x_x):	
			First letter 'x' - pole distance: 1 - quantity<3 3 - quantity=>3	Second letter 'x' - option: 600 - 600mm panel 750 - 750mm panel 1000 - 1000mm panel
	CTA(15_x)	**(7) SGcomp_CT15** Current transformers kit	Alce current transformer	
	CTI(15_x)		Intra current transformer	
			Current transformer up to 17.5kV Characteristics: Letter 'x' - option: 1 - 0-200A, 3 winding, cl.0,5 2 - 200-1250A, 3 winding, cl.0,5 3 - 1250-2500A, 3 winding, cl.0,5 4 - 0-200A, 3 winding, cl.0,2 5 - 200-1250A, 3 winding, cl.0,2 6 - 1250-2500A, 3 winding, cl.0,2 7 - 0-200A, 4 winding, cl.0,2 8 - 200-1250A, 4 winding, cl.0,2 9 - 1250-2500A, 4 winding, cl.0,2 10 - 0-200A, 3 winding, cl.X 11 - 200-1250A, 3 winding, cl.X 12 - 1250-2500A, 3 winding, cl.X	
	CTA(25_x)	**(7) SGcomp_CT25** Current transformers kit	Alce current transformer	
	CTI(25_x)		Intra current transformer	
			Current transformer up to 24kV Characteristics: Letter 'x' - option: 1 - 0-200A, 3 winding, cl.0,5 2 - 200-1250A, 3 winding, cl.0,5 3 - 1250-2500A, 3 winding, cl.0,5 4 - 0-200A, 3 winding, cl.0,2 5 - 200-1250A, 3 winding, cl.0,2 6 - 1250-2500A, 3 winding, cl.0,2 7 - 0-200A, 4 winding, cl.0,2 8 - 200-1250A, 4 winding, cl.0,2 9 - 1250-2500A, 4 winding, cl.0,2 10 - 0-200A, 3 winding, cl.X 11 - 200-1250A, 3 winding, cl.X 12 - 1250-2500A, 3 winding, cl.X	

Type Nr.	Type (Parameter)	Classifier Group_Subgroup	Description	
PARAMETERS	CTA(0_1)	(8) SGcomp_CT15 Zero current transformer	Alce CT Zero-sequence, 1 winding, cl. Protection, Dia=180mm up to 17.5kV	
	CTA(0_2)		Alce CT Zero-sequence, 3 split winding, cl. Protection, Dia=180mm up to 17.5kV	
	CTI(0_1)		Intra CT Zero-sequence, 1 winding, cl. Protection. Dia=180mm up to 17.5kV	
	CTA(EFI)		Elektro-Mechanik EM GmbH EFI Earth Fault Indicator kit up to 17.5kV	
	CTA(0_1)	(8) SGcomp_CT25 Zero current transformer	Alce CT Zero-sequence, 1 winding, cl. Protection, Dia=180mm up to 24kV	
	CTA(0_2)		Alce CT Zero-sequence, 3 split winding, cl. Protection, Dia=180mm up to 24kV	
	CTI(0_1)		Intra CT Zero-sequence, 1 winding, cl. Protection. Dia=180mm up to 24kV	
	CTA(EFI)		Elektro-Mechanik EM GmbH EFI Earth Fault Indicator kit up to 24kV	
	VTA(15_1)	(9) SGcomp_VT15 Voltage transformers kit	Alce Fused VT, 3 winding, cl. 0,5 up to 17.5kV	
	VTA(15_2)		Alce Fused VT, 3 winding, cl. 0,2 up to 17.5kV	
	VTA(15_3)		Alce VT, 3 winding, cl. 0,5 up to 17.5kV	
	VTA(15_4)		Alce VT, 3 winding, cl. 0,2 up to 17.5kV	
	VTI(15_1)		Intra Fused VT, 3 winding, cl. 0,5 up to 17.5kV	
	VTA(25_1)	(9) SGcomp_VT25 Voltage transformers kit	Alce Fused VT, 3 winding, cl. 0,5 up to 24kV	
	VTA(25_2)		Alce Fused VT, 3 winding, cl. 0,2 up to 24kV	
	VTA(25_3)		Alce VT, 3 winding, cl. 0,5 up to 24kV	
	VTA(25_4)		Alce VT, 3 winding, cl. 0,2 up to 24kV	
	Ins(1250)	(10) SGkit_Ins15 Insulators kit (fixed contact and through)	Insulator kits for up to 1250A (Through insulators, fix contact bushings), rated voltage up to 17.5kV	
	Ins (1600)		Insulator kits for up to 1600A (Through insulators, fix contact bushings), rated voltage up to 17.5kV	
	Ins(2000)		Insulator kits for up to 2000A (Through insulators, fix contact bushings), rated voltage up to 17.5kV	
	Ins(2500)		Insulator kits for up to 2500A (Through insulators, fix contact bushings), rated voltage up to 17.5kV	
	Ins(3150)		Insulator kits for up to 3150A (Through insulators, fix contact bushings), rated voltage up to 17.5kV	
	Ins(1250)	(10) SGkit_Ins25 Insulators kit (fixed contact and through)	Insulator kits for up to 1250A (Through insulators, fix contact bushings), rated voltage up to 24kV	
	Ins(1600)		Insulator kits for up to 1600A (Through insulators, fix contact bushings), rated voltage up to 24kV	
	Ins(2000)		Insulator kits for up to 2000A (Through insulators, fix contact bushings), rated voltage up to 24kV	
	Ins(2500)		Insulator kits for up to 2500A	
	ES(x_x)	(11) SGkit_ES15 Earthing switch kit	Earthing switch kit for MILE panel up to 17.5kV Characteristics (x_x):	
			First letter 'x' - pole distance: 150 - 150mm 210 - 210mm 275 - 275mm	Second letter 'x' - option: 1 - with 110VDC electromagnet 2 - with 220VDC electromagnet 3 - with 24VDC electromagnet 4 - with 48VDC electromagnet 5 - with 110VDC motor drive 6 - with 220VDC motor drive
	VS(0)	(12) SGkit_VS15 Voltage indication kits	Capacitive Insulators and Voltage Indicator for Mile panel up to 17.5kV	
	VS(R)		Capacitive Insulators and Voltage Indicator with Relay for Mile panel up to 17.5kV	

Type Nr.	Type (Parameter)	Classifier Group_Subgroup	Description
PARAMETERS	**VS(0)**	**(12) SGkit_VS25** Voltage indication kits	Capacitive Insulators and Voltage Indicator for Mile panel up to 24kV
	VS(R)		Capacitive Insulators and Voltage Indicator with Relay for Mile panel up to 24kV
	Lock(IND)	**(13) SGkit_Lock** Locks kit	Hinges, handles and locks kit
	VAMP(X)	**(14) SGcomp_Relay** Relay protection or arc protection kits	VAMP protection relay terminal (variable types)
	ABB(X)		ABB protection relay terminal (variable types)
	SEPAM(X)		SEPAM protection relay terminal (variable types)
	MiCOM(X)		MiCOM protection relay terminal (variable types)
	SEL(X)		SEL protection relay terminal (variable types)
	IF(x_x_x)	**(15) SGkit_LVcomp** LV compartment kit	Auxiliary Wiring and Accessories for IF panel
	MP(X_X_X)		Auxiliary Wiring and Accessories for any MILE panel except for IF panel
			Characteristics (x_x_x): First, second, third letter 'x' - option 0 - without EnergyMeter/Heater/Instruments Heat - with heater Instr - with Instruments (V,A) EM - with Energy Meter
	BusIns(1)	**(16) SGkit_BusIns15** Insulation kit	Heat-Shrink Insulation, incl. barriers as per GOST or IEC, optional insulation as per customer requirements.
	BusIns(1)	**(16) SGkit_BusIns25** Insulation kit	Heat-Shrink Insulation, incl. barriers as per GOST or IEC, optional insulation as per customer requirements.
	Wire(1)	**(17) SGkit_Wire** Wire kit	Internal panel cabling (CT-LV; ES-LV)
	Wire(2)		Internal Cabling for Mile panel: CT-LV; ES-LV; FixedVT-LV or CT0-LV
	Fast(1)	**(18) SGkit_Fastener** Fasteners and fittings kit	Fasteners and standard fitting kit incl. panel interconnection
	CF(1)	**(19) SGkit_CableFix** Cable fixing kits (holders)	MV cable fixing for 1 cable per phase
	CF(2)		MV cable fixing for 2 cable per phase
	CF(3)		MV cable fixing for 3 cable per phase
	CF(4)		MV cable fixing for 4 cable per phase
	CF(6)		MV cable fixing for 6 cables per phase
	MachP(1)	**(20) SGkit_MechDet** Machining details kit	Small machining details or plastic alloys parts
	SP(X)	**(21) Service_Assembly** Assembly work and routine testing service kits	Panel assembly (with customised services)
	PB(X)		Power Block assembly (with customised services)

Type Nr.	Type (Parameter)	Classifier Group_Subgroup	Description
PARAMETERS	SAI(2_X-x)	(22) SGkit_SA Surge arresters kits	Indoor surge arrestor MVT (various characteristics)
	SAV(2_X-x)		Indoor surge arrestor Varisil (various characteristics)
	PA-DM(2_X-x)		Indoor surge arrestor Polymer Apparat (various characteristics)
	GET(B)	(19) SGkit_CableFix Cable fixing kits (holders)	Exhaust duct for a Mile panel, base module
	GET(T)		Exhaust duct for a Mile panel with outlet in the middle
	GET(R)		Exhaust duct for a Mile panel with outlet at the right end
	GET(L)		Exhaust duct for a Mile panel with outlet at the left end
	GET(Ext)		Exhaust bridge duct for a Mile section to a wall outlet. Typical length – 600mm
	Con(3_1250)	(24) SGkit_Con15 Fixed primary contacts kits	Kit of 3 of 1250A contacts for Mile panels up to 17.5kV
	Con(6_1250)		Kit of 6 of 1250A contacts for Mile panels up to 17.5kV
	Con(6_1600)		Kit of 6 of 1600A contacts for Mile panels up to 17.5kV
	Con(6_2000)		Kit of 6 of 2000A contacts for Mile panels up to 17.5kV
	Con(6_2500)		Kit of 6 of 2500A contacts for Mile panels up to 17.5kV
	Con(6_3150)		Kit of 6 of 3150A contacts for Mile panels up to 17.5kV
	Con(3_1250)	(24) SGkit_Con25 Fixed primary contacts kits	Kit of 3 of 1250A contacts for Mile panels up to24kV
	Con(6_1250)		Kit of 6 of 1250A contacts for Mile panels up to 24kV
	Con(6_1600)		Kit of 6 of 1600A contacts for Mile panels up to 24kV
	Con(6_2000)		Kit of 6 of 2000A contacts for Mile panels up to 24kV
	Con(6_2500)		Kit of 6 of 2500A contacts for Mile panels up to 24kV
	LBS(Z_1)	(25) SGcomp_LBS15 Load break switch kits	12kV Load Break Switch for Mile panels. ZWAE LBS+ES+F
	LBS(Z_2)		12kV Load Break Switch for Mile panels. ZWAE LBS+ES+F+shunt+intrl.solenoid
	LBS(Z_3)		12kV Load Break Switch for Mile panels. ZWAE LBS+ES+F+Motor
	LBS(Z_1)	(25) SGcomp_LBS25 Load break switch kits	24kV Load Break Switch for Mile panels. ZWAE LBS+ES+F
	LBS(Z_2)		24kV Load Break Switch for Mile panels. ZWAE LBS+ES+F+shunt+intrl.solenoid
	LBS(Z_3)		24kV Load Break Switch for Mile panels. ZWAE LBS+ES+F+Motor
	HT(25)	(26) SGcomp_HT15 House transformer kit	House Transformer for Mile panels 25kVA up to 17.5kV
	HT(100)		House Transformer for Mile panels 100kVA up to 17.5kV
	HT(160)	(26) SGcomp_HT25 House transformer kit	House Transformer for Mile panels 160kVA up to 24kV

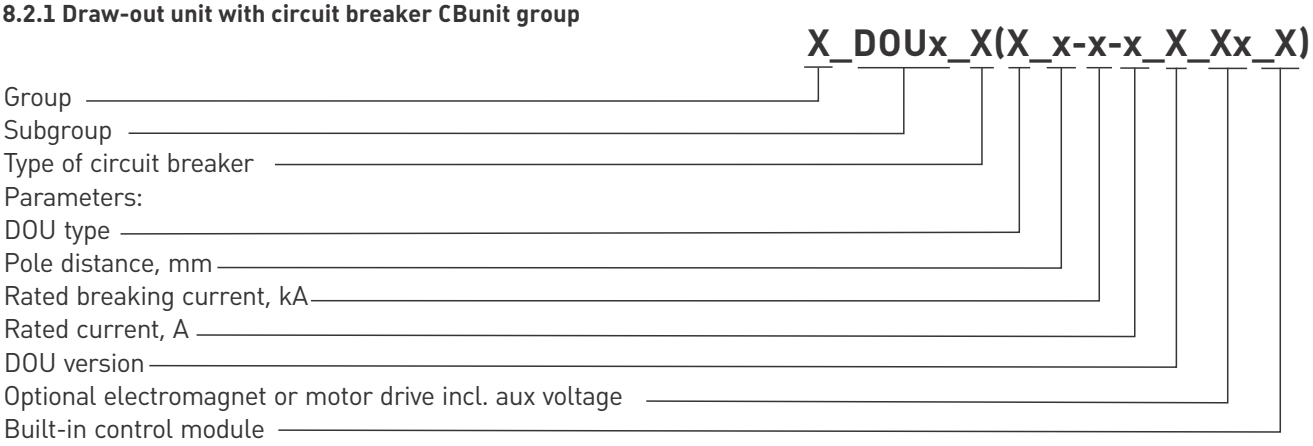
Example:

SP15_Mile_IF-C(W(750)_M(2000)_Br(2000)_LT(2000)_LVStd
(1)_PBmet(1)_CTA(15_3)_CTA(0_1)_0_Ins(2000)_ES(210_4)_VS(R)_Lock(IND)_VAMP(255_A)_IF(Heat
_Instr)_BusIns(1)_Wire(1)_Fast(1)_CF(3)_MachP(1)_SP(RT)_SAV(2_HE-18)_ GET(B)_Con(6_2000)_
0_0)

SP15	Fully assembled and routine testes panel up to 17.5kV
Mile	SG_Mile series switchgear
IF-C	Incomer (Cassette)
W(750)	Panel width 750mm
M(2000)	Main busbar kits rated current 2000A
Br(2000)	Branch busbar kits
LT(2000)	Left side panel attachment for rated current 2000A
LVStd (1)	LV cabinet standard size 690mm
PBmet(1)	Metal enclosure without LV compartment
CTA(15_3)	Alce CT 1250-2500A, 3 winding, cl. 0,5
CTA(0_1)	Alce CT Zero-sequence, 1 winding, cl. Protection, Dia=180mm
0	Voltage transformers not included
Ins(2000)	Insulator kits for up to 2000A, rated voltage up to 17.5kV
ES(210_4)	Earthing switch kit for Mile panel with 210mm PCD up to 17.5kV with 48VDC electromagnet
VS(R)	3x capacitive insulators, indicator with relay, cable kit up to 17.5kV
Lock(IND)	Hinges, handles and locks kit
VAMP(255_A)	Feeder Terminal. VAMP255 18 I/O + Accessories
IF(Heat_Instr)	Aux. Wiring and Accessories with heater and Instruments (V,A) for IF
BusIns(1)	Heat-Shrink Insulation, incl. barriers as per GOST or IEC
Wire(1)	Internal panel cabling (CT-LV; ES-LV; CT0-LV)
Fast(1)	Fasteners and standard fitting kit incl. panel interconnection
CF(3)	MV cable fixing for 3 cables per phase
MachP(1)	Small machining details or plastic alloys parts
SP(RT)	Panel assembly and Routine testing without current tests
SAV(2_HE-18)	Indoor SA Varisil HE18-15.3/18
GET(B)	Exhaust duct for a Mile panel, base module
Con(6_2000)	Kit of 6 of 2000A contacts for Mile panels up to 17.5kV
0	Load break switch not included
0	House transformer not included

8.2 Selection guide for Draw-out units

8.2.1 Draw-out unit with circuit breaker CBunit group



X – letter, x - number

Selection parameters of the draw-out unit with circuit breaker CBunit group

Classifier Group	Abbreviation	Description	
GROUP	**CBunit**	Draw-out units with circuit breaker	
SUBGROUP	**DOU15**	Rated voltage up to 17.5kV	
	DOU25	Rated voltage up to 24kV	
TYPE of circuit breaker	**LD1**	ISM15_LD1; ISM25_LD1 circuit breaker	
	Shell1	ISM25_Shell1 circuit breaker	
	Shell2	ISM15_Shell2 circuit breaker	
	HD1	ISM15_HD1 circuit breaker	
	Sion3AE1	Sion 3AE1 circuit breaker	
	Sion3AE5	Sion 3AE5 circuit breaker	
PARAMETERS	**Mile**	DOU Type	Mile series switchgear
	150	Pole distance	150mm
	210		210mm
	275		275mm
	16	Rated breaking current	16kA
	20		20kA
	25		25kA
	31.5		31.5kA
	630	Rated current	630A
	1250		1250A
	1600		1600A
	2000		2000A
	2500		2500A
	3150		3150A
	C	DOU version	Cassette
	e24	Optional electromagnet or motor drive incl. aux voltage	Electromagnet, aux voltage 24VDC
	e48		Electromagnet, aux voltage 48VDC
	e110		Electromagnet, aux voltage 110VDC/AC
	e125		Electromagnet, aux voltage 125VDC/AC
	e220		Electromagnet, aux voltage 220VDC/AC
	m110		Motor drive, aux voltage 110VDC (additional electromagnet on request)
	m220		Motor drive, aux voltage 220VDC (additional electromagnet on request)
	CM	Built-in control module	CM_16 control module onboard

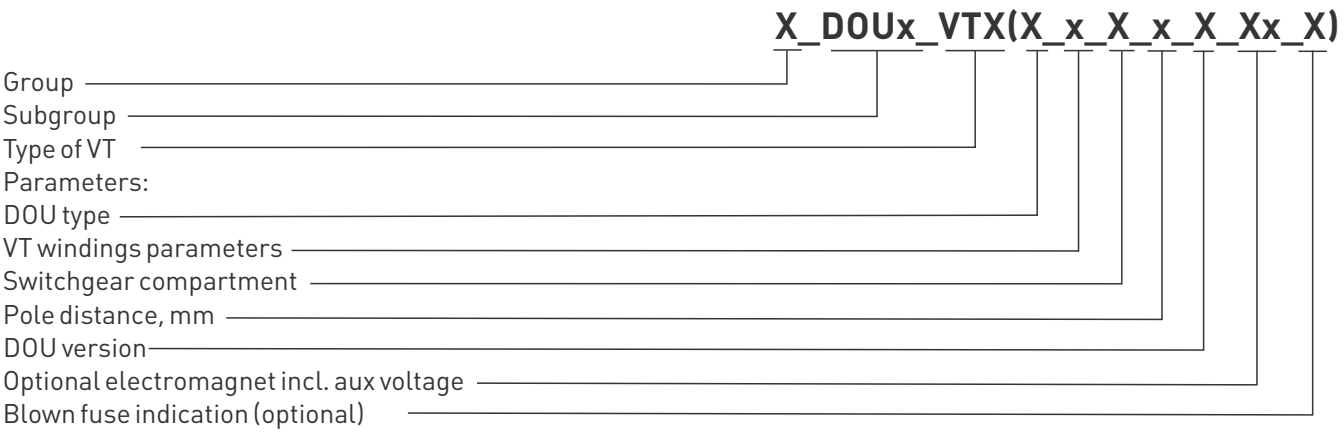
If any of the option is not included, a "0" is displayed.

Example:

CBunit_DOU15_Shell2(Mile_150-25-1250_C_0_CM)

CBunit	Draw-out units with circuit breaker
DOU15	Rated voltage up to 17.5kV
Shell2	ISM15_Shell2 circuit breaker
Mile	Mile series switchgear
150	Pole distance 150mm
25	Rated breaking current 25kA
1250	Rated current 1250A
C	DOU version cassette
0	Electromagnet/motor drive not included
CM	Built-in control module included

8.2.2 Draw-out unit with voltage transformers SGunit group



X – letter, x - number

Selection parameters of the draw-out unit with voltage transformers SGunit group

Classifier Group	Abbreviation	Description	
GROUP	**SGunit**	Draw-out units without circuit breaker	
SUBGROUP	**DOU15**	Rated voltage up to 17.5kV	
	DOU25	Rated voltage up to 24kV	
TYPE of VT	**VTA**	Voltage transformers ALCE Elektrik	
	VTI	Voltage transformers KPB Intra	
PARAMETERS	**Mile**	DOU Type	Mile series switchgear
	noVT		DOU platform without voltage transformers (customer supply)
	1	VT windings parameters	Fused VT, 3 winding, cl. 0,5
	2		Fused VT, 3 winding, cl. 0,2
	3		VT, 3 winding, cl. 0,5
	4		VT, 3 winding, cl. 0,2
	CB	Switchgear compartment	Circuit breaker compartment
	CC		Cable compartment
	150	Pole distance	150mm
	210		210mm
	275		275mm
	C	DOU version	Cassette
	e24	Optional electromagnet or motor drive incl. aux voltage	Electromagnet, aux voltage 24VDC
	e48		Electromagnet, aux voltage 48VDC
	e110		Electromagnet, aux voltage 110VDC/AC
	e125		Electromagnet, aux voltage 125VDC/AC
	e220		Electromagnet, aux voltage 220VDC/AC
	m110		Motor drive, aux voltage 110VDC
	m220		Motor drive, aux voltage 220VDC
	S	Blown fuse indication	Blown fuse indication system included

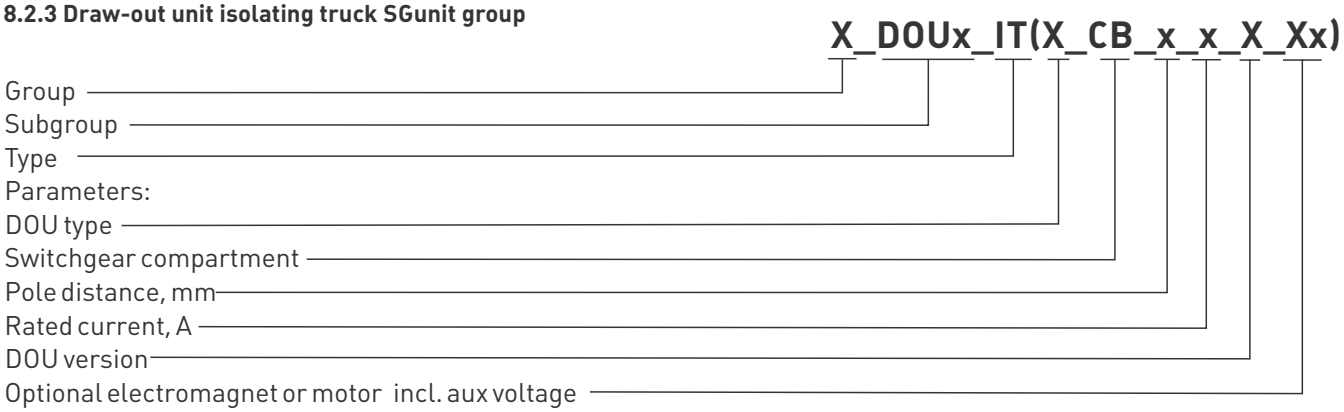
If any of the option is not included, a "0" is displayed.

Example:

SGunit_DOU25_VTA(Mile_2_CB_150_C_e48_S)

SGunit	Draw-out units without circuit breaker
DOU25	Rated voltage up to 24kV
VTA	Voltage transformers ALCE Elektrik
Mile	Mile series switchgear
2	fused VT, 3 winding, cl. 0,2
CB	Circuit breaker compartment
150	Pole distance 150mm
C	DOU version cassette
e48	Electromagnet, aux voltage 48VDC
S	Blown fuse indication system included

8.2.3 Draw-out unit isolating truck SGunit group



X – letter, x - number

Selection parameters of draw-out unit with isolating truck

Classifier Group	Abbreviation	Description	
GROUP	**SGunit**	Draw-out units without circuit breaker	
SUBGROUP	**DOU15**	Rated voltage up to 17.5kV	
	DOU25	Rated voltage up to 24kV	
TYPE	**IT**	Isolating Truck	
PARAMETERS	**Mile**	DOU Type	Mile series switchgear
	CB	Switchgear compartment	Circuit breaker compartment
	150	Pole distance	150mm
	210		210mm
	275		275mm
	630	Rated current	630A
	1250		1250A
	1600		1600A
	2000		2000A
	2500		2500A
	3150		3150A
	C	DOU version	Cassette
	e24	Optional electromagnet or motor drive incl. aux voltage	Electromagnet, aux voltage 24VDC
	e48		Electromagnet, aux voltage 48VDC
	e110		Electromagnet, aux voltage 110VDC/AC
	e125		Electromagnet, aux voltage 125VDC/AC
	e220		Electromagnet, aux voltage 220VDC/AC
	m110		Motor drive, aux voltage 110VDC (additional electromagnet on request)
	m220		Motor drive, aux voltage 220VDC (additional electromagnet on request)

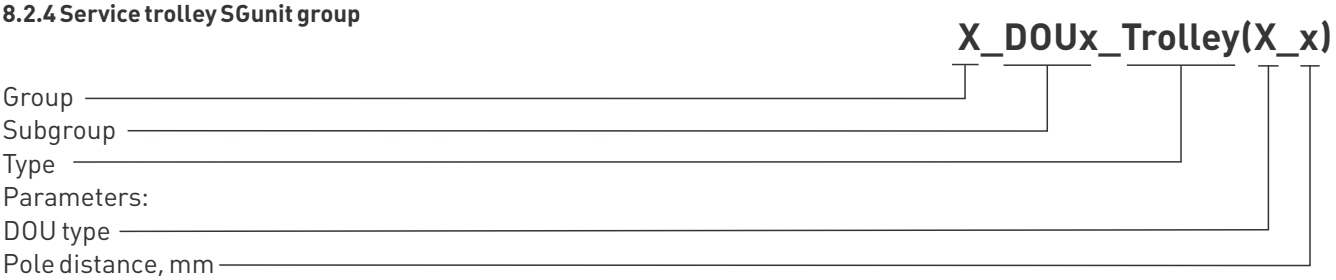
If any of the option is not included, a “0” is displayed.

Example:

SGunit_DOU15_ IT(Mile_CB_210_2000_C_0)

SGunit	Draw-out units without circuit breaker
DOU15	Rated voltage up to 17.5kV
IT	Isolating Truck
Mile	Mile series switchgear
CB	Circuit breaker compartment
210	Pole distance 210mm
2000	Rated current 2000A
C	DOU version cassette
0	Electromagnet/motor not included

8.2.4 Service trolley SGunit group



X – letter, x - number

Selection parameters of service trolley

Classifier Group	Abbreviation	Description	
GROUP	SGunit	Draw-out units without circuit breaker	
SUBGROUP	DOU15	Rated voltage up to 17.5kV	
	DOU25	Rated voltage up to 24kV	
TYPE	Trolley	Service trolley	
PARAMETERS	Mile	DOU Type	Mile series switchgear
	150	Pole distance	150mm
	210		210mm
	275		275mm

If any of the option is not included, a "0" is displayed.

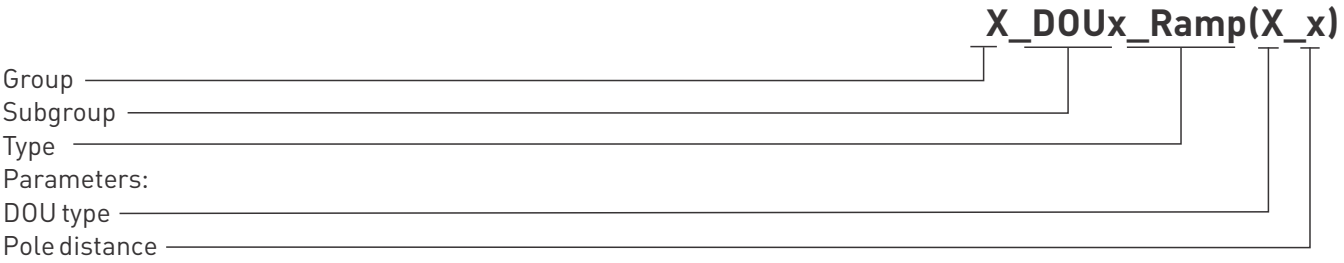
Example:

SGunit_DOU15_Trolley(Mile_210)

SGunit	Draw-out units without circuit breaker
DOU15	Rated voltage up to 17.5kV
Trolley	Service trolley
Mile	Mile series switchgear
210	Pole distance 210mm

8.2.4.1 Ramp SGunit group

The ramp is required for convenient removal or racking in operation of the voltage transformers cassette into and out of the switchgear cable compartment. Ramp is mounting construction for DOU15(25)_VTX on service trolley lower shelf.



X – letter, x - number

Selection parameters of ramp

Classifier Group	Abbreviation	Description	
GROUP	**SGunit**	Draw-out units without circuit breaker	
SUBGROUP	**DOU15**	Rated voltage up to 17.5kV	
	DOU25	Rated voltage up to 24kV	
TYPE	**Ramp**	Ramp for cable compartment voltage transformers cassette	
PARAMETERS	**Mile**	DOU Type	Mile series switchgear
	150	Pole distance	150mm
	210		210mm
	275		275mm

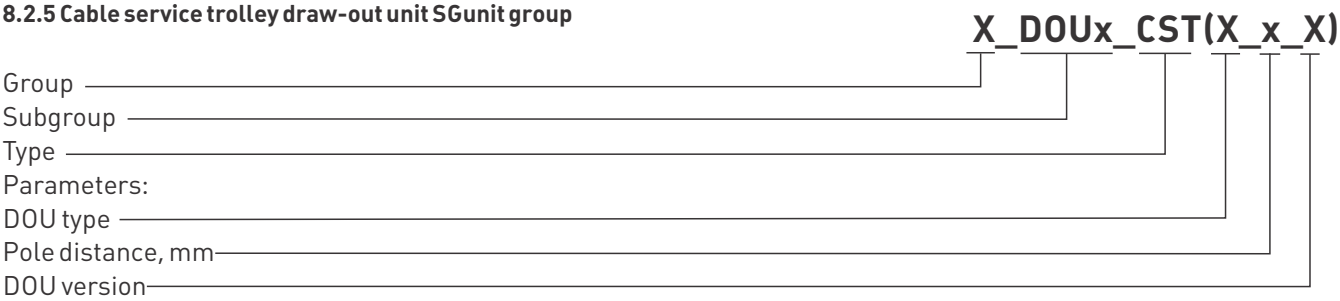
If any of the option is not included, a "0" is displayed.

Example:

SGunit_DOU25_Ramp(Mile_275)

SGunit	Draw-out units without circuit breaker
DOU25	Rated voltage up to 24kV
Ramp	Ramp for cable compartment voltage transformers cassette
Mile	Mile series switchgear
275	Pole distance 275mm

8.2.5 Cable service trolley draw-out unit SGunit group



X – letter, x - number

Selection parameters of cable service trolley draw-out unit

Classifier Group	Abbreviation	Description	
GROUP	**SGunit**	Draw-out units without circuit breaker	
SUBGROUP	**DOU15**	Rated voltage up to 17.5kV	
	DOU25	Rated voltage up to 24kV	
TYPE	**CST**	Cable service draw-out unit	
PARAMETERS	**Mile**	DOU Type	Mile series switchgear
	150	Pole distance	150mm
	210		210mm
	275		275mm
	C	DOU version	Cassette

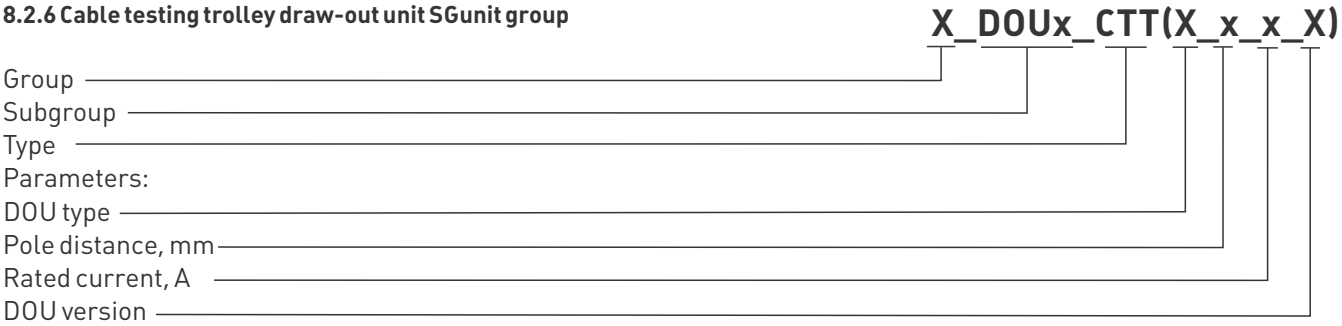
If any of the option is not included, a "0" is displayed.

Example:

SGunit_DOU15_CST(Mile_150_C)

SGunit	Draw-out units without circuit breaker
DOU15	Rated voltage up to 17.5kV
CST	Cable service draw-out unit
Mile	Mile series switchgear
150	Pole distance 150mm
C	DOU version cassette

8.2.6 Cable testing trolley draw-out unit SGunit group



X – letter, x - number

Selection parameters of cable testing trolley draw-out unit

Classifier Group	Abbreviation	Description	
GROUP	**SGunit**	Draw-out units without circuit breaker	
SUBGROUP	**DOU15**	Rated voltage up to 17.5kV	
	DOU25	Rated voltage up to 24kV	
TYPE	**CTT**	Cable testing draw-out unit	
PARAMETERS	**Mile**	DOU Type	Mile series switchgear
	150	Pole distance	150mm
	210		210mm
	275		275mm
	630	Rated current	630A
	1250		1250A
	1600		1600A
	2000		2000A
	2500		2500A
	3150		3150A
	C	DOU version	Cassette

Example:

SGunit_DOU15_ CTT(Mile_210_1250_c)

SGunit	Draw-out units without circuit breaker
DOU15	Rated voltage up to 17.5kV
CTT	Cable testing draw-out unit
Mile	Mile series switchgear
210	Pole distance 210mm
1250	Rated current 1250A
c	DOU version cassette

9. INSTALLATION

9.1 Packaging, handling, storage

9.1.1 Packaging and lifting

Each panel is fixed to the pallet with the bolts. Before the equipment is packaged:
- Withdrawable parts are fixed in draw-in position.
- Earthing switch is opened.

Panel packaging for road transport (soft wrapping):
- Enveloped in plastic stretch wrapping (thickness > 100µ), bolted to the pallet tightened with special belts.

Panel packaging for air and sea transport (wooden box):
- Enveloped in plastic stretch wrapping (thickness > 100µ), bolted to the pallet and tightened with special belts.
- Covered in wooden box.

Additional equipment and spare parts are packed separately or together in one package.

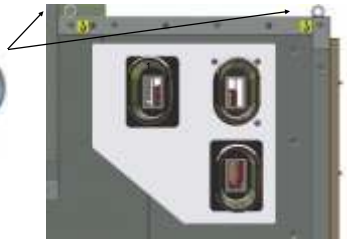
Fig.9.1. The panel on pallet ready for shipment

Handling of panel and withdrawable part:

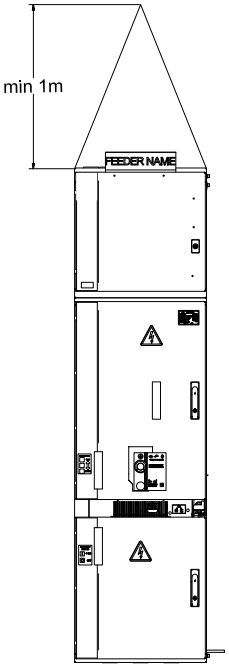
It is important that the forks of the truck are fully engaged throughout the entire width of the wooden pallet.

In order to lift or deposit panel with the pallet, use special lifting lugs on the top of the panel.

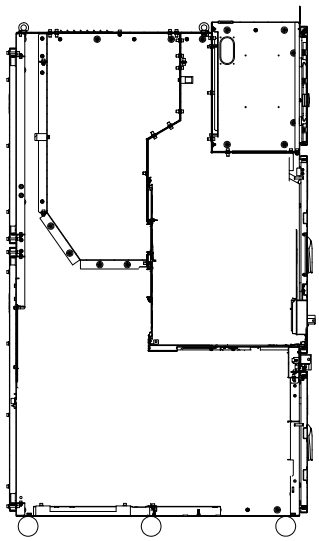
Marking of special lifting facilities/provisions.



Four points are provided for connection of lifting lugs on the sides of each panel.



Lift the panel unit by 4 lifting lugs.



Slide the panel, using three cylindrical rollers of 30 mm min. diameter.

Never handle the circuit breaker by its contact parts.

Never lift circuit breaker by lifting it under its chassis or under its trolley.

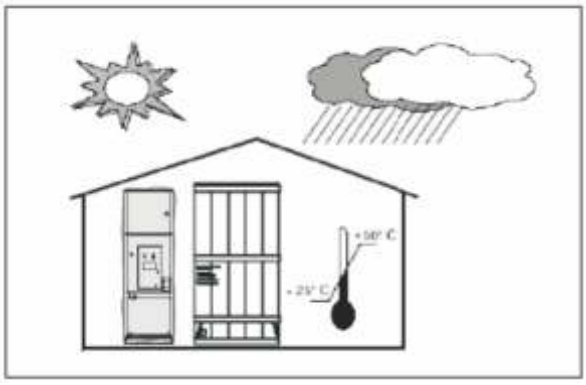
Never tip the pallet over.

All lifting, towing equipment must be in good condition, checked and regularly inspected according to national safety rules. Always lift the equipment in a balanced mode.

NB! Use only special provisions on withdrawable units for lifting. Do not use any other parts.

9.1.2 Storage

Panels, equipment, spare parts, and instructions must be stored indoors. The storage area must be free of dust particles, fumes or smoke, corrosive or flammable gases, vapors or salts.



9.2 Unpacking and installation of the equipment

9.2.1 Foundation surface

Installation of a SG_Mile switchboard requires a flat, concrete structure. The following floor surface requirements must be obeyed:

- Evenness tolerance: ± 1mm within a measuring length of 1m.
- Straightness tolerance: 1mm per 1m, but not more than 3mm over entire length of frame.

Floor, ceiling and walls of the building must be finished with materials, which do not raise or collect dust.

9.2.2 Unpacking panels

Preparation
Unpacking panels should only take place on the installation site.

To prepare panel:

1. Gently remove plastic stretch wrapping from the panel. Visually inspect the exterior of panel.
2. Open the door of VCB compartment.
3. Remove transportation bracket which fixes DOU in draw-in position.
4. Remove alarming sticker from door of VCB compartment.

5. Manually draw out the VCB using special crank.
6. Close earthing switch using special handle.
7. Open the door of cable compartment. Find and remove bolts which are fixing panel to wooden pallet.

Restoring the door interlock
Prior to fix withdrawable parts the door interlock was removed at the factory to provide temporary access to cable compartment.

<u>To restore the interlock:</u>
1. Find and remove interlocking hook from VCB compartment door.
2. Install interlocking hook onto proper place on the door.

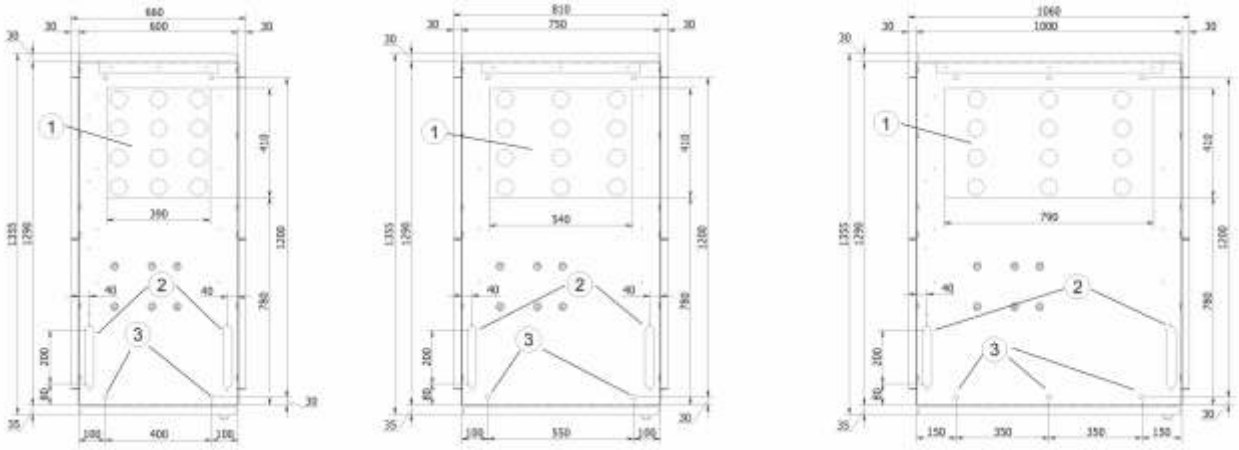
NB! Pay attention to line marking. This marking shows right position and angle of the hook.

3. Close the door of VCB compartment and check that interlock is working properly. Door of compartment should be locked when DOU is in draw-in position.

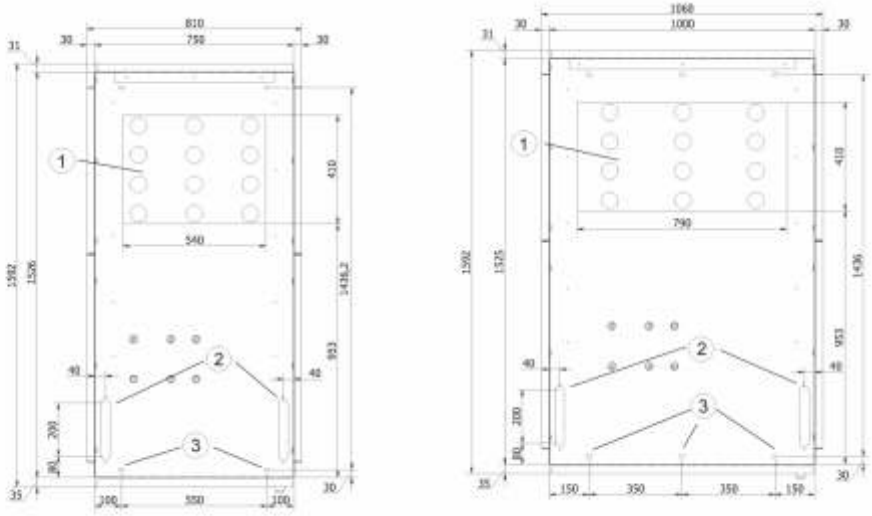
9.3 Panels installation, fixing and positioning

Panels must be positioned on the site in accordance with developed and approved civil project and single line diagram. Floor openings for high-voltage cables must be provided.

SG15_Mile mounting drawings



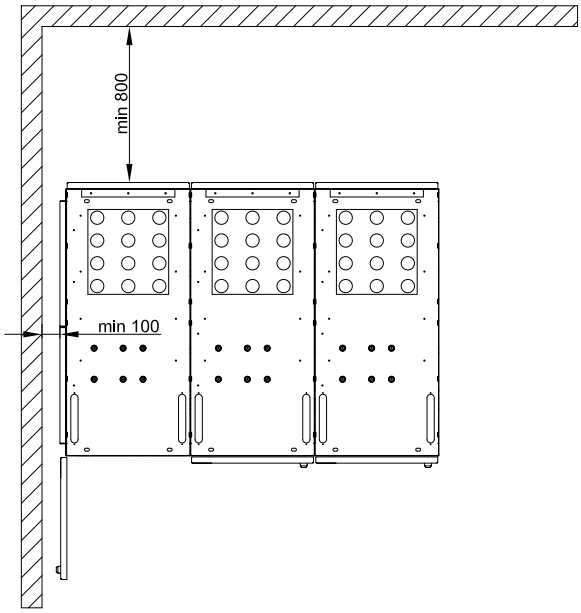
SG25_Mile mounting drawings



1 – Passage for high-voltage cables
2 – Opening 60x200 mm for passage of low-voltage cables (Optional)
3 – Fixing places with floor by anchor bolts

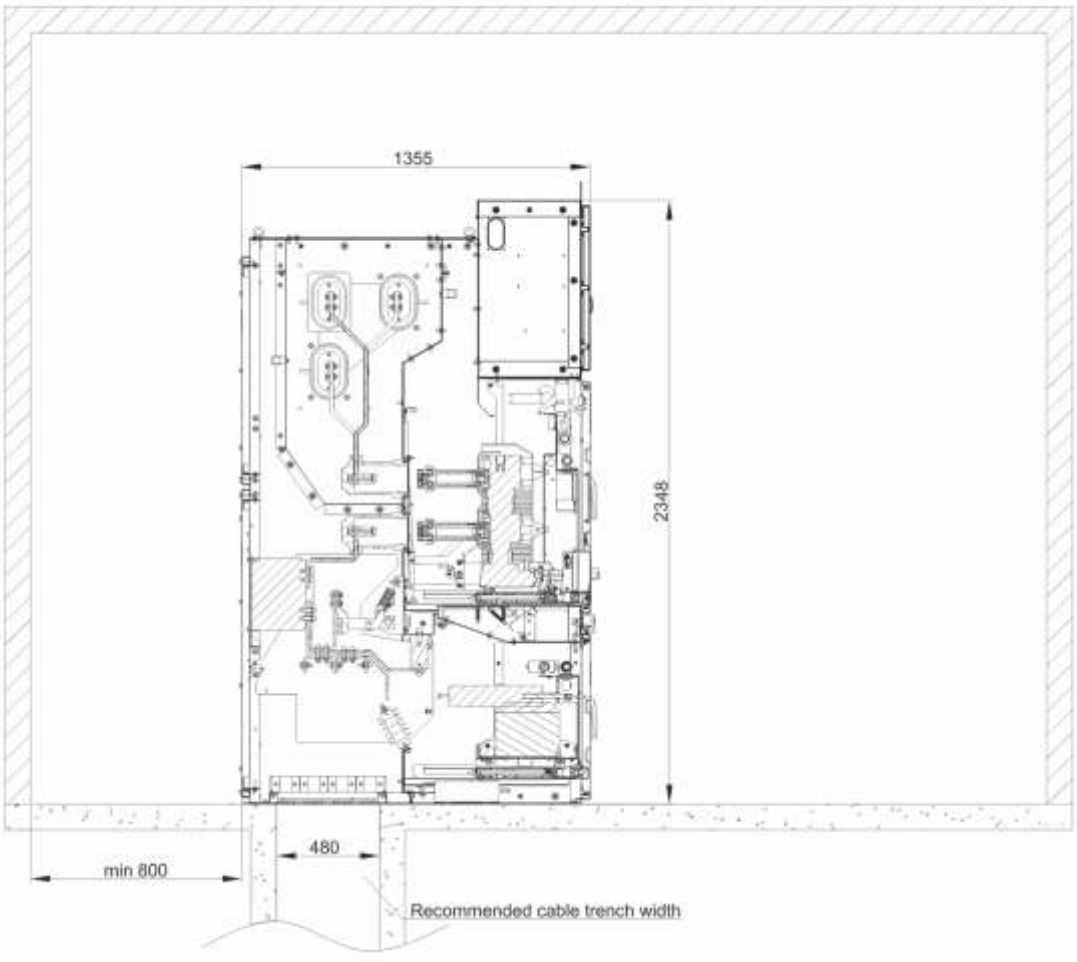
Recommended switchboard placement inside switchgear room with front and front and rear access:

A. Back-to-wall positioning. Front and rear access.

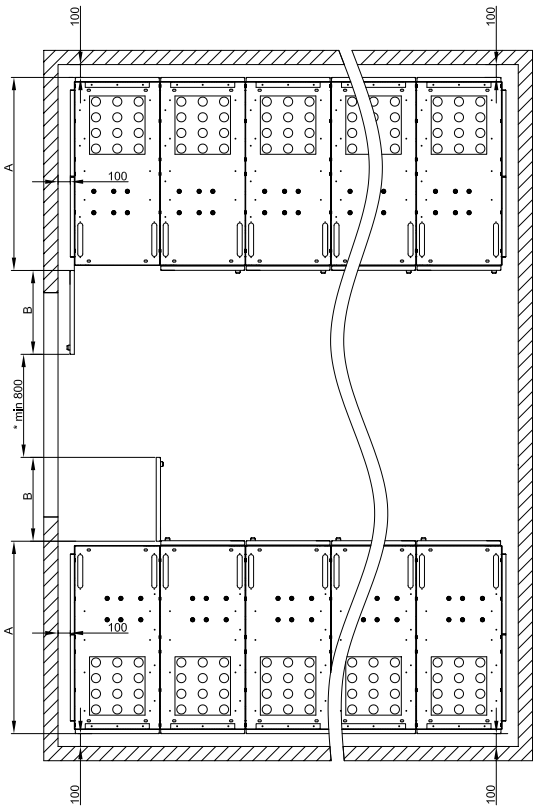


Special attention to the height of substation ceiling must be taken into consideration due to the requirements for passive arc protection.

Side view.



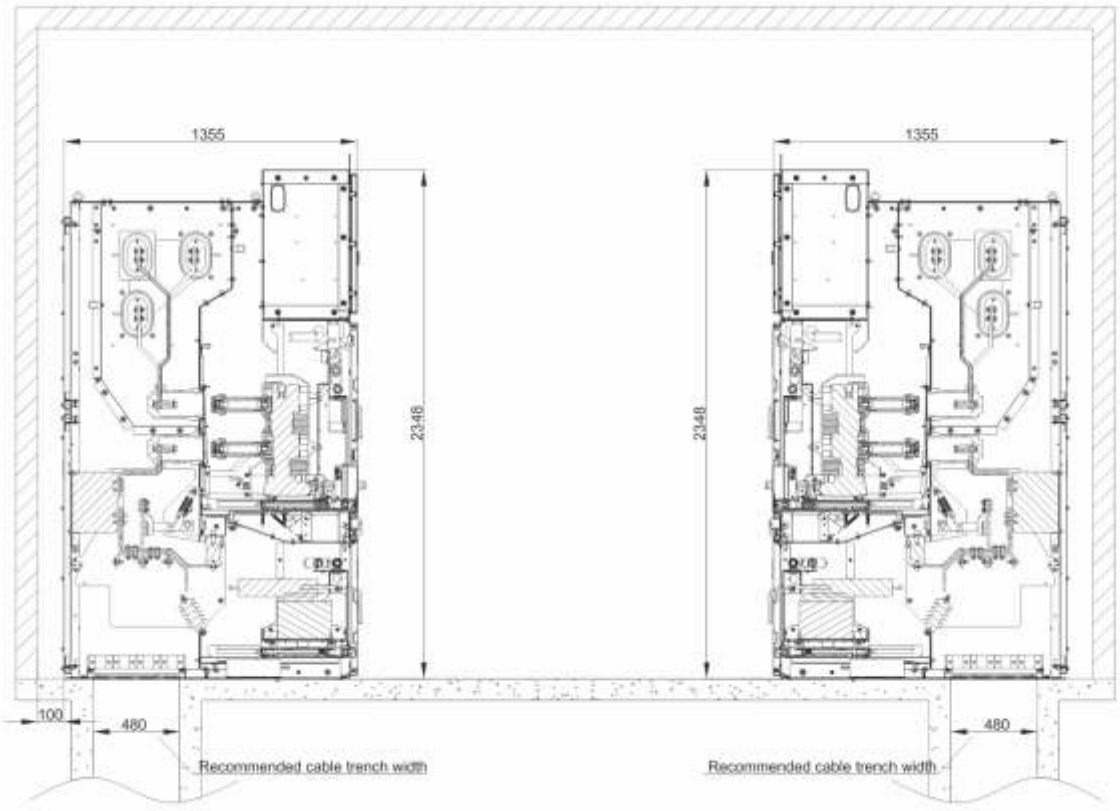
B. Front access.



A – Depth of switchgear
B – Length of door

Special attention to the height of substation ceiling must be taken into consideration due to the requirements for passive arc protection.

Side view.



Depending on short-circuit current levels and the application of the gas exhaust chimney, the following table must be considered for substation ceiling height.

DANGER!

Rated short circuit current	20kA		25kA		31.5kA	
Arcing time	**0.5 sec**	**1 sec**	**0.5 sec**	**1 sec**	**0.5 sec**	**1 sec**
Ceiling height without gas exhaust chimney (H)	H>2,95 m	H>3,15 m	H>3,15 m	H>3,65 m	H>3,65 m	H>4,15 m
Ceiling height with gas exhaust chimney (H)	H>2,83 m*	H>2,83 m*	H>2,83 m*	H>2,83 m*	H>2,83 m*	H>2,83 m*

* - Or ceiling can be erected at 200mm higher than the highest point of the gas exhaust duct.

The exit area for hot gases evacuation must be chosen carefully with the consideration of the following points:

- The area must be restricted for access of personnel
- The area must be clearly indicated
- The hot gases must not damage the equipment or machinery located nearby
- The access of water, animals, and small objects into the exhaust chimney must be prevented

DANGER!

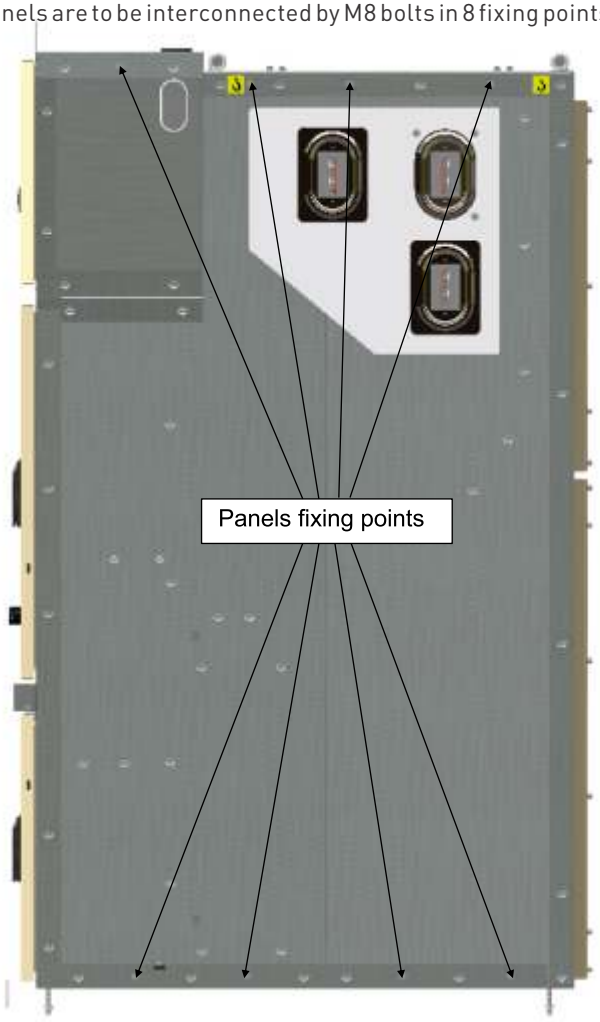
9.4 Positioning of panels in switchboards

Panels must be positioned in accordance with the single-line diagram. If switchboard is composed of 1-10 panels, it is recommended to begin the installation from the first panel, counting from a side opposite to the room entry. If switchboard is composed of more than 10 panels, then begin the installation from the middle of the switchboard.

9.5 Connecting panels

Make sure that all panels are perpendicular in relation to the floor surface. Align the front facing panels.
Proceed with the layout of the other panels by repeating the same checks each time.

Panels are to be interconnected by M8 bolts in 8 fixing points.

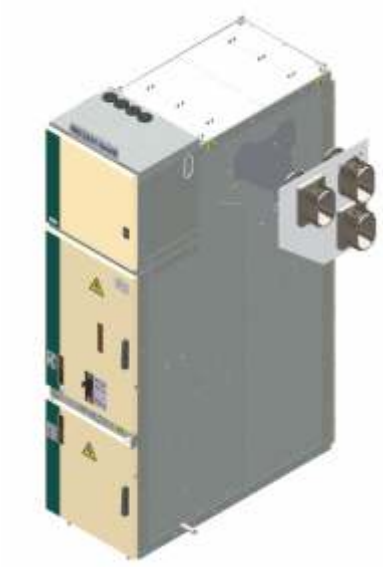


9.5.1.1 Panels interconnection

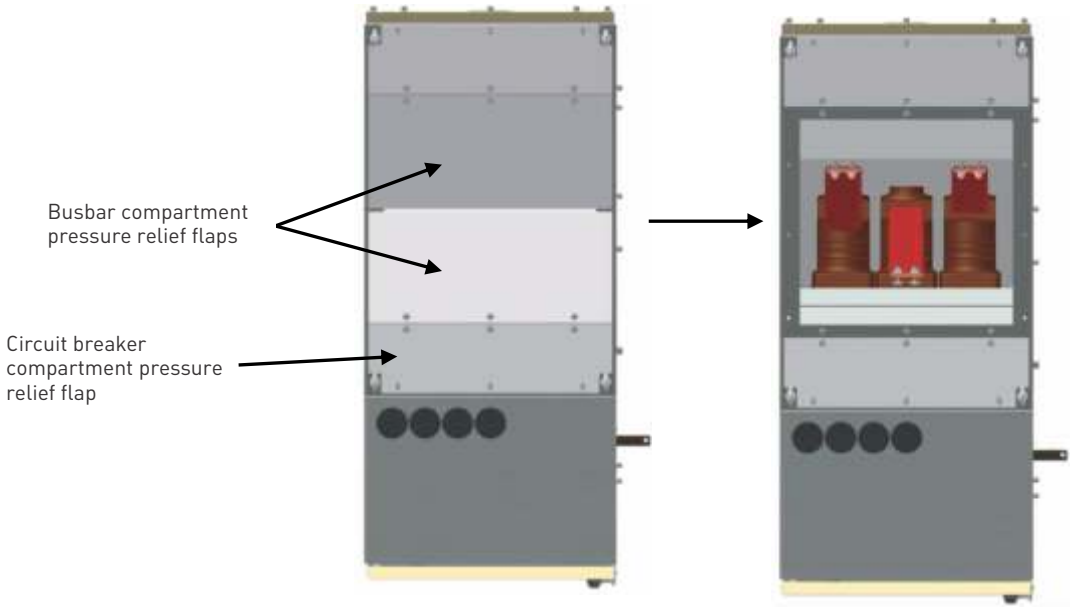
If the through insulators and an aluminum (plastic) plate is installed, please proceed with connecting 2 panels together at page 77.

1. Install through insulators with plate to the right side of the panel.

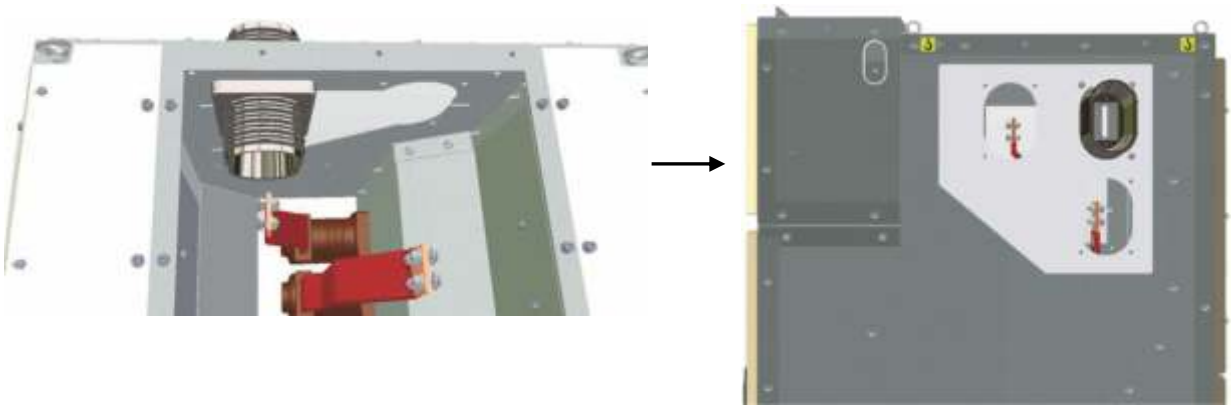
Follow the steps below:

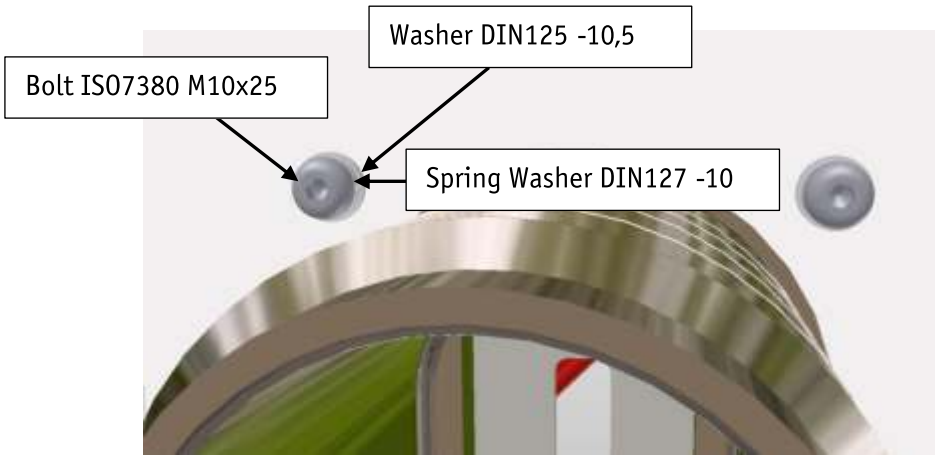


– Remove panel busbar compartment pressure relief flaps:

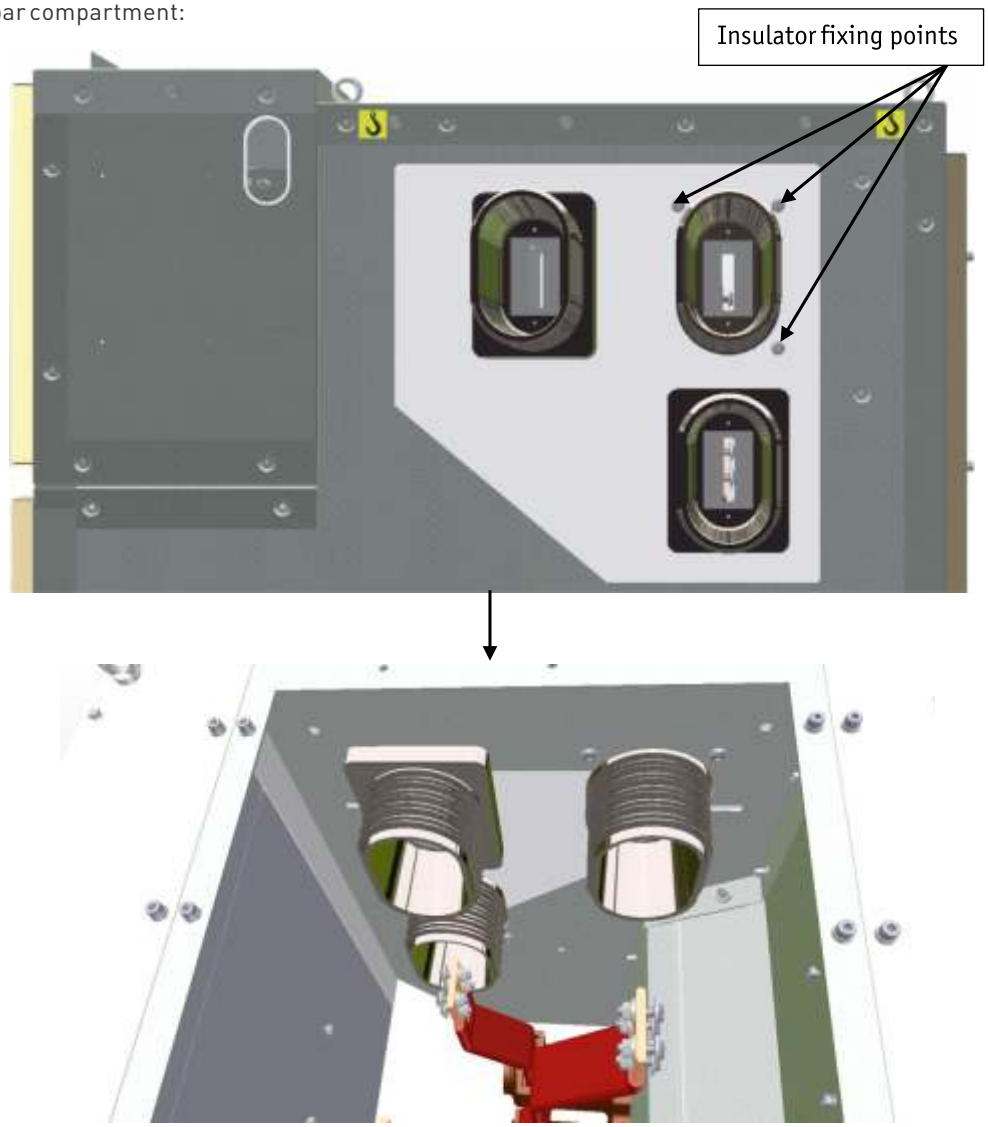


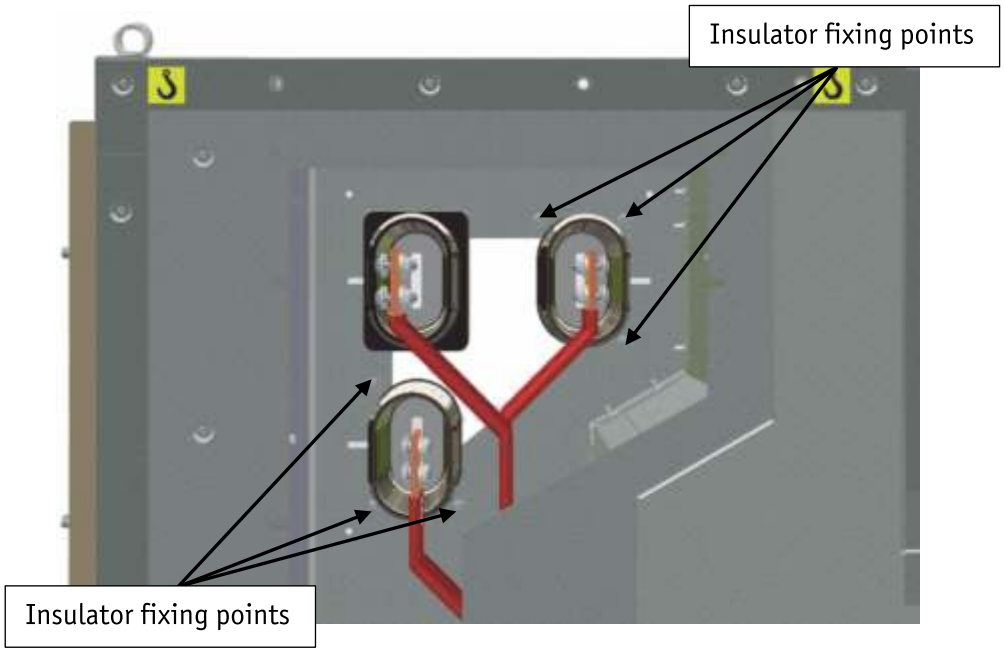
– Insert upper rear through insulator from internal side of the busbar compartment and put aluminium plate into inserted through insulator, fix them with bolt connection ISO7380 M10x25 from the external side of the panel:



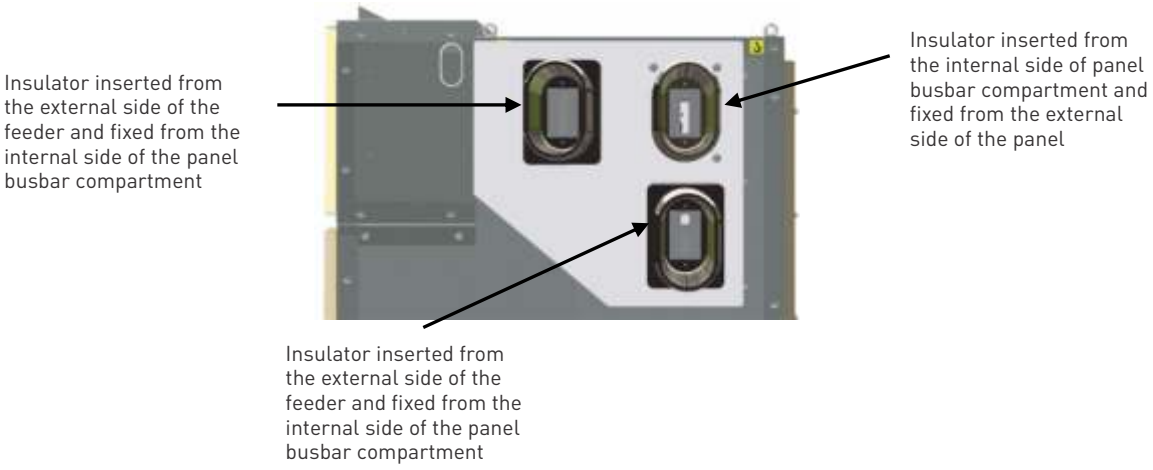


– Insert two other through insulators into the plate from the external side of the panel and hold each insulator. Fix with bolt connection ISO7380 M10x25 from the internal side of the panel busbar compartment:

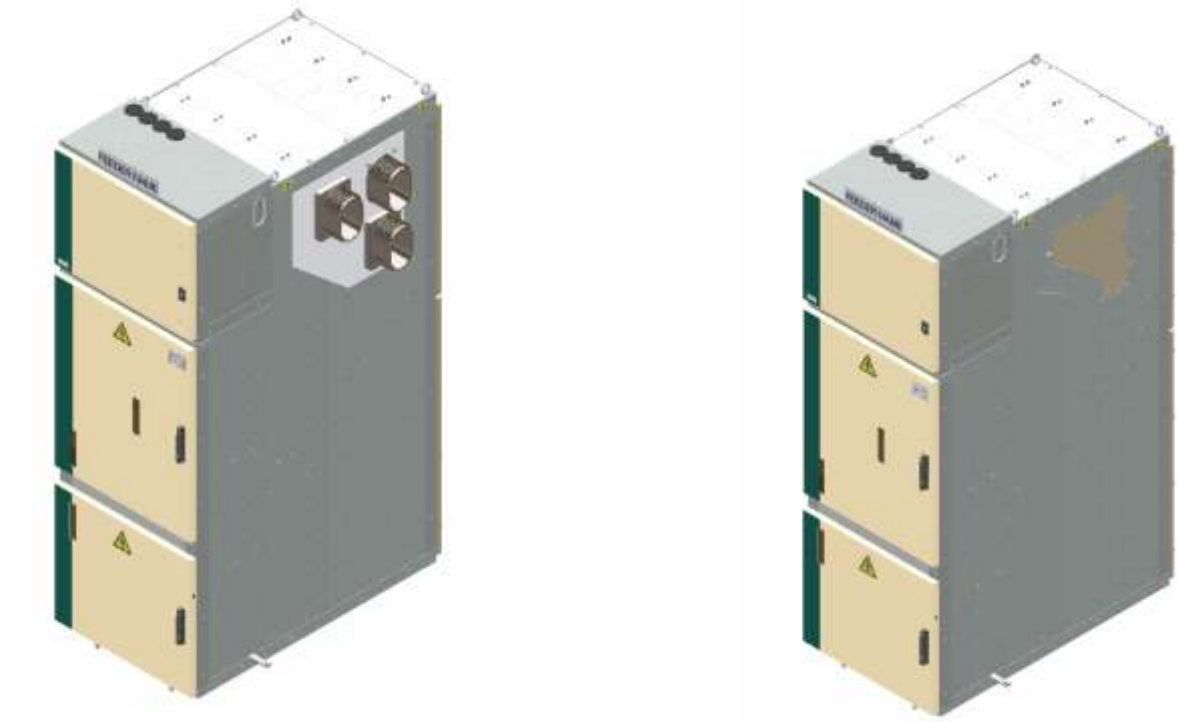




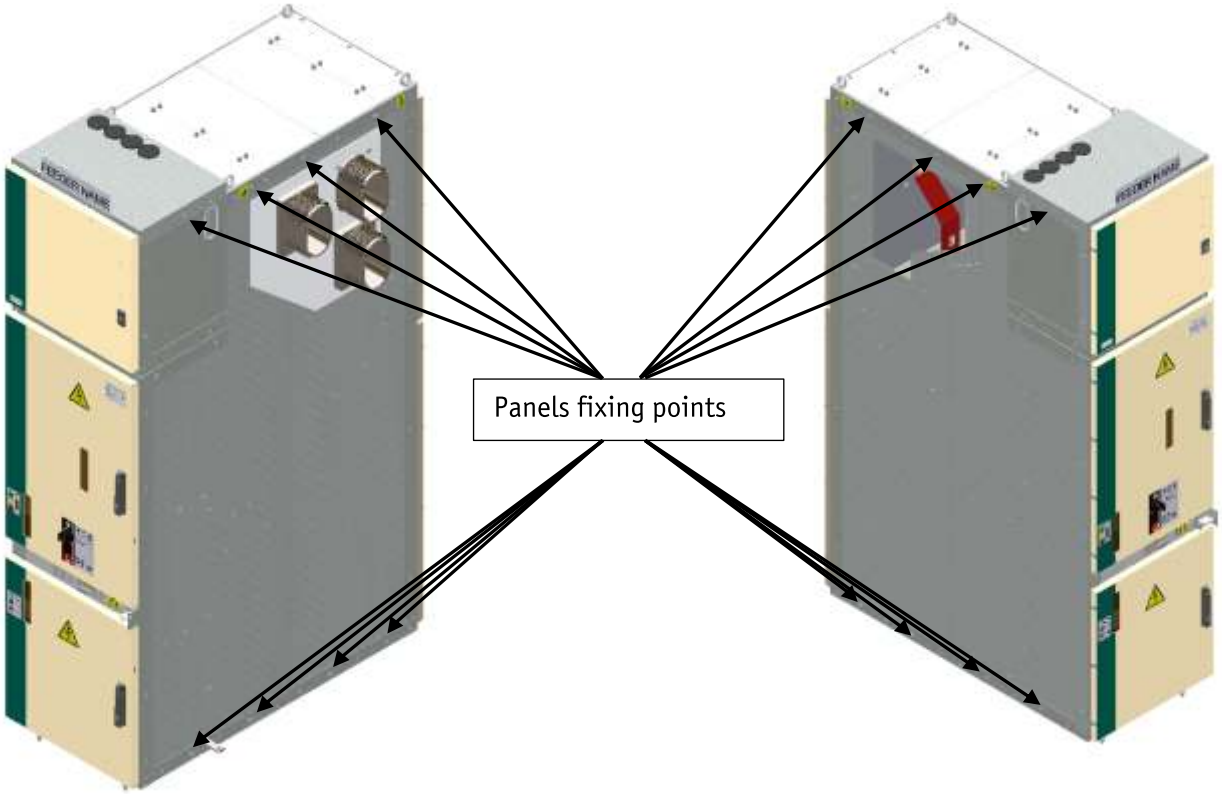
2. Prior to the attaching panels together ensure that through insulators and plate are installed correctly at the left panel:



3. Fix left and right panels together:

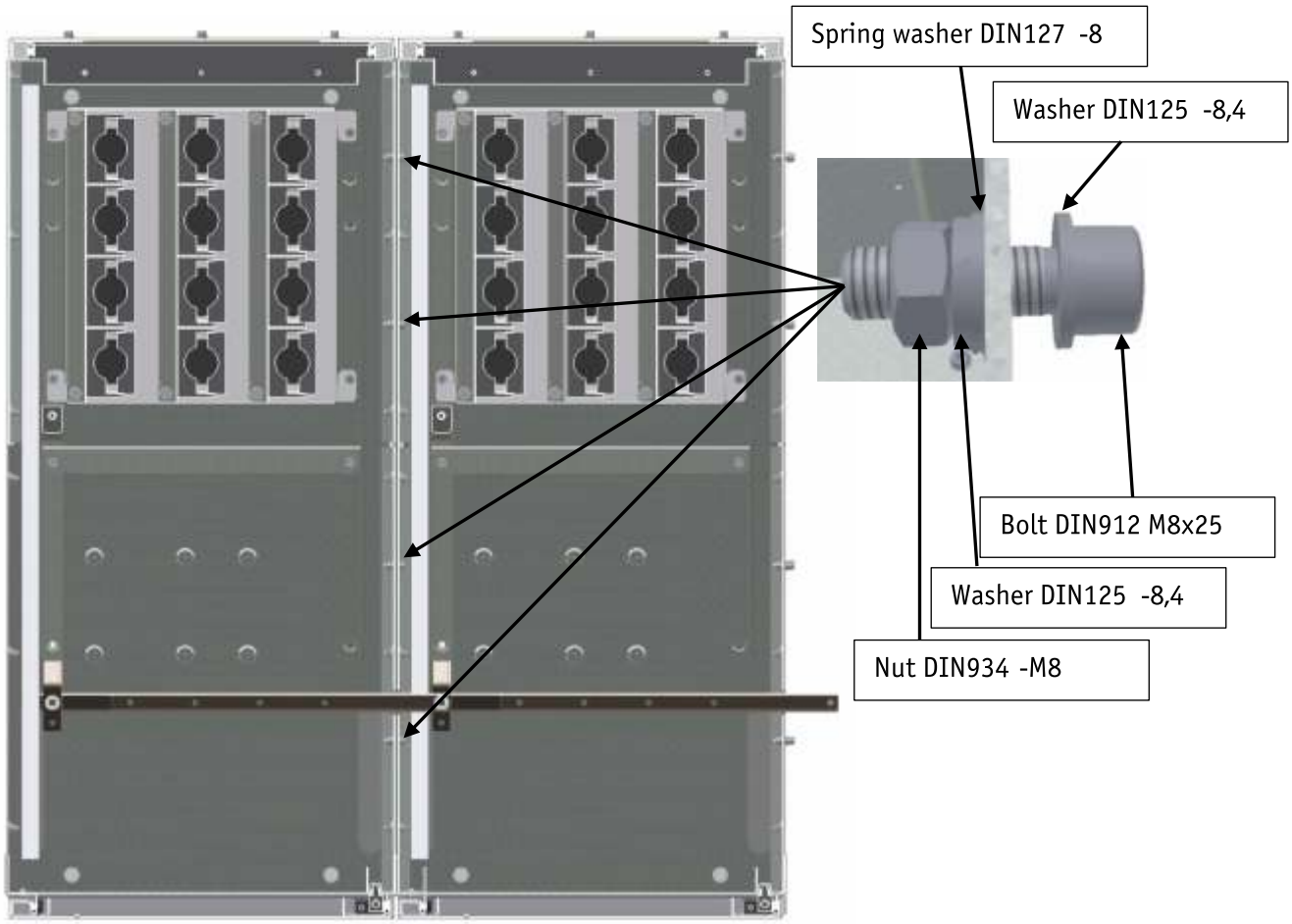


4. Use 4 upper openings and 4 lower openings
Ø9mm designated to the panels attachment. Fix panels with the bolt connections DIN912 M8x25:



– The circuit breaker compartment pressure relief flap should to be removed for fixing one of 4 upper panel bolts DIN912 M8x25.

5. Proceed with all connections with bolt connection DIN912 M8x25 as shown in the picture:



9.5.2 Main busbar connection

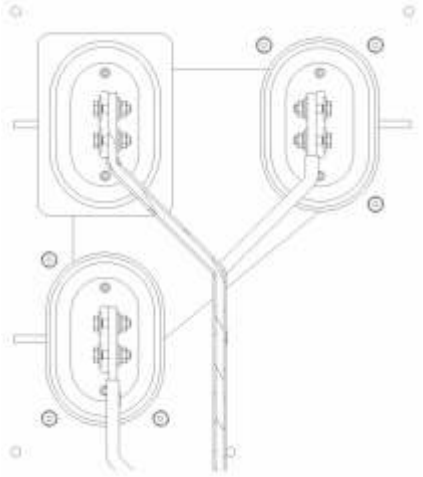
Before assembling the main substation busbar, the connection surface must be cleaned by wire brush for better electrical contact. Position connection places and fix them together with 4xM12x65 bolts.

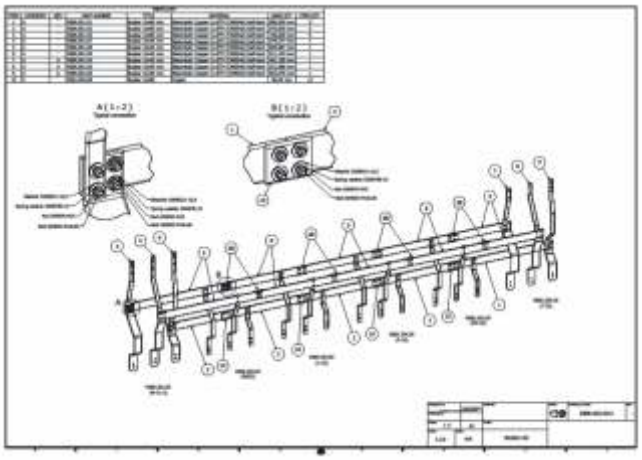
Recommended tightening torques for busbar bolt connection:

Bolt connection size	Tightening torque without lubricant, Nm	Tightening torque with lubricant, Nm
M8	5	10
M10	30	20
M12	60	40
M16	120	80
M20	250	160

Each specific substation project is supplied with a busbar system installation instruction-drawing.

NB! The heads of bolts should be placed as shown below:



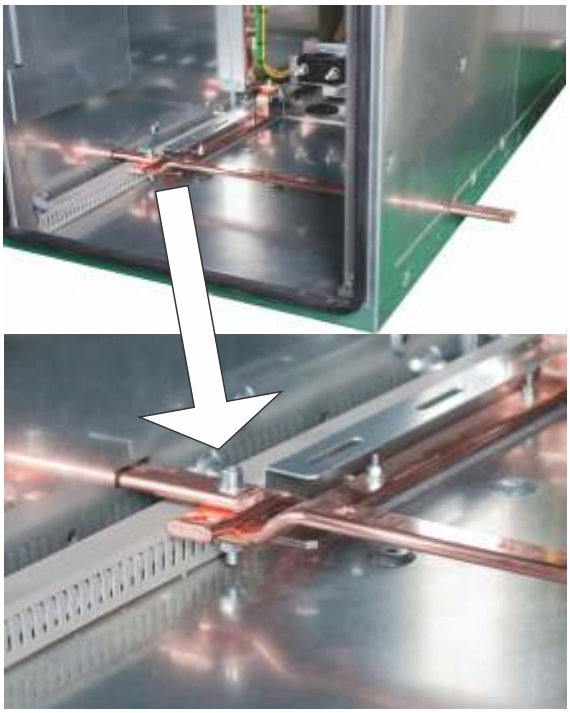


9.5.3 Earthing busbar connection

The earthing bar is inserted into the cable compartment through the special rectangular openings and fixed by bolt. Make sure that the contact surface of earthing busbar is flat and clean.
Connection between panel earthing busbar and the substation main earthing bar must be done according to maximum earth-fault current of switchgear.

Connection of cable or wire with earthing contour at substation is permitted, if their cross-section conforms to short-circuit current.

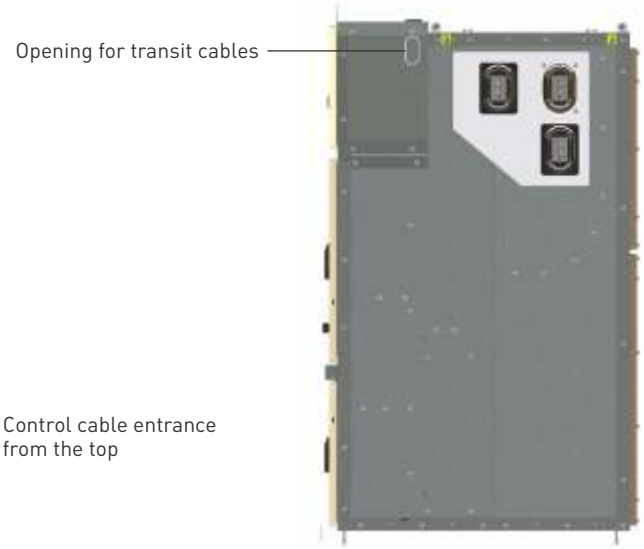
Adjoin the earth busbar to the connection point and fix with M12 bolt.



9.5.4 Control cables interconnection

The interconnection between panels is accomplished by the control cables through openings in both sides of the low voltage compartment. Openings are provided from the top and from the bottom of the cable compartment for connection with external devices (DC distribution board or SCADA).

Control cable entrance from the top



9.6 Input and fixing the cables

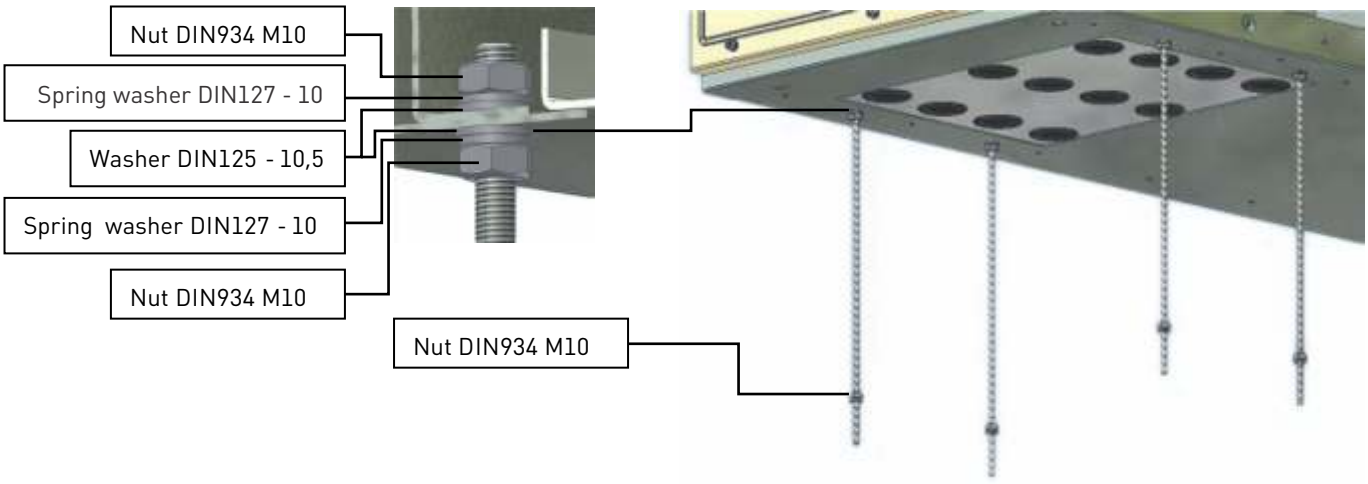
The cables are connected according to the project. For cable installation, each panel bottom has holes with rubber sealings.
For convenient cable installation, the panel bottom can be made of half-plates with one or three holes providing easy disassembly. Each cable core is established inside the panel and attached with special clamp. Cable joint is installed from above to clamp. Cable earthing braid is connected with main earthing bar using designated holes.

NB! Use only special antioxidant joint compound Ensto SR1 to connect cables with aluminum cores to copper branch busbars.

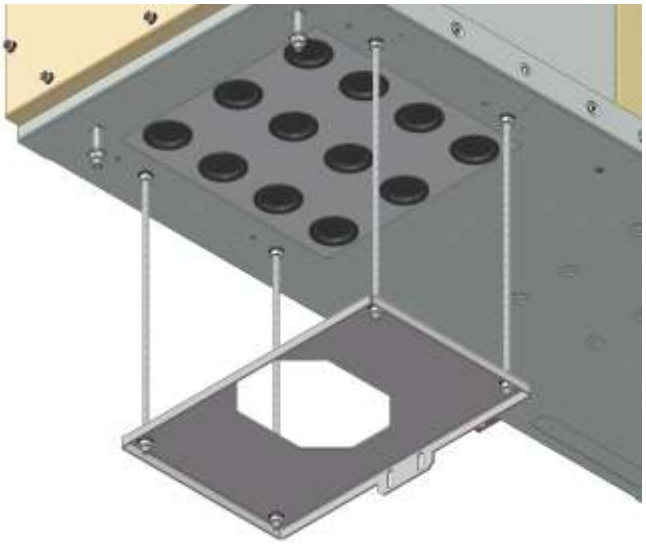
9.7 Neutral CT installation

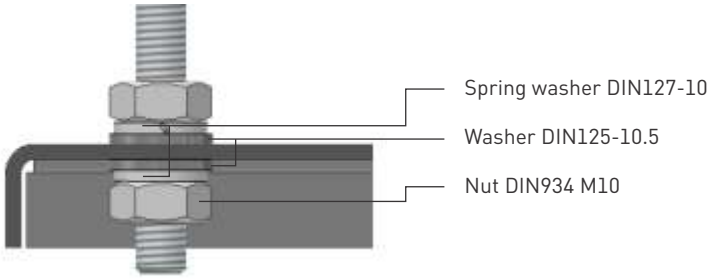
The neutral CT installation is available in two options:
- inside the panel (is mounted at the factory);
- in cable cellar (panel is supplied with special mounting kit).

1. Drill 4 openings Ø11mm at the bottom of the panel according to the drawing RIBR.bottom-layout. Install 4 threaded studs M10 L= 500mm and fix them with the help of M10 nuts:

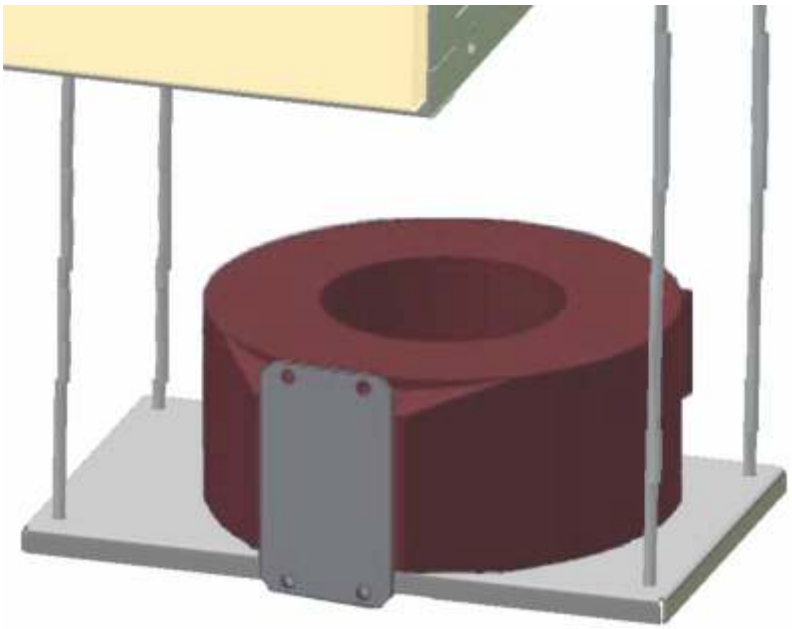


2. Install and fix mounting frame RIDA.548.01:



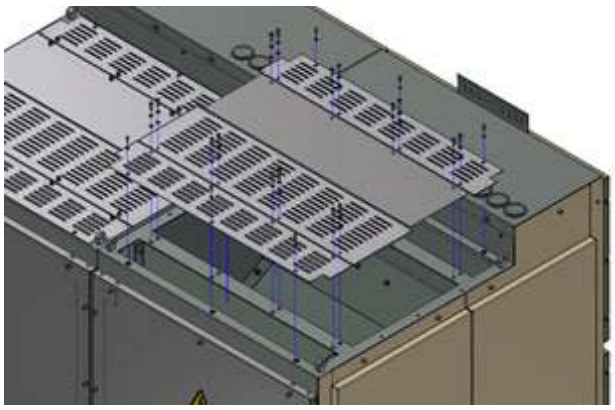


3. Install Neutral CT and connect its secondary cable to the LV compartment related terminal board:

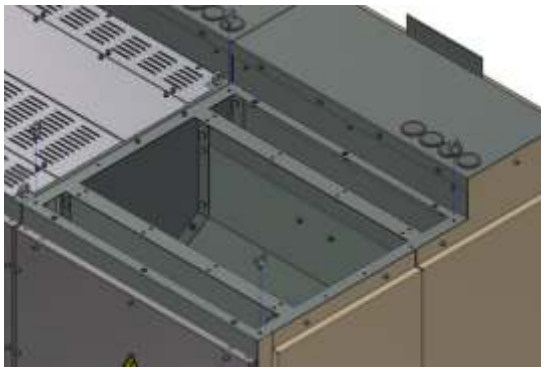


9.8 Gas exhaust duct mounting

1. Uninstall all pressure relief flaps from the switchgears panels:

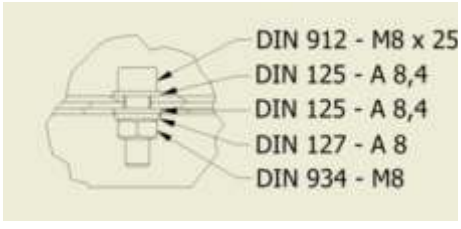


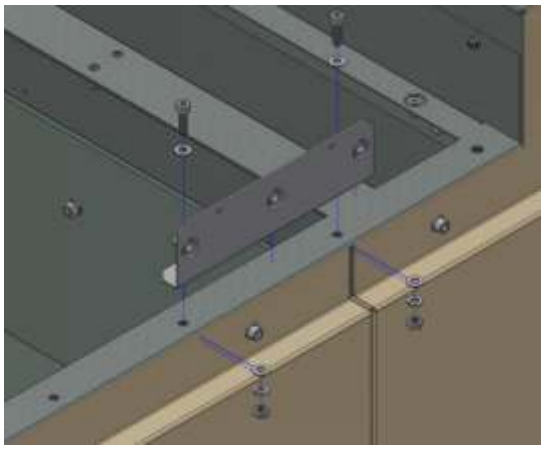
2. Remove all lifting eyes:



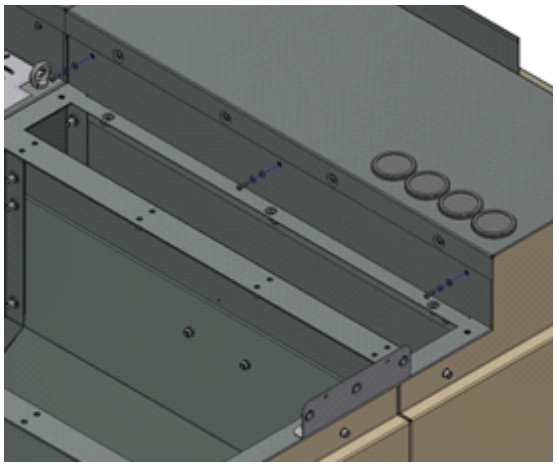
3. Attach the Plate RIDA.303. Attach the Plate RIDA.303.02 onto the opposite side:

Fastening scheme:



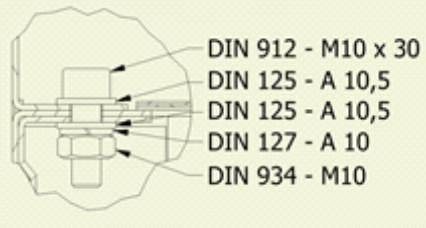


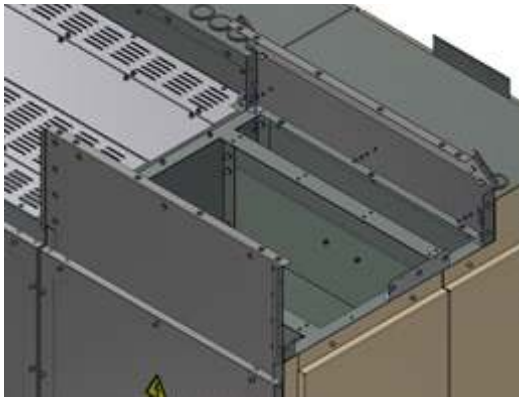
4. Unscrew bolts ISO7380 M6x16 from LV compartments:



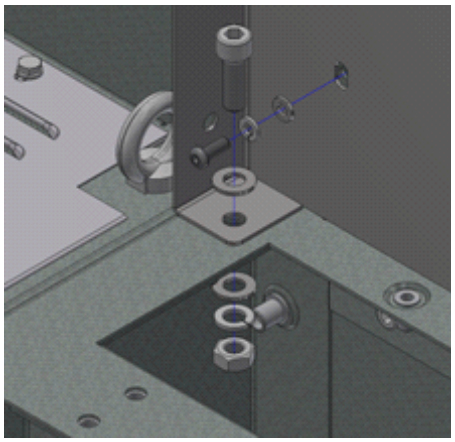
5. Attach the Front panel RIDA.543.02 and Back panel RIDA.543.01:

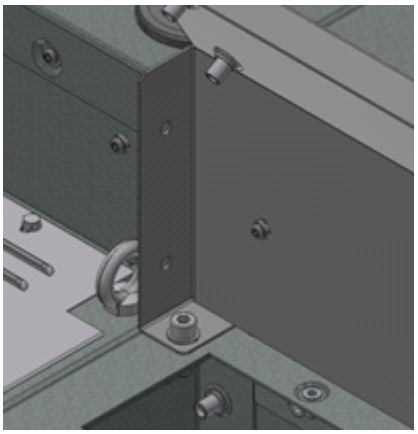
Fastening scheme:





6. Screw the bolts ISO7380 M6x16 into LV compartment back throw the Front panel RIDA.543.02:

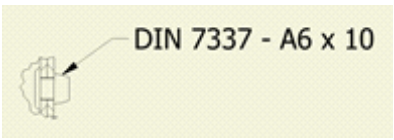


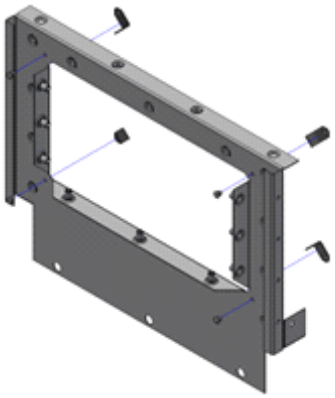


NB! Use Front panel RIDA.051.02 and Back panel RIDA.051.01 for switchgear panels 600mm width.

7. To mount gas duct outlet attach four plates RIDA.306.04 to the Back panel RIDA.535.01:

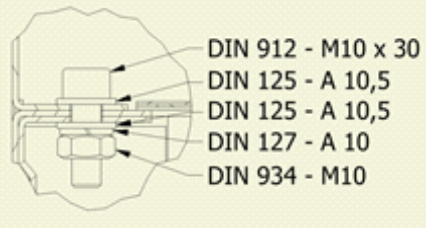
Fastening scheme:

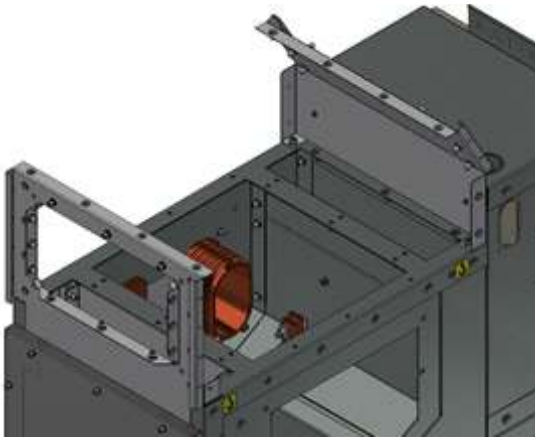




8. Attach the Front panel RIDA.535.01:

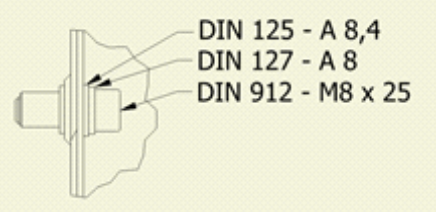
Fastening scheme:

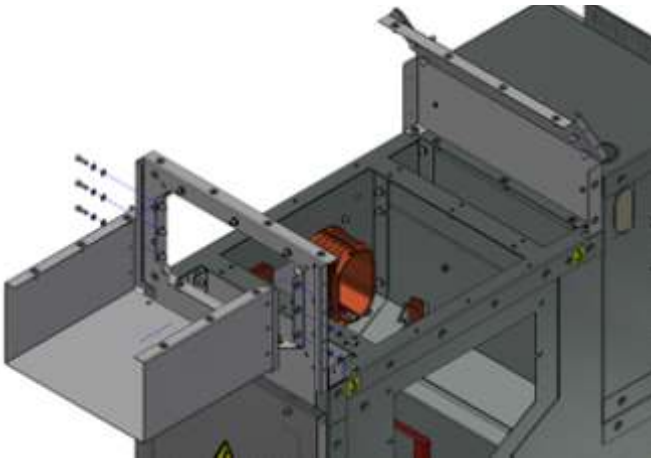




9. Attach the bracket SE-18-88.047.01 01:

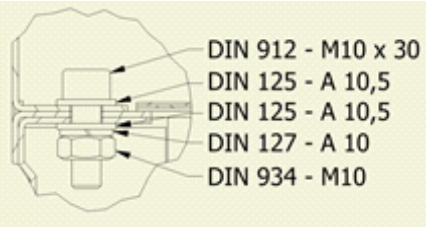
Fastening scheme:

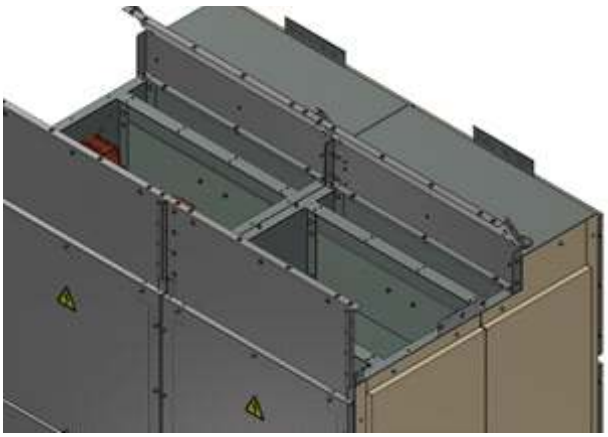




10. Attach the Front panel RIDA.543.02 and Back panel RIDA.543.01 to the second switchgear panel:

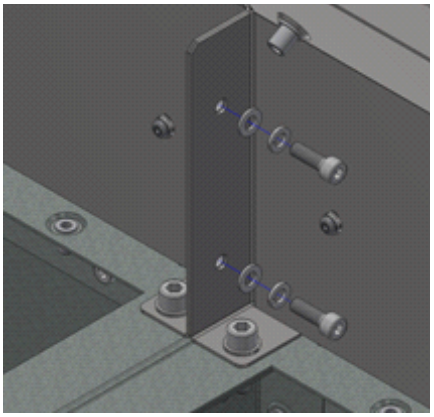
Fastening scheme:





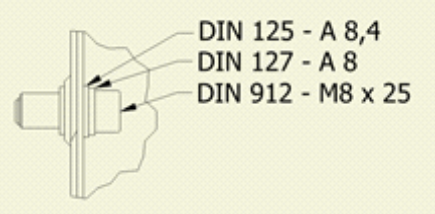
NB! Use Front panel RIDA.051.02 and Back panel RIDA.051.01 for switchgear panels 600mm width.

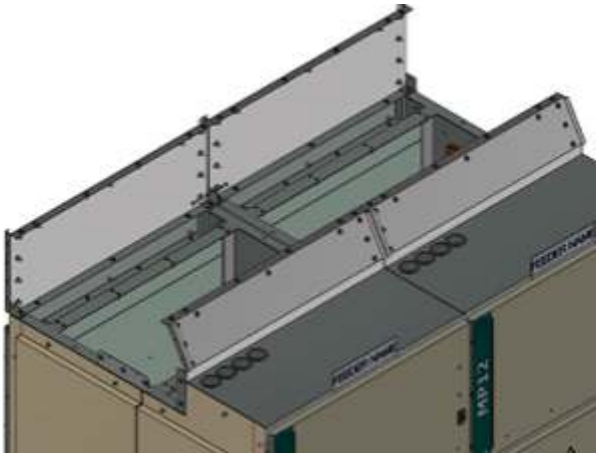
11. Screw the bolts ISO7380 M6x16 into LV compartment back throw the Front panel RIDA.543.02:

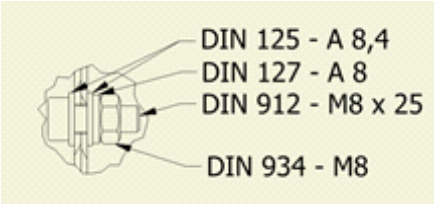


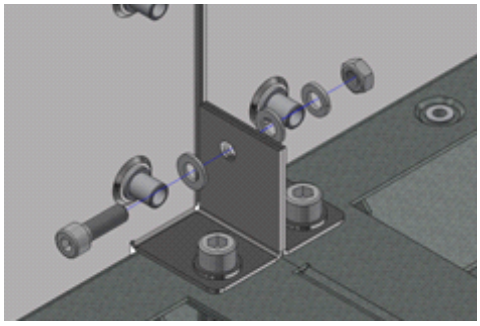
12. Join the panels that are next to each other:

Fastening scheme:

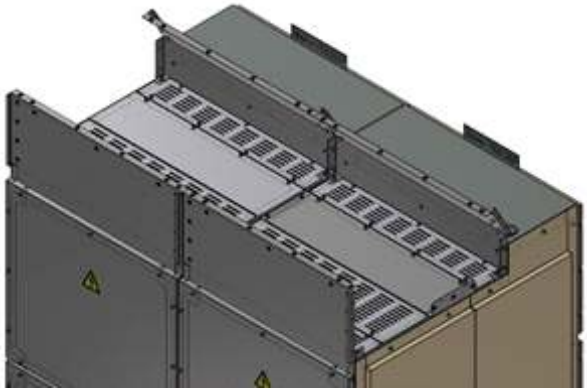






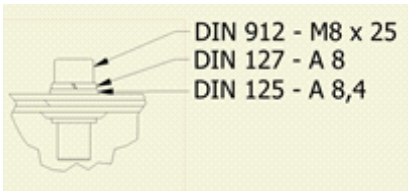


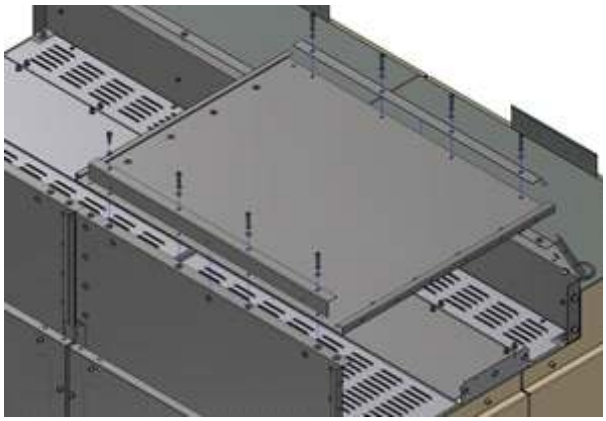
13. Install all pressure relief flaps back to the switchgears panels:



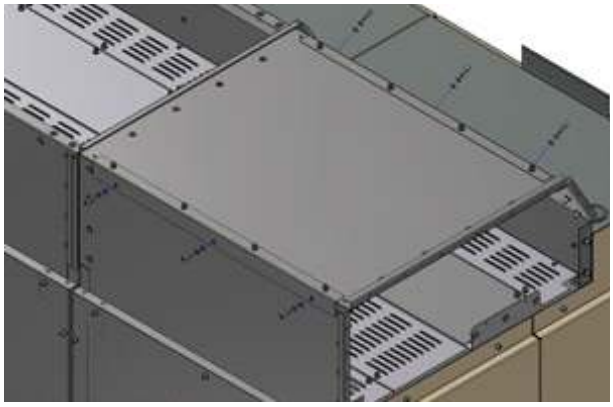
14. Attach the Top plate RIDA.543.03 with support plates RIDA.543.04 and RIDA.543.05:

Fastening scheme:



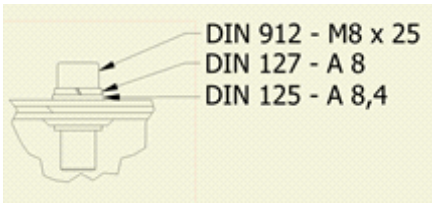


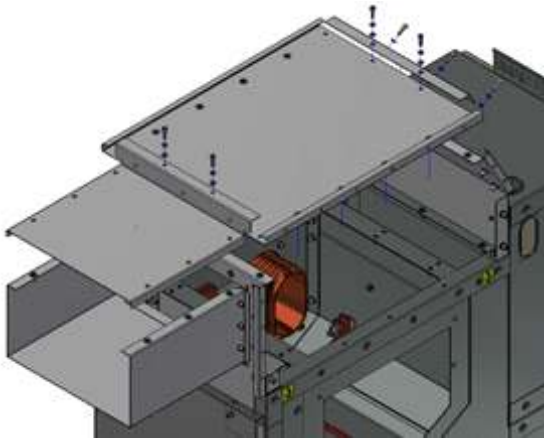
NB! Use Top plate RIDA.051.03 and support plates RIDA.051.04; RIDA.051.05 for switchgear panels 600mm width.



15. For panel with gas duct outlet use top plate RIDA.051.03 and support plates RIDA.051.04:

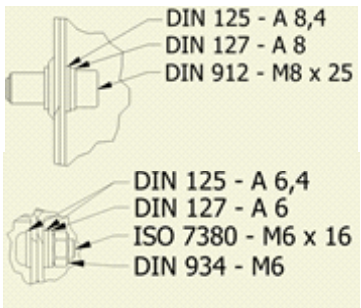
Fastening scheme:

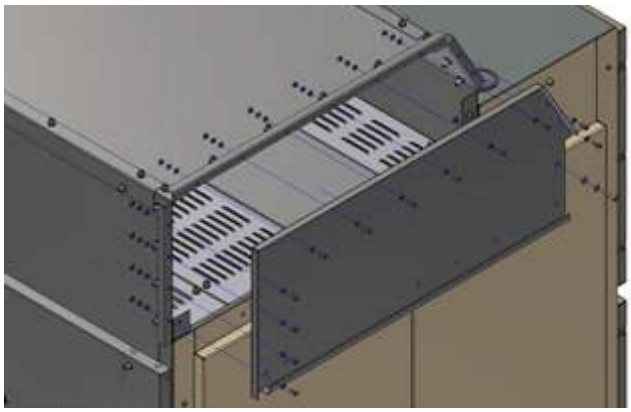




16. Attach the Support bracket RIDA.303.01 to the Front panel RIDA.543.02, Back panel RIDA.543.01 and Top plate RIDA.543.03. Use Support bracket RIDA.304.02 on the opposite side:

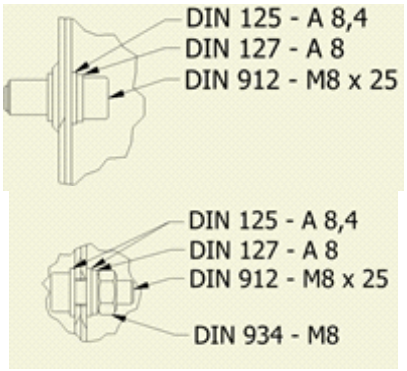
Fastening scheme:

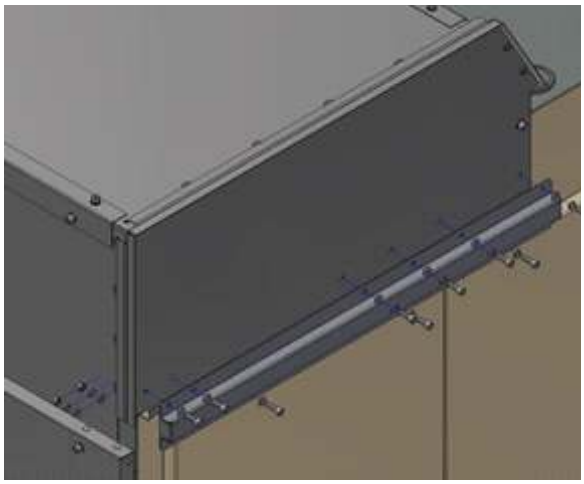




17. Attach the Support bracket RIDA.303.04 to the support bracket RIDA.303.01. Use Support bracket RIDA.304.03 on the opposite side:

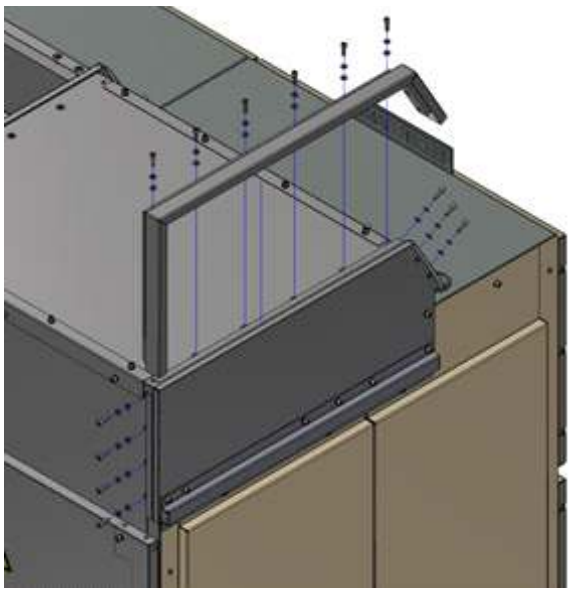
Fastening scheme:





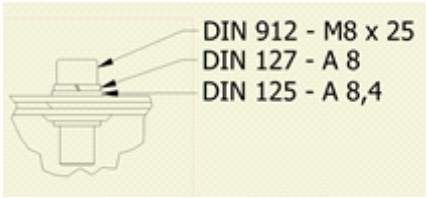
18. Attach the Support bracket RIDA.303.03 to the Back panel RIDA.543.01, Front panel RIDA.543.02 and Top plate RIDA.543.03. Use Support bracket RIDA.304.01 on the opposite side:

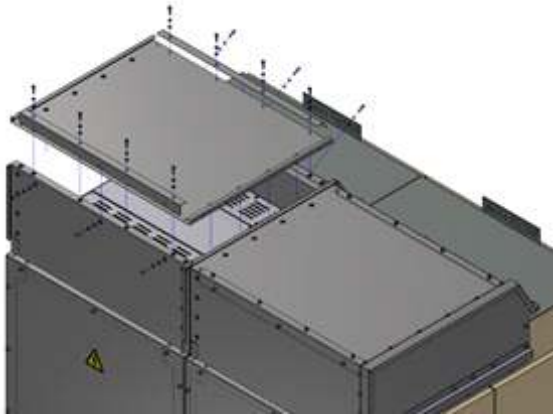
Fastening scheme:



19. Attach the Top plate RIDA.543.03 with support plates RIDA.543.04 and RIDA.543.05:

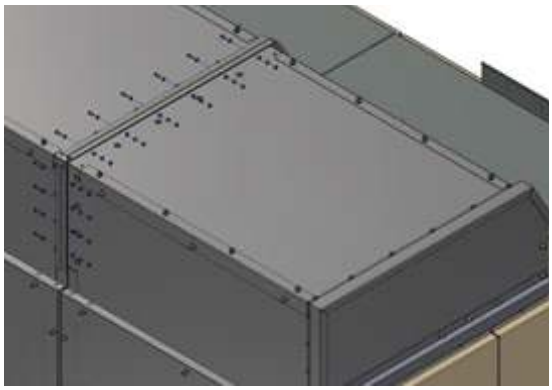
Fastening scheme:





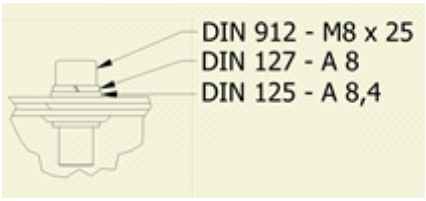
20. Join the panels and top plates that are next to each other:

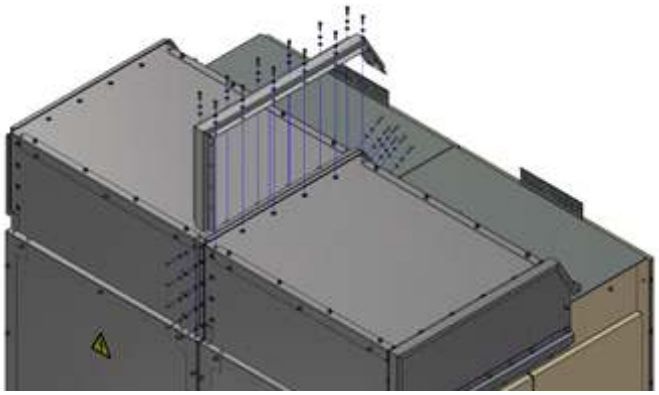
Fastening scheme:



21. Attach the Support bracket RIDA.305.01 to the Back panel RIDA.543.01, Front panel RIDA.543.02 and Top plate RIDA.543.03:

Fastening scheme:





NOTE:
The outlet of gas exhaust duct can vary, depending on customer`s requirement:

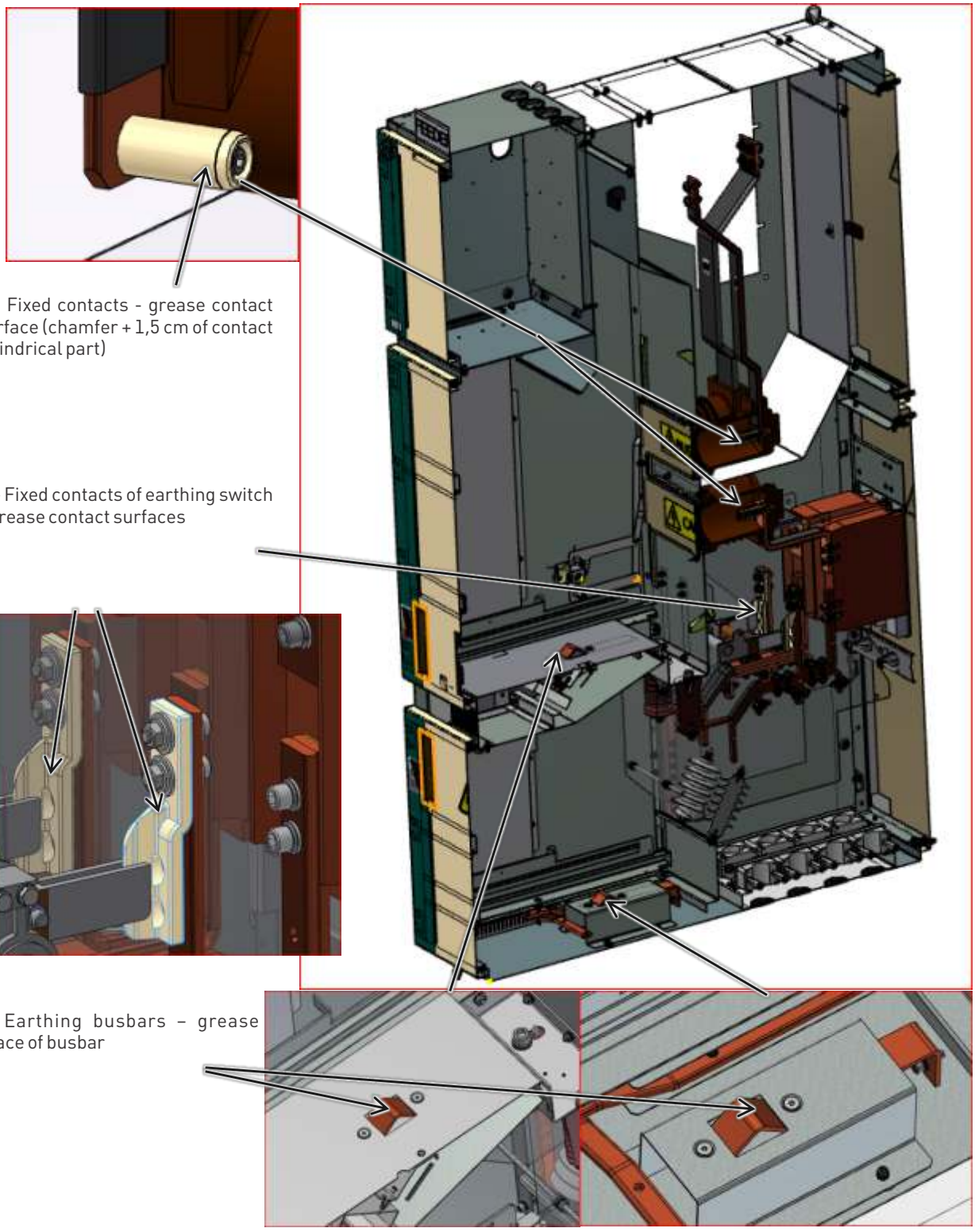
Classifier Group	Abbreviation	Description
GROUP	**SGkit**	Kits for Mile series switchgear
SUBGROUP	**ArcDuct**	Exhaust duct for switchgear panel
TYPE	**GET(B)**	Exhaust duct for a Mile panel, base module
	GET(T)	Exhaust duct for a Mile panel with outlet in the middle
	GET(R)	Exhaust duct for a Mile panel with outlet at the right end
	GET(L)	Exhaust duct for a Mile panel with outlet at the left end
	GET(Ext)	Exhaust bridge duct for a Mile section to a wall outlet. Typical length – 600mm

9.9 Greasing instruction for SG_Mile and draw-out unit

Two types of grease are used during SG15(25)_Mile assembly:
- Ensto SR1, HHS 2000 – for covering contact surfaces;
- Klüber-Isoflex Topas L32 and HHS Wurth (liquid) – for greasing machinery parts.

NB! Usage of WD4 grease and its analogues is prohibited.

SG_Mile greasing

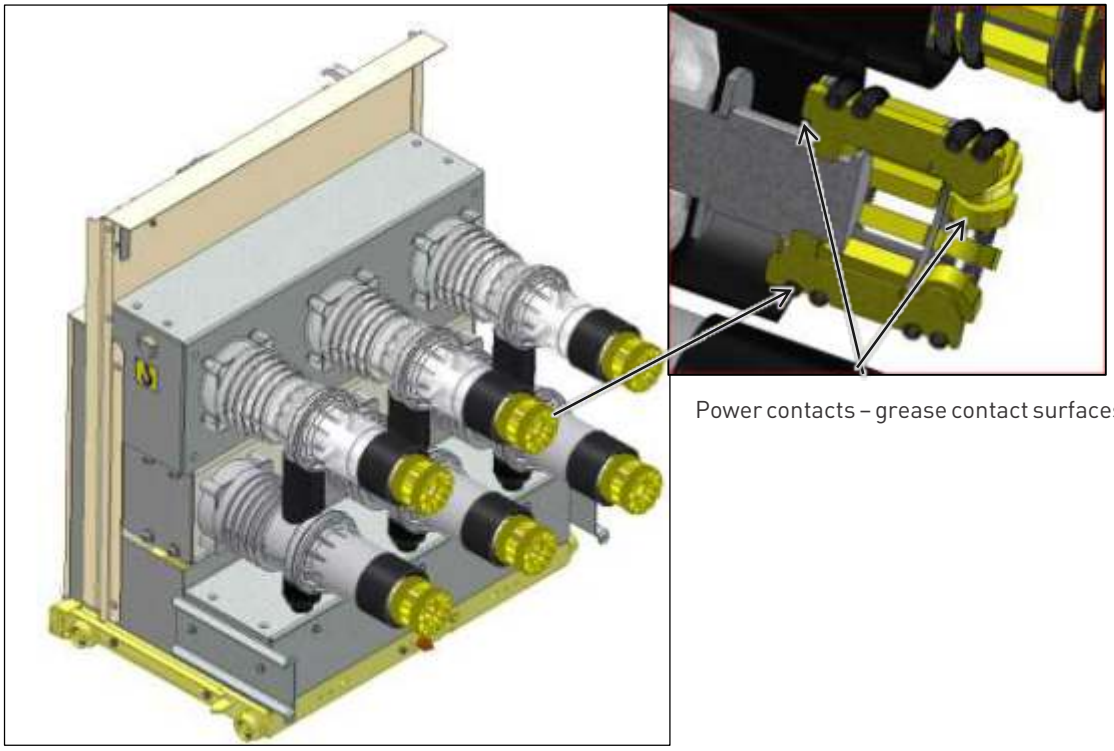


A - Fixed contacts - grease contact surface (chamfer + 1,5 cm of contact cylindrical part)

B – Fixed contacts of earthing switch – grease contact surfaces

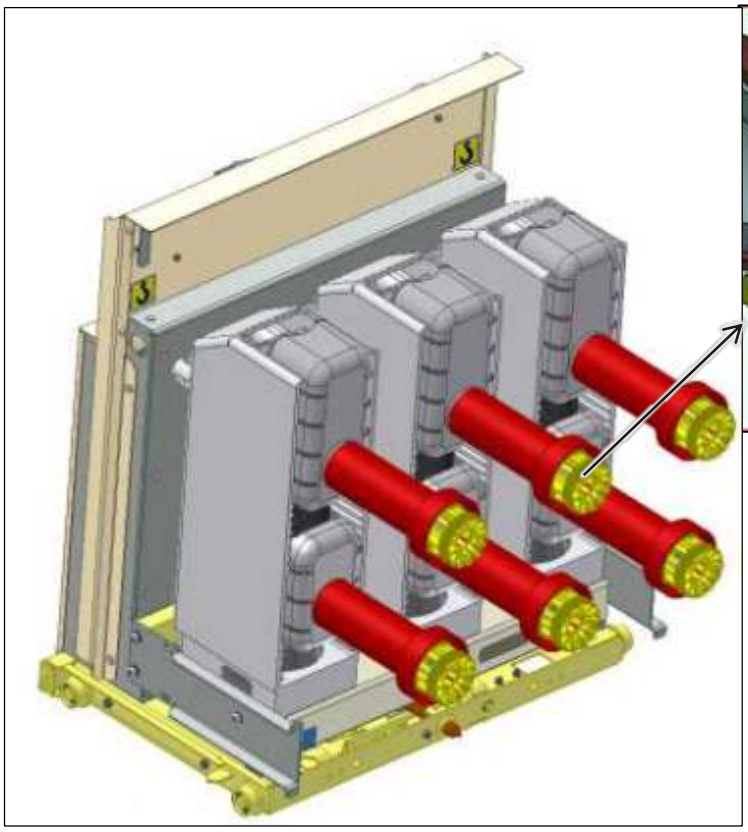
C – Earthing busbars – grease surface of busbar

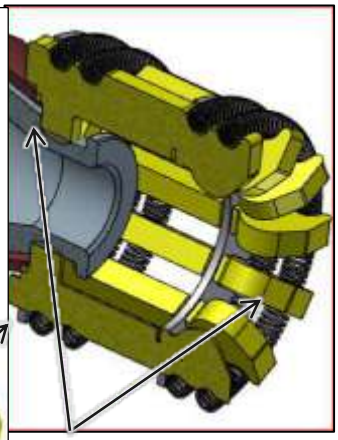
Draw-out unit greasing
Draw-out unit with ISM15(25)_LD1 greasing



Power contacts – grease contact surfaces

Draw-out unit with ISM15_Shell2, ISM25_Shell1, ISM15_HD greasing





Power contacts – grease contact surfaces

10. OPERATION

10.1 Withdrawable parts position definitions

Service position
– Main circuits are connected
– Auxiliary circuits are connected
– The circuit breaker can be CLOSED and OPENED
– The circuit breaker compartment door is closed and cannot be opened
Test position
– Main circuits are disconnected
– Auxiliary circuits are connected
– The circuit breaker can be CLOSED and OPENED for testing purposes
– The circuit breaker compartment door can be opened and closed
Intermediate position
– The withdrawable part is between the service and the test positions
– Auxiliary circuits are connected
– The circuit breaker is OPENED and interlocked
– The circuit breaker compartment door is closed and cannot be opened
Isolated position
– Main circuits are disconnected
– Auxiliary circuits are disconnected
– The circuit breaker cannot operate
Removed position
– The DOU is physically removed from the panel

10.2 Interlocking Conditions

Panel cassette type

Operations	CB		CB in		Panel Earthing Switch with Mechanical Interlock		Respective Busbar Earthing Switch		Circuit breaker compartment Door with Mechanical Interlock		Cable compartment Door with Mechanical Interlock	
	Open	Closed	Test Position	Service Position	Open	Closed	Open	Closed	Open	Closed	Open	Closed
Test Position - CB closing	X		X									
Test Position - CB opening		X	X									
Service Position - CB closing	X			X	X*		X			X*		
Service Position - CB opening		X		X	X*		X			X*		
CB Moving from												
Service position to Test position	X				X*		X			X*		
Test position to Service Position	X				X*		X			X*		
Panel Earthing Switch												
Closing	X		X		X							X*
Opening	X		X			X						X*
Bus Earthing Switch												
Closing	X		X				X			X		
Opening	X		X					X		X		
LV Plug												
Disconnecting	X		X						X			
Connecting	X		X						X			

X – Conditions to be met
* – Mechanical interlock

10.3 Interlocks

Interlock 1
It will not be possible to operate the circuit breaker when the circuit breaker is in the intermediate position and vice versa.
It will not be possible to rack the circuit breaker in or out, when the circuit breaker is closed.
The permission key must be turned 90° counterclockwise to access the rack-in mechanism. If the circuit breaker is in the CLOSED state during key operation, the interlock will trip the circuit breaker to prevent a dangerous situation.

Interlock 2
It will not be possible to rack in the draw-out unit from the isolated position to the service position when the circuit breaker compartment door is open. Upon closing the door, the door hook presses on the DOU engaging slide, which releases the DOU operating mechanism.

Interlock 3
It will not be possible to close the circuit breaker compartment door in the isolated position unless the low voltage control plug is connected.

Interlock 4
It will not be possible to open the circuit breaker compartment door when the draw-out unit is in the test position.

Interlock 5
It will not be possible to close the earthing switch, unless the draw-out unit is in the test position and vice versa. This ensures physical isolation between the withdrawable part and the busbar and cables.
It will not be possible to rack in the withdrawable part from the test position to the service position when the cable earthing switch is closed.

Interlock 6
It will not be possible to the open cable compartment door when the earthing switch is opened.

Interlock 7
It will not be possible to operate the earthing switch when the cable compartment door is opened.

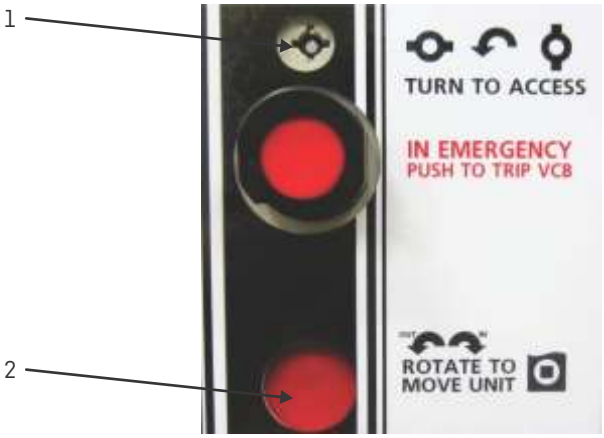
Interlock 8
It will not be possible to open the cable compartment door if the earthing switch operating tool is plugged into the earthing switch operating socket.

Interlock 1

To rack in or rack out the withdrawable unit it is necessary to turn the permission key (1) counter-clockwise 90°. It opens access to the rack-in mechanism (2). If the circuit breaker was closed when turning the key (1), the interlock trips the circuit breaker to prevent a dangerous situation.

NB! If the circuit breaker was closed, counterclockwise rotation will trip it!

Additional interlocking solenoid to prevent access to the permission key slot could be installed on request.

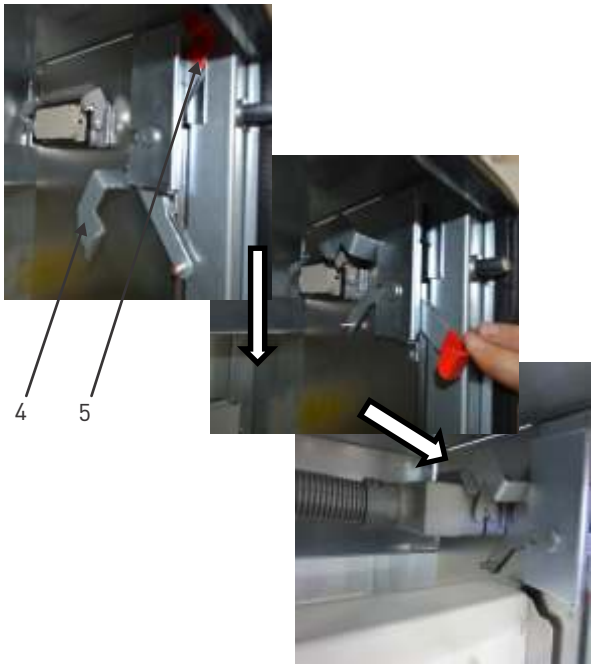


Interlock 2

When closing the door, the door bracket (3) presses the DOU engaging facility, which releases the DOU operating mechanism.

Interlock 3

If the low voltage control plug is not inserted, the lever (4) blocks the door from closing and a fluorescent red sticker is visible(5). To close the door the service personnel must push the lever down, free access to the socket and insert the plug. In cassette type panel, the same interlock is used in the cable compartment when a draw-out unit with voltage transformers is installed.

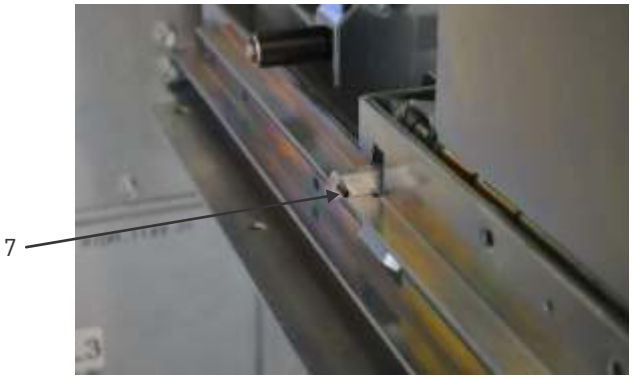


Interlock 4

When the DOU is racked in, the end of the bracket engaged by the shutter mechanism moves downward and blocks the circuit breaker door hook (6).

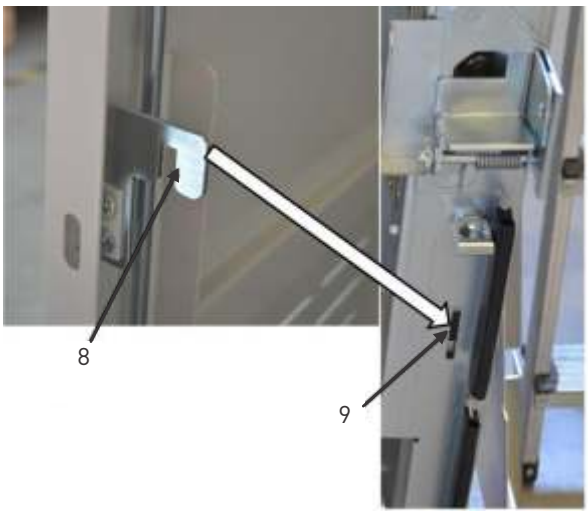
Interlock 5

When the earthing switch is in the closed position the locking shaft (7) withdraws to slide a joint mechanism and blocks the circuit breaker from being racked in.



Interlock 6

When the earthing switch is in the opened position the locking shaft fixes the door hook (8) in opening (9). To open the cable compartment door turn the operating tool clockwise and close the earthing switch. The locking shaft slides upwards and releases the hook.

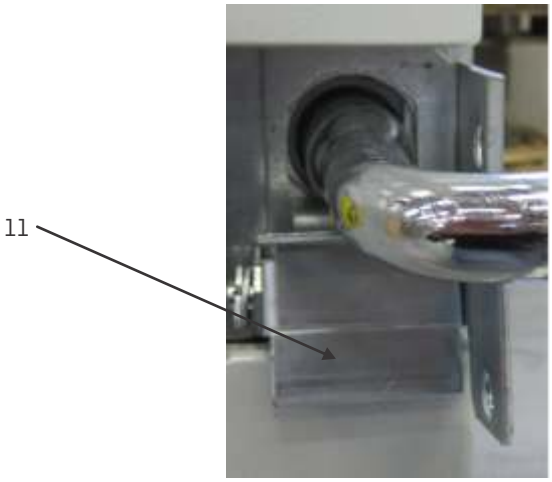


Interlock 7

When closing the door the blade fits into an opening, releasing a locking pin (10) which allows access to the earthing switch slot. When the door is opened the locking pin is engaged.

Interlock 8

If the earthing switch operation tool is inserted into earthing switch operating slot, the earthing mechanism's cover (11) blocks opening of the cable compartment door. To open the cable compartment door, the earthing switch operation tool must be removed from the earthing switch slot.



10.3.1 Optional interlocks

The interlocks below are supplied as optional equipment.

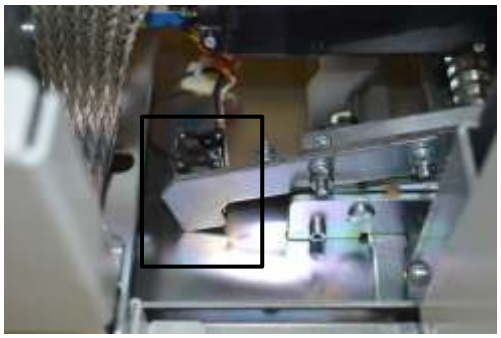
Draw-out unit electromagnetic interlock

It will be not possible to operate the draw-out unit unless the control cable auxiliary connector is plugged in or permission from the auxiliary circuit is granted (voltage applied).

The electromagnetic interlock blocks rotation of the DOU operating handle and the DOU is not operable with when the control cable auxiliary connector is not plugged into panel female connector or the permission from the auxiliary circuit is not granted (voltage not applied).

The electromagnetic interlock can be added to motor-drive to prevent moving (upon requirement).

Position of activated interlock inside DOU (no voltage applied)



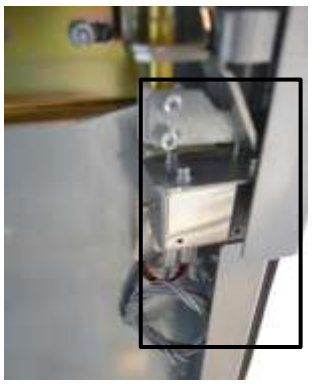
Position of not activated interlock inside DOU (voltage applied)

Control cable female connector

Earthing switch electromagnetic interlock

It will be not possible to operate the earthing switch unless permission from the auxiliary circuits is granted (voltage applied).

The earthing switch electromagnetic interlock blocks access to the socket for operating the earthing switch if the supply voltage of the panel is disconnected (permission is not granted).



Earthing switch electromagnetic interlock

Socket for operation with earthing switch

Castell key interlock

Castell key interlock is a mechanical alternative to an electromagnetic interlock of the draw-out unit and the earthing switch.

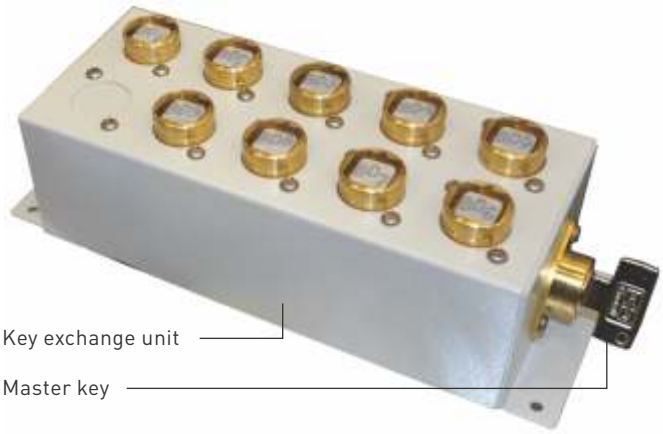
1. Castell lock blocks DOU movement from the test position to the service position.
Castell lock is located on the draw-out unit as shown on the right:

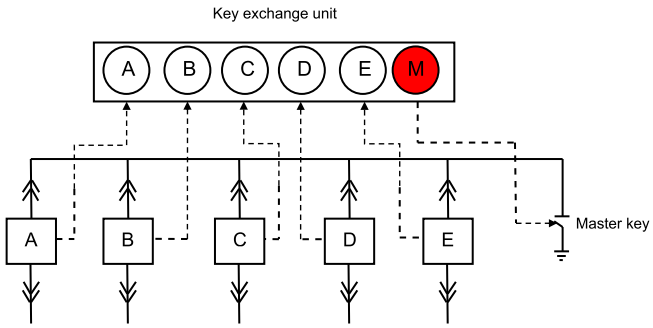
In the test position VCB DOU can be blocked by the Castell lock. After blocking the truck the Castell key can be released from the lock.

2. Castell lock blocks access to socket for operation with busbar earthing switch.

Castell lock

Castell key





All Castell keys from each VCB DOU must be put into the key exchange unit to release the master key, opening access to busbar earthing switch.

Castell key interlocking diagram (options are available).

10.4 Locking facilities

A standard double bit key lock can be used for locking DOU in the test and service positions

The earthing switch can be locked with a padlock

Live shutters can be securely locked in the open and closed positions with a padlock

Access to the circuit breaker or cable compartment can be restricted with the padlocks or key-locks

Access to the low voltage compartment can be restricted with the key-lock

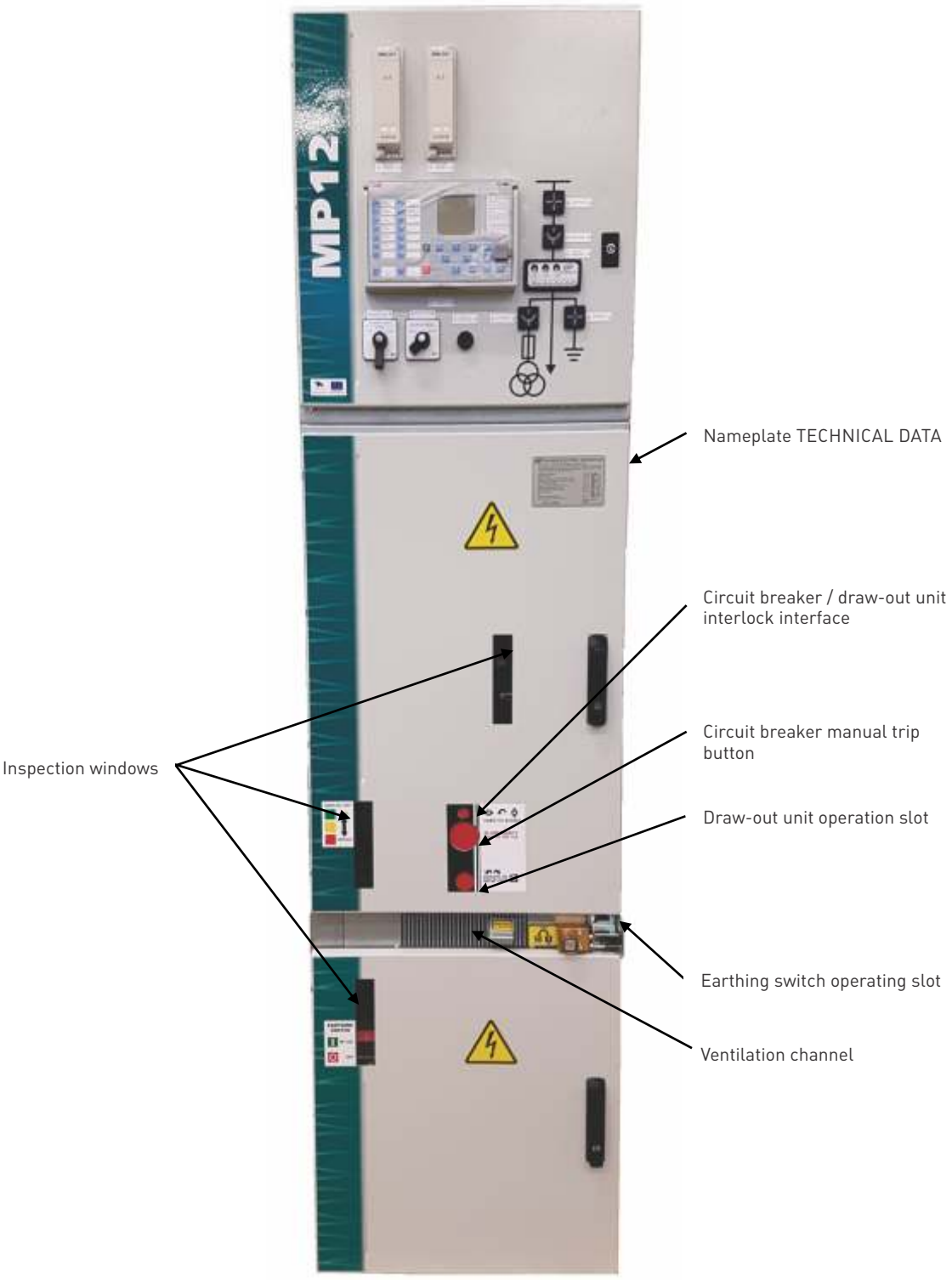
10.5 Busbar earthing switch close operation conditions

Prior to a busbar earthing switch CLOSE operation, the following conditions must be observed:
- all switching devices must be opened;
- all withdrawable parts must be racked out to the test position;
- all cable earthing switches must be closed;
- all secondary connection plugs must be connected.

If all of above mentioned points are observed, the busbar earthing switch is released for operation.

10.6 Appearance and interface of panel with draw-out unit with circuit breaker (IF, OF, BC, BT)

Cassette type panel with standard LV compartment



10.6.1 Operations with draw-out unit

Accessories:

Key 1 –
Draw-out unit interlock
SGcomp_Lever_Mile
(DoubleBit5)

Key 2 – for racking in and
racking out draw-out unit
SGcomp_Lever_Mile
(DOUHandle)

NB! DRAW-OUT UNIT MOVEMENT CAN BE DONE ONLY WHEN EARTHING SWITCH IS OPEN!

Draw-out unit movement from TEST to SERVICE position and switching circuit breaker.
Before closing the door make sure the interface position of manual disconnection on DOU is in the BLOCKED position.

1. Close the door.
2. Push emergency disconnect button to guarantee that circuit breaker is open.
3. Socket for VCB blocking unit and manual disconnecting interface: Plug key 1 to draw-out unit interlock socket and turn to 90° counterclockwise to release access to draw-out unit operating interface.
4. Draw-out unit operating interface: Plug key 2 into the Draw-out unit operating interface and turn it clockwise until it stops (there must be clicking before the stop position).
5. Turn key 1 to 90° clockwise to permit operation with circuit breaker.
6. Take out key 1 from VCB blocking unit and manual disconnecting interface.
7. Circuit breaker is in SERVICE position.

Draw-out unit movement from SERVICE to TEST position

1. Switch off the circuit breaker with key 1, using the emergency disconnect push button.
2. VCB blocking unit and manual disconnecting interface: Plug key 1 to VCB blocking unit and manual disconnecting interface and turn to 90° counterclockwise to release access to draw-out unit operating interface.
3. Draw-out unit operating interface: Plug key 2 to draw-out unit operation socket and turn it counterclockwise until it stops (there must be clicking before the stop position).
4. Draw-out unit is in TEST position. Door can be opened.

NB! IF CIRCUIT BREAKER IS CLOSED, TURNING KEY 1 TO 90° COUNTERCLOCKWISE WILL LEAD TO EMERGENCY TRIPPING OF CIRCUIT BREAKER.

10.6.2 Operations with earthing switch

Accessories:

Key 3 – Earthing switch operating tool -
SGcomp_Lever_Mile(ESHandle)

NB! FOR OPERATION WITH EARTHING SWITCH DRAW-OUT UNIT MUST BE IN TEST POSITION!

Switching ON

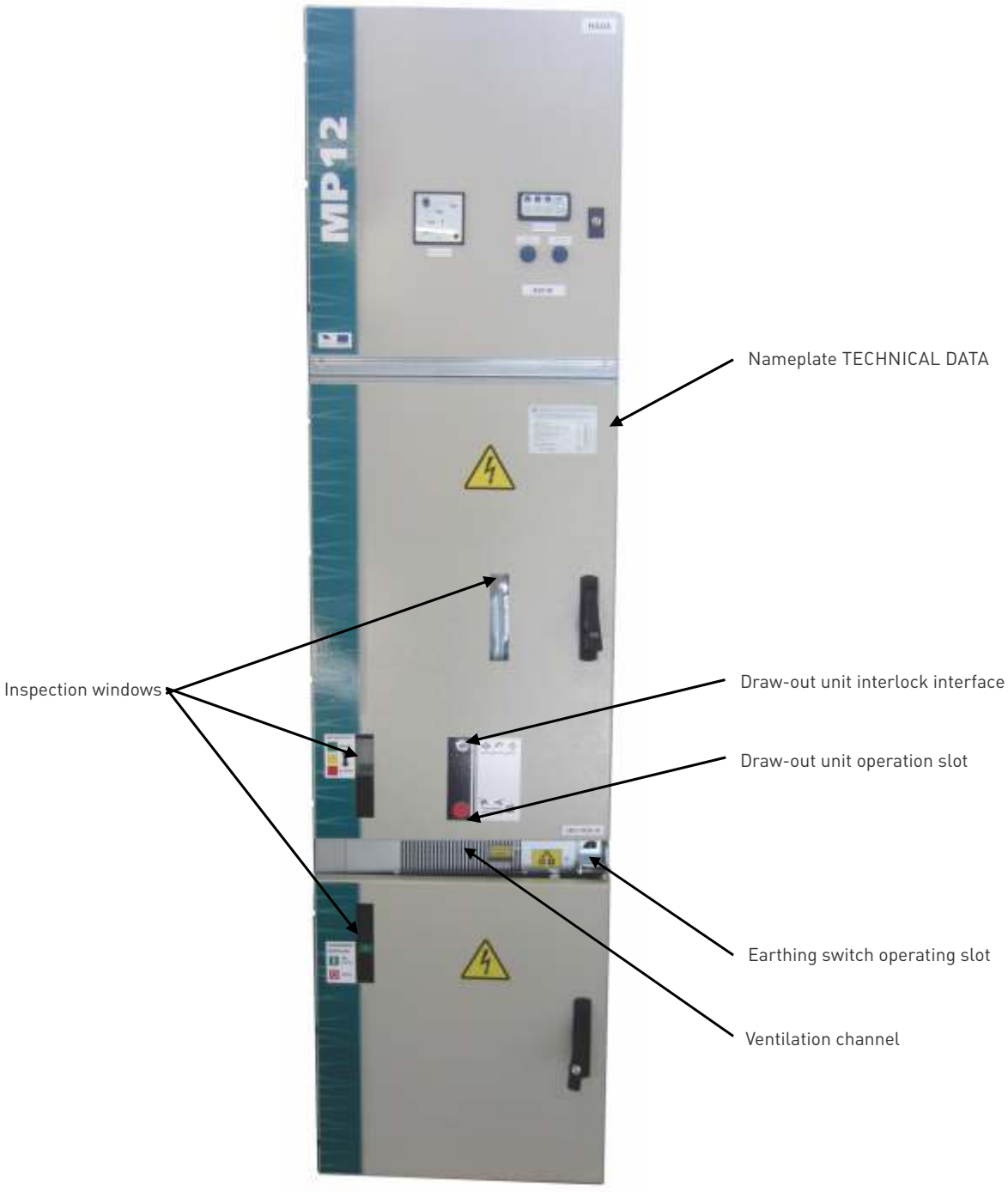
1. Open earthing mechanism cover.
2. Push the tag downward and insert earthing switch tool (3).
3. Turn tool to 180° clockwise to CLOSE earthing switch.
4. Remove the earthing switch tool to open cable compartment door.

Switching OFF

1. Close the cable compartment door.
2. Open earthing mechanism cover.
3. Push the tag downward and insert earthing switch tool (3).
4. Turn tool to 180° counterclockwise to OPEN earthing switch.
5. Remove the earthing tool.

10.7 Appearance and interface of panel with DOU and without circuit breaker (MES, M, BRES, BR, BRM)

Cassette type panel with standard LV compartment



10.7.1 Operations of switchgear with DOU and without circuit breaker

Accessories:

Key 1 –
Draw-out unit interlock
SGcomp_Lever_Mile
(DoubleBit5)

Key 2 – for racking in and racking out the draw-out unit -
SGcomp_Lever_Mile
(DOUHandle)

NB! DRAW-OUT UNIT MOVEMENT CAN BE DONE ONLY WHEN EARTHING SWITCH IS OPEN!

Draw-out unit with VT movement from TEST to SERVICE position

1. Close the door.
2. Socket for draw-out unit interlock: Plug key 1 into the draw-out unit interlock socket and turn 90° counterclockwise to release access to the draw-out unit operation socket.
3. Socket for draw-out unit operation: Plug key 2 into draw-out unit operation socket and turn it clockwise until it stops (there must be clicking before the stop position).
4. Turn key 1 to 90° clockwise to permit operation with circuit breaker.
5. Take out key 1 from draw-out unit interlock socket.

Draw-out unit with VT movement from SERVICE to TEST position

ATTENTION! Ensure no voltage is present on either side before racking-out draw-out unit with insolation truck!

1. Socket for draw-out unit interlock: Plug key 1 into the draw-out unit interlock socket and turn to 90° clockwise to release access to draw-out unit operation socket.
2. Socket for draw out unit operation: Plug key 2 into the draw-out unit operation socket and turn it counterclockwise until it stops (there must be clicking before the stop position).
3. Draw-out unit is in the TEST position. The door can be opened.

10.7.2 Operations with busbar earthing switch

Accessories:

Key 3 – Earthing switch operating tool-
SGcomp_Lever_Mile(ESHandle)

NB! FOR OPERATION WITH EARTHING SWITCH DRAW-OUT UNIT MUST BE IN TEST POSITION!

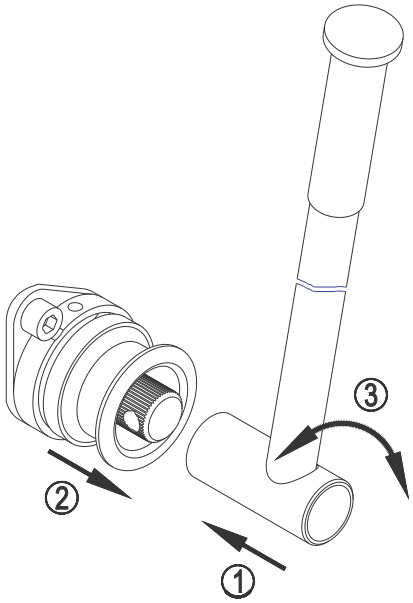
Switching ON

1. Open earthing mechanism cover.
2. Push the tag downward and insert earthing switch tool (3).
3. Turn tool to 180° clockwise to CLOSE earthing switch.
4. Remove the earthing switch tool to open cable compartment door.

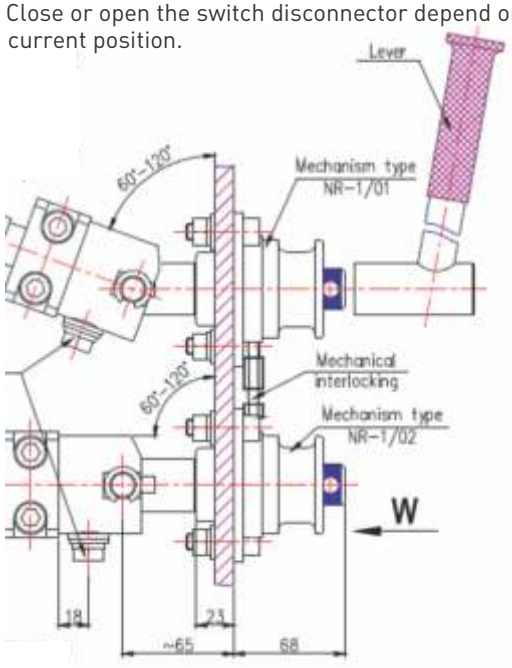
Switching OFF

1. Close the cable compartment door.
2. Open earthing mechanism cover.
3. Push the tag downward and insert earthing switch tool (3).
4. Turn tool to 180° counterclockwise to OPEN earthing switch.
5. Remove the earthing switch tool.

10.8 Load-break switch panel LBSF



1. Attach the operating lever to the mechanism's shaft.
2. Pull back the operation sleeve.
3. Close or open the switch disconnector depend on its current position.



The load break switch is mechanically and electrically interlocked with the earthing switch.

10.8.1 Operations with load break switch

1. Attach the operation lever to the mechanism shaft.
2. To switch LBSF ON, turn operation lever 180° clockwise.
3. To switch LBSF OFF, turn operation lever 180° counterclockwise.

10.8.2 Operations with earthing switch

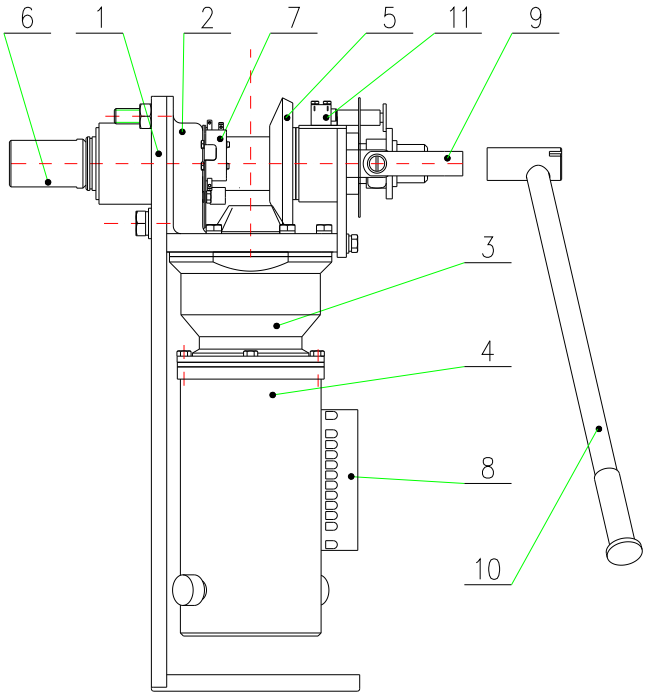
1. Attach the operation lever to the red mechanism shaft.
2. To switch earthing switch ON, turn operation lever 180° clockwise.
3. To switch earthing switch OFF, turn operation lever 180° counterclockwise.

10.8.3 Load-break switch panel LBSF with motor operating device NSW30

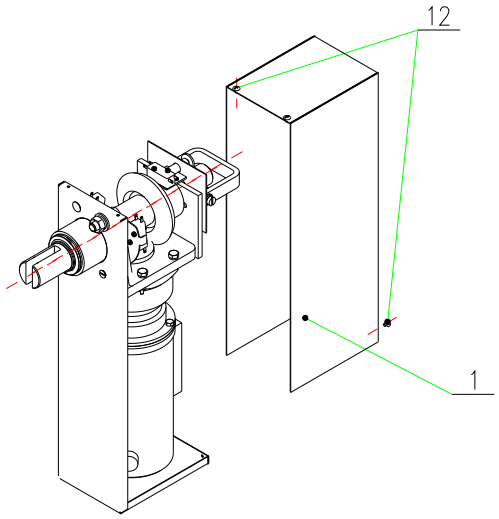
Load break switches and earthing switches are available with motor drive in LBSF panel.

LBSF panel with motor operating devices inside

Motor operating device type NSW30 is designed for application within the medium voltage switchboard. The motor operating device can be operated manually or via remote control.
The motor operating device consists of:
- Graded gearbox mechanism, drives by DC series motor.
- Microswitches that switch the motor off after reaching nominal shaft angle.
- Terminals for control and supply circuit.
- Interlocking microswitch for disconnecting the supply when operating the device manually.



The operating device structure:
1 - Enclosure
2 - Frame
3 - Transmission
4 - Motor
5 - Gearbox
6 - Output shaft
7 - Microswitch
8 - Terminal strip
9 - Clutch hand grip/blocking holder
10 - Hand lever
11 – Interlocking microswitch



Manual operation
In the case of manual emergency operation, the following procedure should be followed:

1. Attach the operating lever - 10 on the blocking holder - 9.
2. Deflect operation sleeve as shown in the sketch below.
3. Attach the operating lever - 10 on the mechanism's shaft.
4. Close or open the switch disconnector depending on its position.

The output shaft should be blocked by setting back the blocking holder.

NOTE: Ensure shaft coupling is complete after a manual operation (For primary position withdrawal).

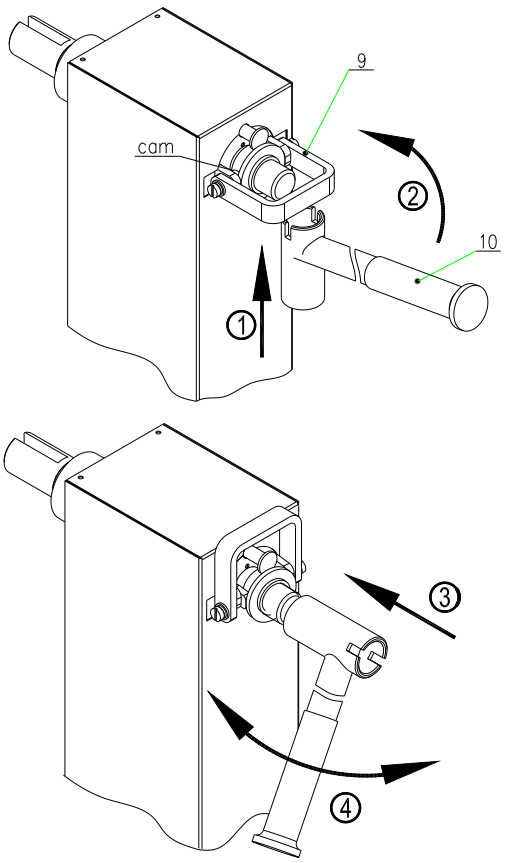
Door Interlock

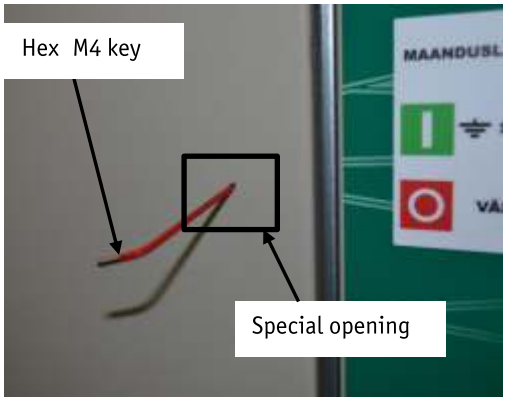
LBSF panel with a motor operating device for load break switch and earthing switch is equipped with an electromagnetic door interlock.
If the earthing switch is in the OPEN position, the interlock blocks LBSF panel door.

Opening of the blocked door in case of emergency - insert hexahedron spanner into special opening in the LBSF door and push.

LBSF electromagnetic interlock door

Enclosure:
The enclosure - 1 is made of painted sheet aluminium. Its cover is bolted on with four pieces M2.9 bolts - 12. In the lower part, a 14mm cable choke will be found. It allows control and supply conductor connection.





Opening of a blocked door in case of emergency

10.9 Service trolley operation

For the convenience of transportation, inserting and withdrawal of all types of DOUs, TE Energy has designed a Service Trolley. It is intended for application for both the circuit breaker compartment and the cable compartment DOUs. The service trolley has 2-level adjustable ramps. The upper ramp is used with the circuit breaker compartment DOUs, the lower ramp is used for the cable compartment DOUs. The service trolley is equipped with four wheels with stoppers, hardened handles, and a self-locking mechanism which guarantees secure coupling of the trolley and the SG_Mile switchgear during inserting and withdrawal operations. Both DOUs (the circuit breaker and the voltage transformer trucks) can be moved at once. Both DOUs are secured with sliding locks during their transportation on the trolley. The SG_Mile switchgear interface for service trolley operation is shown in the picture.

Openings for trolley guides

Trolley guides

Voltage transformer ramp

10.9.1 Inserting the draw-out unit to the panel

- Open the switchgear door.
- Position trolley in a such way that trolley guides are directed into the guide openings of the panel. Adjust the height of the ramp, if needed.
- Move the trolley close to the panel, push the trolley forward until the trolley guides clicks in.
- In order to release DOU, slide 2 handles simultaneously to the middle, holding the DOU handles push DOU into the compartment until it sets into place.
- The DOU must be fixed by clicking into 2 locks.
- Release DOU lock and roll it from panel.

Position trolley guides directed into the guide openings

Slide 2 handles simultaneously to the middle

Push DOU into the compartment until it sets into place

DOU is in the test position

Service trolley handle fixator should be pushed down for trolley guides fixing in the guide openings of the panel

10.9.2 Removing the draw-out unit from the panel

- Open the switchgear door.
- Disconnect the auxiliary plug. The DOU is in the isolated position.
- Move the trolley close to the panel as described above.
- In order to release DOU from the compartment, slide 2 handles simultaneously to the middle and pull DOU back on to the trolley ramp until the DOU fixing guides click.
- In order to remove the service trolley, press fixator handle downward and move the trolley back at the same time.

Service trolley handle fixator should be pushed down for trolley guides fixing in the guide openings of the panel

Position of trolley guides directed into the guide openings

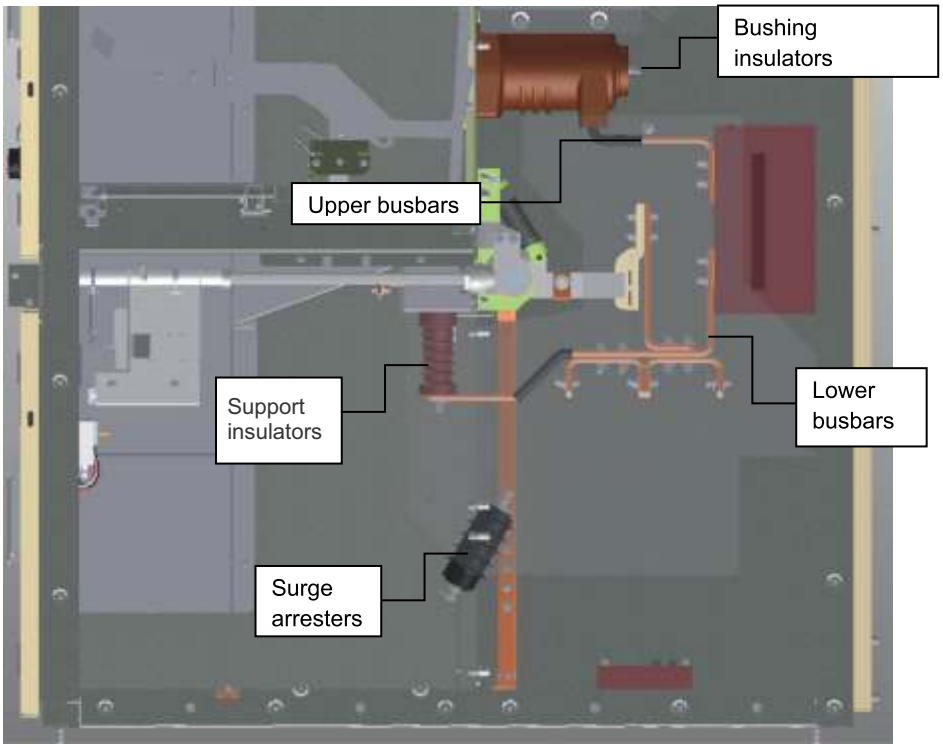
Slide 2 handles simultaneously to the middle

Pull DOU backward on the trolley ramp until the DOU fixing blades click

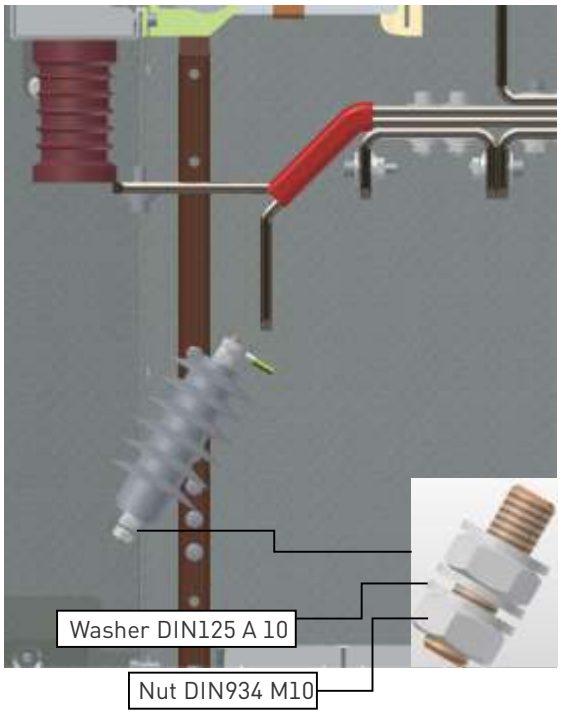
DOU is in the removed position

10.10 Current transformer replacement (front access only)

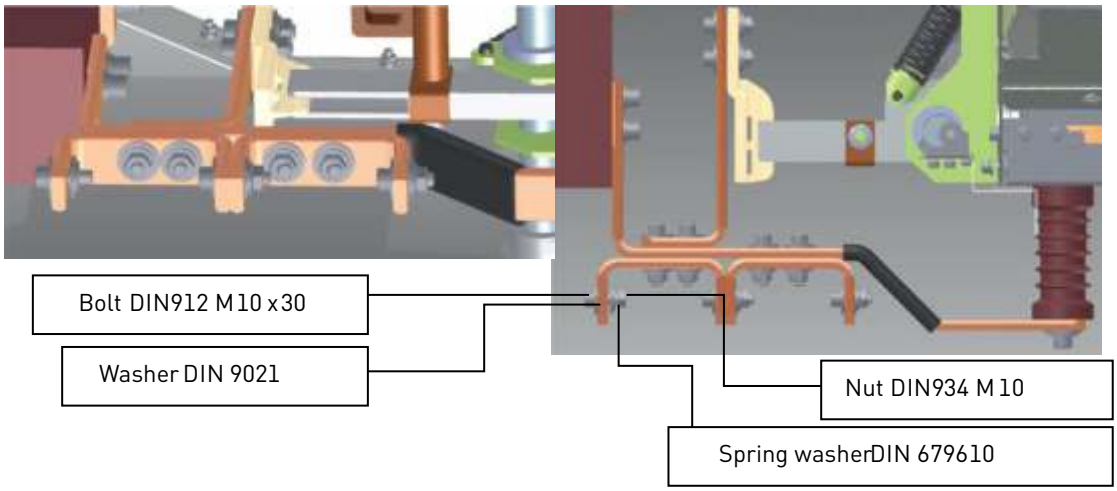
General view of upper and lower branch busbars system, connected with current transformers (cassette type)



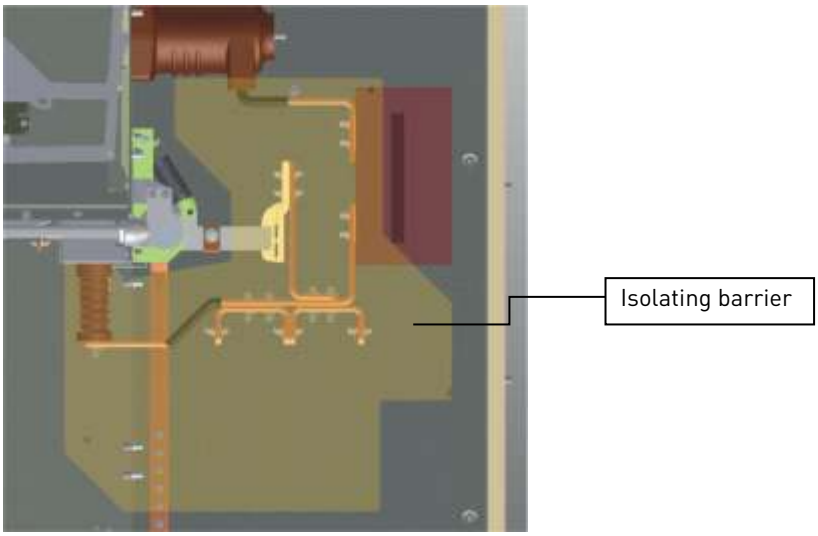
1. Make sure that the draw-out unit is in test position and circuit breaker is opened.
2. Close the earthing switch.
3. Make sure there is no voltage present, no light at LED diodes of the voltage indication unit. Double-check with a hot-stick indicator.
4. Open cable compartment door.
5. If surge arresters are installed, they should be removed first.



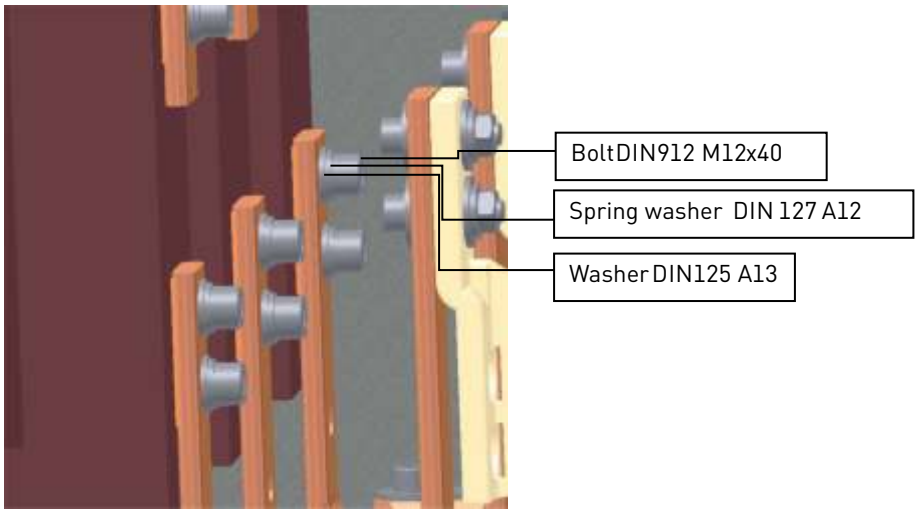
6. Disconnect power cables. Remove them carefully to cable cellar.



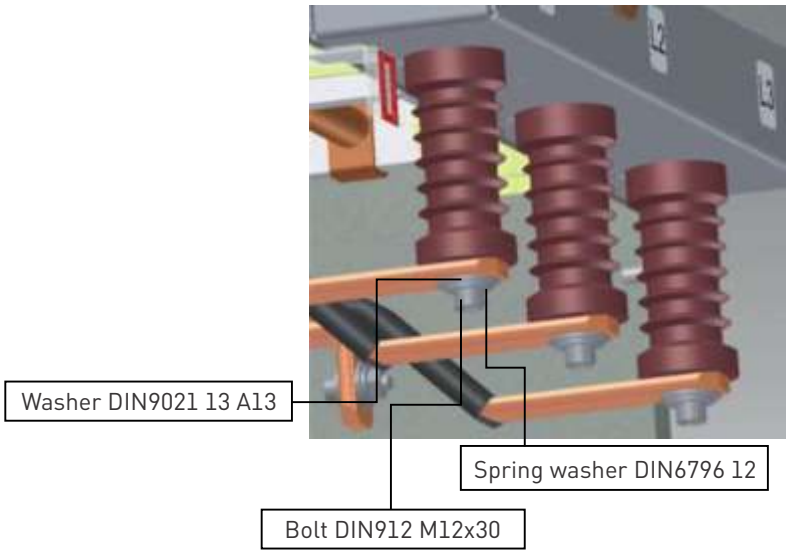
7. Remove isolating barriers fixed between phases.



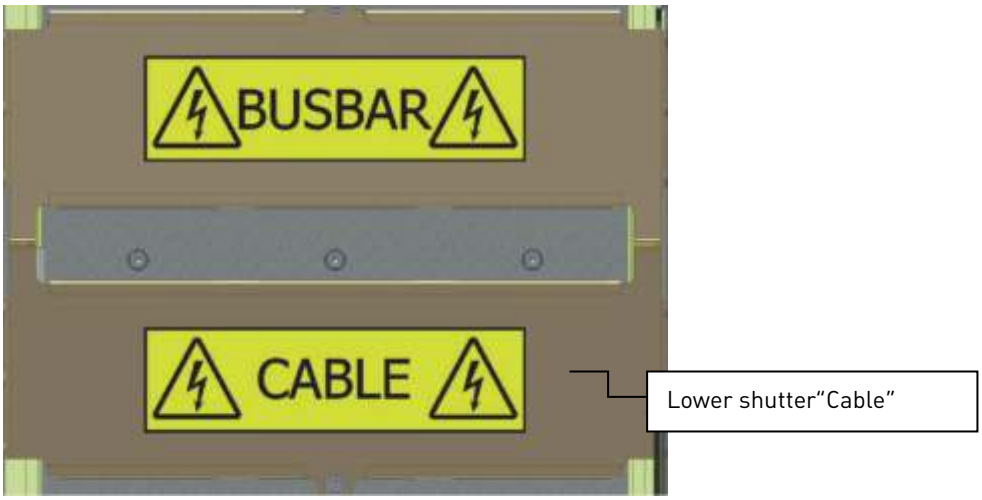
8. Dismantle the lower busbars.
   - Remove all current transformer lower busbars bolts.



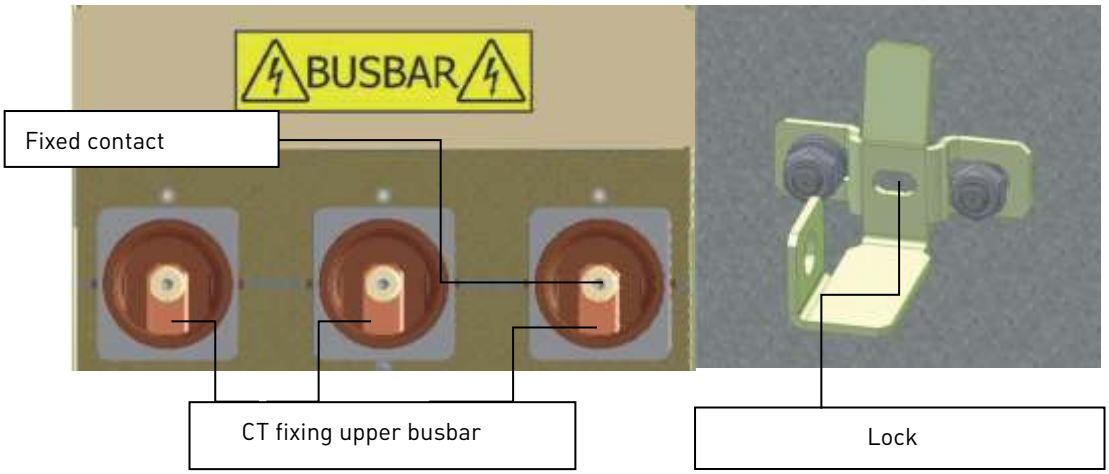
- Remove the bolt, that holds the lower busbars to the support insulator. Continue for all phases. (the busbar must be supported by hand, otherwise it may fall when all bolts are removed).



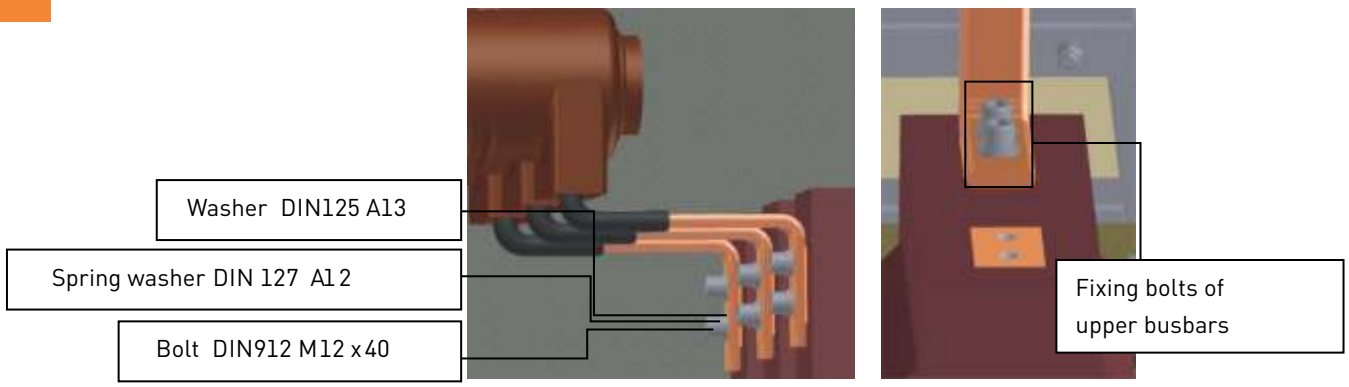
9. Disassemble the upper busbars.
   - Open the circuit breaker compartment door.



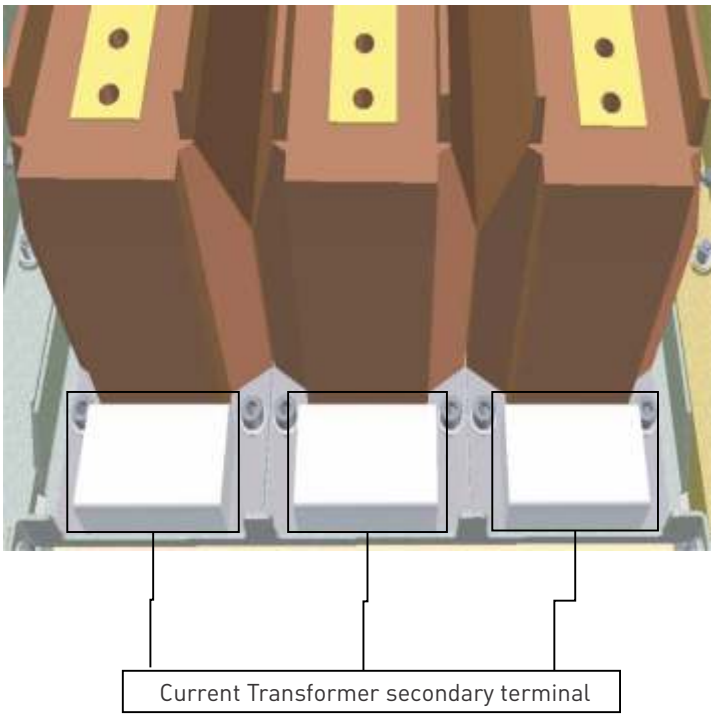
- Open the lower shutter "Cable" and fix it with the lock by manually lowering the shutter down until "click".



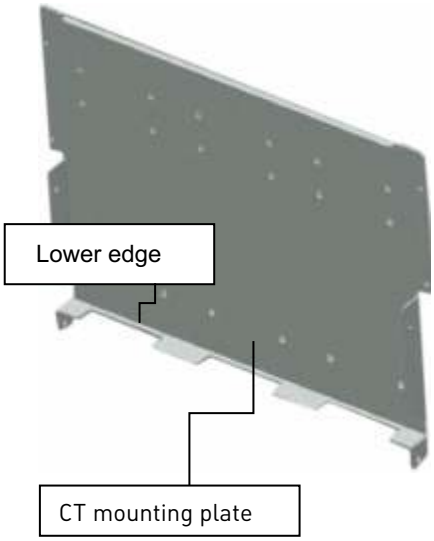
- Remove all CT upper connection bolts.
  (the busbar must be supported by hand, otherwise it may fall when all bolts are removed).

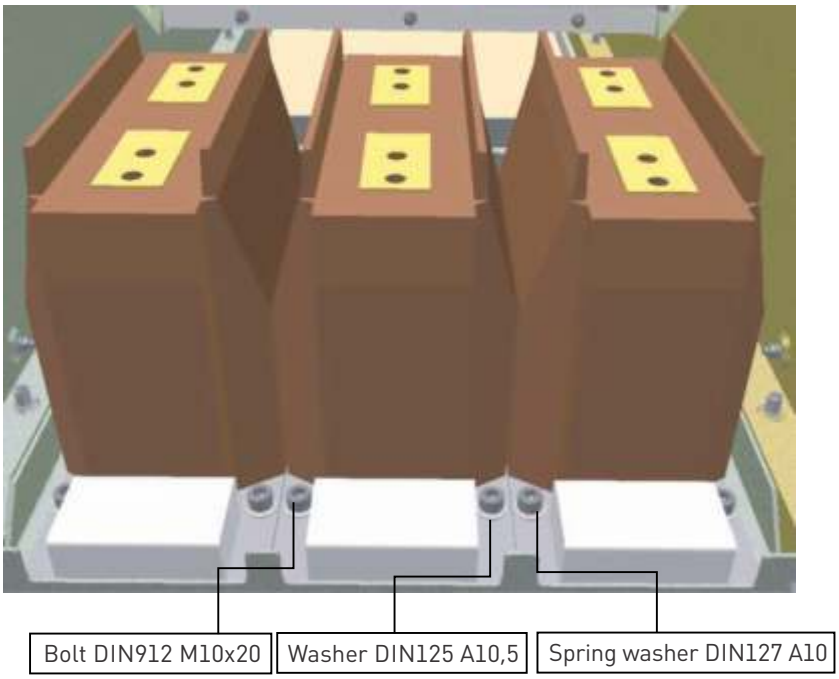


10 . Disconnect the secondary cables from CT secondary terminals.



11. Disconnect the current transformers from mounting plate.
   – Remove lower bolts (2 pcs).





– Remove upper bolts (2 pcs), holding the current transformer to the mounting plate with one hand(lower edge of the mounting plate bears the whole weight of the CT).

DANGER!

NB! Please proceed with extreme caution, heavy items may fall.

NB! The current transformer primary connection threads are not designed for frequent bolt tightening or untightening. Threads can be damaged with frequent use.

10.11 Set of tools

DOU operation tool
SGcomp_Lever_Mile(DOUHandle)

DOU interlock key
SGcomp_Lever_Mile(DoubleBit5)

Earth switch operation tool
SGcomp_Lever_Mile(ESHandle)

10.12 Control Module Malfunction detection

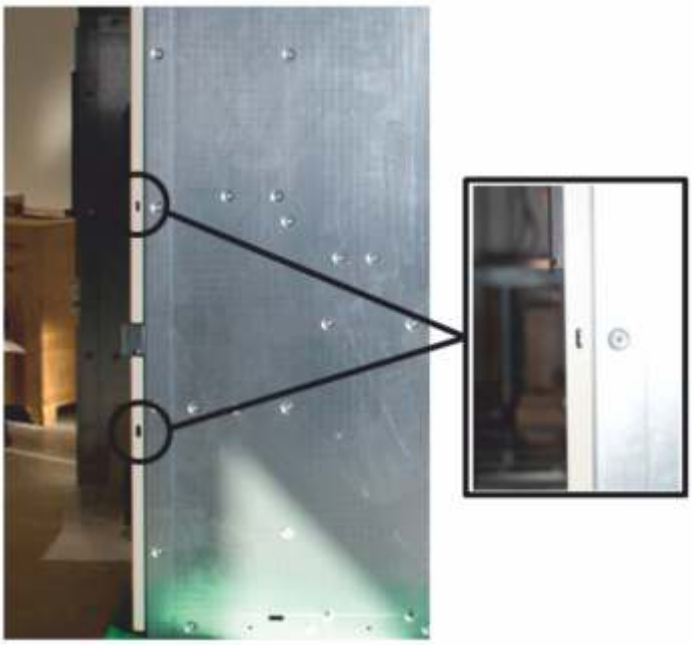
Failure Code LED indication (No. of flashes)	Type of malfunction
1	Power outage exceeds 1,5 s ± 0,5 s or applied voltage exceeds prescribed limit value
2	VCB closing or tripping failure
3	Actuator-coil is open-circuited
4	Actuator-coil is short circuited
5	VCB opened and locked
6	Overheating of CM
7	VCB emergency trip
Continuous red light	Internal failure of CM

If the malfunction can not been determined and failure cannot be eliminated, please contact your nearest TE Energy office.

10.13 Troubleshooting

Malfunction	Possible issue	Solution
Cannot open the cable compartment door	Earthing switch is open	Check if the earthing switch is open by the indicator or through the rear window. Close the earthing switch
Cannot open the CB compartment door	CB is not in the test position	Check the DOU CB position (indicator, inspection window), move DOU CB to the test position
Cannot close CB compartment door	Low voltage plug of DOU is not inserted	Check the position of low voltage plug of DOU, insert it
Cannot rack out the CB	CB is closed	Check the condition of CB, open it
	CB compartment door is open	Check the position of the door, close the door
	Earthing switch is closed	Check the position of the earthing switch, open it
Cannot open the earthing switch	The cable compartment door is open	Check the position of cable compartment door, close it
Cannot close CB	CB is in intermediate position	Check the position of CB, move CB to the test or to the service position
	After manual trip RESET was not performed	Press OPEN button
Blinking LED indicator "Failure"		See the table Failure Code Control Module

10.14 Opening the cable and circuit breaker compartment doors in case of emergency. Interlock bypass.



Two openings are located on the side of the cable and circuit breaker door.

Put M4 hex key into the opening and unscrew two bolt that hold the interlocked hook.

When hook is released the door can be opened.

Hex M4 key

11. DISPOSAL

The equipment and materials applicable in SG_MILE series switchgear do not contain any materials that are hazardous for the environment or for personnel. No special methods of disposal are required.

AMENDMENT SHEET

Date	Page	Changes	Reason
13.03.14	35-50	Draw-out unit constructive changes	Renewal of draw-out unit products
13.03.14	63-79	New designations of the switchgear	Classifier update
13.03.14	59, 62	Technical parameters update	Construction design update
13.03.14	60-61, 82-84	Overall dimensions changes	Construction design update
13.03.14	94-98	Gas Exhaust Duct mounting construction update	Construction design update
13.03.14	99-100	Greasing instruction	New instructions
13.03.14	107	Optional interlock – Castell key	Customer requirement
13.03.14	122-125	Truck Type VCB rack-in/out operation steps changes	Construction design update
13.03.14	126-130	Current transformer replacement (front access only)	Construction design update
08.11.2018	1-117	Document design update	New design
08.11.2018	1-117	Information about Truck Type VCB removed	Renewal of draw-out unit products
08.11.2018	41	Information about HCD added	New product
08.11.2018	46-49	Dimensions of panels adjusted, new main busbar ratings added, new designs of STP and LBSF panels added	Construction design update
08.11.2018	50-64	Changes in the classifier (Intra CTs removed, Truck version removed) and visual form optimization	Classifier update
08.11.2018	65-67	Packaging, labeling and storage information update	Product quality improvement
05.03.2024	1-117	Document design update	New design v2

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