SG40_MILE

AIS MV SWITCHGEAR | 36 kV, 31.5 kA, 3150 A

TECHNICAL MANUAL

ISO 9001:2015
ISO 14001:2015

Table of Contents

1. General

1.1. Common abbreviations and acronyms

AC	Alternating Current
CB	Circuit Breaker
CC	Cable Compartment
CT	Current Transformer
DC	Direct Current
DIN	German Institute for Standardization
EM	Electromagnetic
EMC	Electromagnetic Compatibility
EU	European Union
GB	Great Britain
GOST	State Standard
IAC	Internal Arc Classification
IEC	International Electrotechnical Commission
IED	Intelligent Electronic Device
IP	Ingress Protection
LED	Light-Emitting Diode
LV	Low Voltage
M	Metering (panel)
PB	Power Block
PCD	Pole-Center Distance
PD	Partial Discharge
PM	Partition Metal (class)
R&D	Research and Development
RTU	Remote Terminal Unit
SA	Surge Arrester
SF6	Sulfur Hexafluoride
SG	Switchgear
SP	Switchgear Panel
VDS	Voltage Detecting System
VI	Voltage Indicator
VPIS	Voltage Presence Indicating System
VCB	Vacuum Circuit Breaker
VT	Voltage Transformer

1.2. Presentation

Thank you for choosing this TE Energy product. The SG40_MILE series switchgear is an air insulated LSC2B-PM class designed for primary distribution up to 36 kV, 3150 A, 31.5 kA. The switchgear is used to distribute electric power for wide range of applications such as utility, industrial and renewable energy generation substations.

High reliability
High-performing core materials are designed to operate under harsh industrial environments and provide excellent protection against mechanical shocks, dust and moisture.

Operator safety
Arc-proof design and Intelligent interlock system eliminates any risks associated with service and maintenance.

Environmentally friendly
SF6-free technology for sustainability and safety.

Global leader
More than 20 years of experience. International certification according to the latest IEC 62271-200 and access to global markets.

Value for money
Affordable and flexible pricing, comprehensive turnkey solutions from the most experienced engineers.

1.3. Reference standards

SG40_MILE series switchgear meets all the requirements for prefabricated metal enclosed switchgear for indoor installation in accordance with the latest revision of IEC 62271-200. A complete list of applicable standards is given in Table 1.1.

Table 1.1 Applicable standards

Equipment	Standard
IEC 62271-1	HV switchgear and controlgear: common specifications
IEC 62271-100	Alternating current circuit breakers
IEC 62271-102	Alternating current disconnectors and earthing switches
IEC 62271-200	AC metal enclosed switchgear and control gear above 1 kV and up to and including 52 kV
IEC 60529	Degrees of protection provided by enclosures (IP Code)
IEC 61869-1	Instrument transformers - Part 1: General requirements
IEC 61869-2 IEC 61869-3	Instrument transformers - Part 2: Current transformers Instrument transformers - Part 3: Inductive voltage transformers
IEC 60255	Measuring relays and protection equipment
IEC 60099-4	Surge arresters - Part 4: Metal-oxide surge arresters without gaps for a.c. systems
IEC 61243-5	Voltage detecting systems (VDS)
IEC 62271-206	VPIS systems for rated voltages between 1kV and 52kV
IEC 61140	Protection against electric shock - Common aspects for installation and equipment
2014/35/EU	EU LV directive
2014/30/EU	EU EMC directive
ISO 9001	Quality management
ISO 14001	Environmental management

1.4. Normal service conditions

The rated characteristics of the switchgear are guaranteed under the ambient conditions given in Table 1.2.

Table 1.2 Service conditions

Parameter	Value
Minimum ambient temperature, °C	-5[1]
Maximum ambient temperature, °C	+55[2]
Maximum altitude above sea level, m	1000[3]
Maximum 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; Degree of severity of service conditions under condensation and pollution as per IEC 62271-304: Degree 0: C0PI.	

[1]Value is limited by instrument transformers and electronic protection devices.

[2]IEC 62271-1 limits the upper level of ambient temperature at +40°C.

[3]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.

1.5. Rated characteristics

The main rated characteristics of the switchgear and circuit breaker are given in Table 1.3.

Table 1.3 Rated characteristics

Switchgear panel	**SG40_MILE**
Type	Air insulated
Rated voltage, kV	36
Rated frequency, Hz	50/60
Rated power frequency withstand voltage, kV	70/80
Rated lightning impulse withstand voltage, kV	170/195
Rated peak withstand current, kA	64/82
Rated short-time withstand current, kA (3s)	25/31.5
Rated current, A	630; 1250; 1600; 2000; 2500; 3150
IAC classification	AFLR
Loss of service continuity	LSC2B
Partition type	PM
Partial discharge level at 1.1 x Urated, pC	<20
Degree of protection	IP4X[1]/IK10
Auxiliary voltage, V	24/48/110/220DC; 100-230AC
Dimensions (WxDxH), mm	1200 x 2700 x 2500
Weight, kg	≤ 1350[2]
Vacuum circuit breaker	**Susol VH-36**
Type	Withdrawable truck version
Interrupting medium	Vacuum
Type of driving mechanism	Spring charging motor
Mechanical endurance class	M2
Electrical endurance class	E2
Capacitive current switching class	C2
Operating cycles, rated breaking current (CO-cycles)	80
Closing time, ms	≤ 60
Opening time, ms	≤ 40
Motor charging time, s	≤ 12
Autoreclosing cycle	O-0.3s-CO-3min-CO
DC component, %	50
Dimensions (WxDxH), mm	962 x 885 x 1354
Weight, kg	400

[1]IP41 on request.

[2]Maximum weight without a withdrawable circuit breaker. The exact weight depends on the configuration and apparatuses used.

2. Safety information

2.1. General recommendations

The instructions in this manual are not intended as a substitute for competency in the use of the equipment described. Installation, use and repair should only be carried out by trained and experienced personnel, who are familiar with the equipment and with electrical safety requirements.

Pay attention to the following recommendations:

- Make sure that during installation, commissioning and operation, the respective legal regulations (GB/IEC/IEEE/GOST) and appropriate national safety regulations are adhered to.
- Only install and operate the switchgear in an environment suitable for the installation and operation of electrical equipment.
- Make sure that the parameters specified by the manufacturer 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 described in section 2.2.

2.2. Hazard statements

This manual may contain three types of hazard statements:

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

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

NOTE: Indicates important items of information throughout the manual.

2.3. Personnel safety

2.3.1. Internal Arc Classification (IAC)

The personnel safety factor was a primary goal when SG40_MILE switchgear was designed. Thus, the SG40_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 SG40_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 SG40_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 SG40_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 SG40_MILE switchgear is IAC classified: AFLR 31.5kA, 1s.

The following factors are obligatory to be considered for installation:

Level of the fault current (up to 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

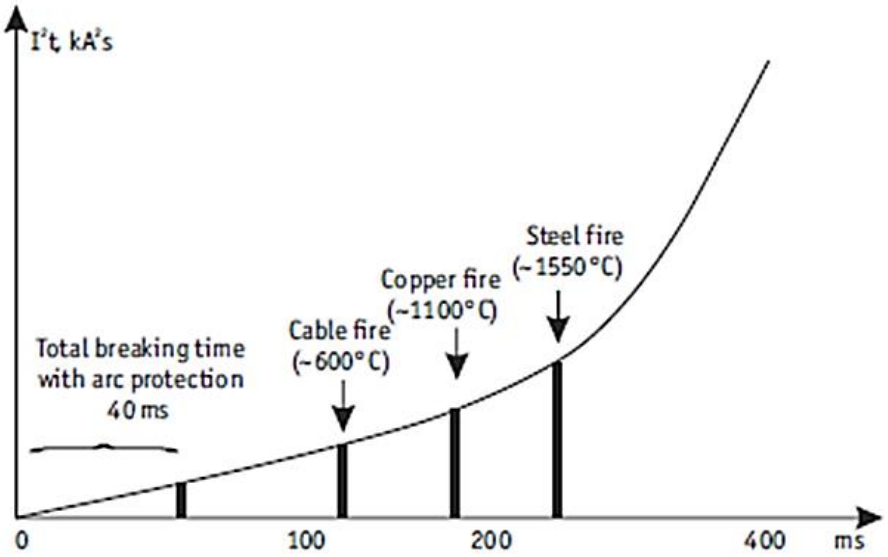


Fig.2.1. Internal arc development

2.3.2. Interlocks and locking devices

The SG40_MILE switchgear is fitted with the mechanical interlocks needed to guarantee the highest level of safety for operators. According to Table 2.1 the interlocking devices prevent:

Table 2.1 Standard safety mechanical interlocks

Circuit breaker closing when the truck is in intermediate position
Circuit breaker racking in/out when the circuit breaker is closed
Earthing switch closing when the truck is in intermediate or service position
Circuit breaker racking in if the earthing switch is closed
Circuit breaker compartment door opening when the earthing switch is open and the truck is inside
Circuit breaker racking in when the circuit breaker compartment door is open

In addition to the standard safety interlocks, the locking magnets can be provided on request for electrical interlocking. According to Table 2.2 the electrical interlocking devices prevent:

Table 2.2 Optional electrical interlocks

Description	**Condition to be fulfilled**
Truck racking in/out	Locking magnet energized
Earthing switch operation	Locking magnet energized

All mechanical and electrical interlocks have a defeat option.

All compartment doors are equipped with a standard double bit key lock. The available padlock facilities are described in Table 2.3.

Table 2.3 Padlock facilities

Circuit breaker compartment door
Low voltage compartment door
Circuit breaker racking-in/out interface
Circuit breaker manual close/open interface
Earthing switch operating interface
Shutters mechanism (open position only)

Castell trapped key interlocks can be provided on request to prevent unauthorized access to the circuit breaker or/and earthing switch.

Castell lock

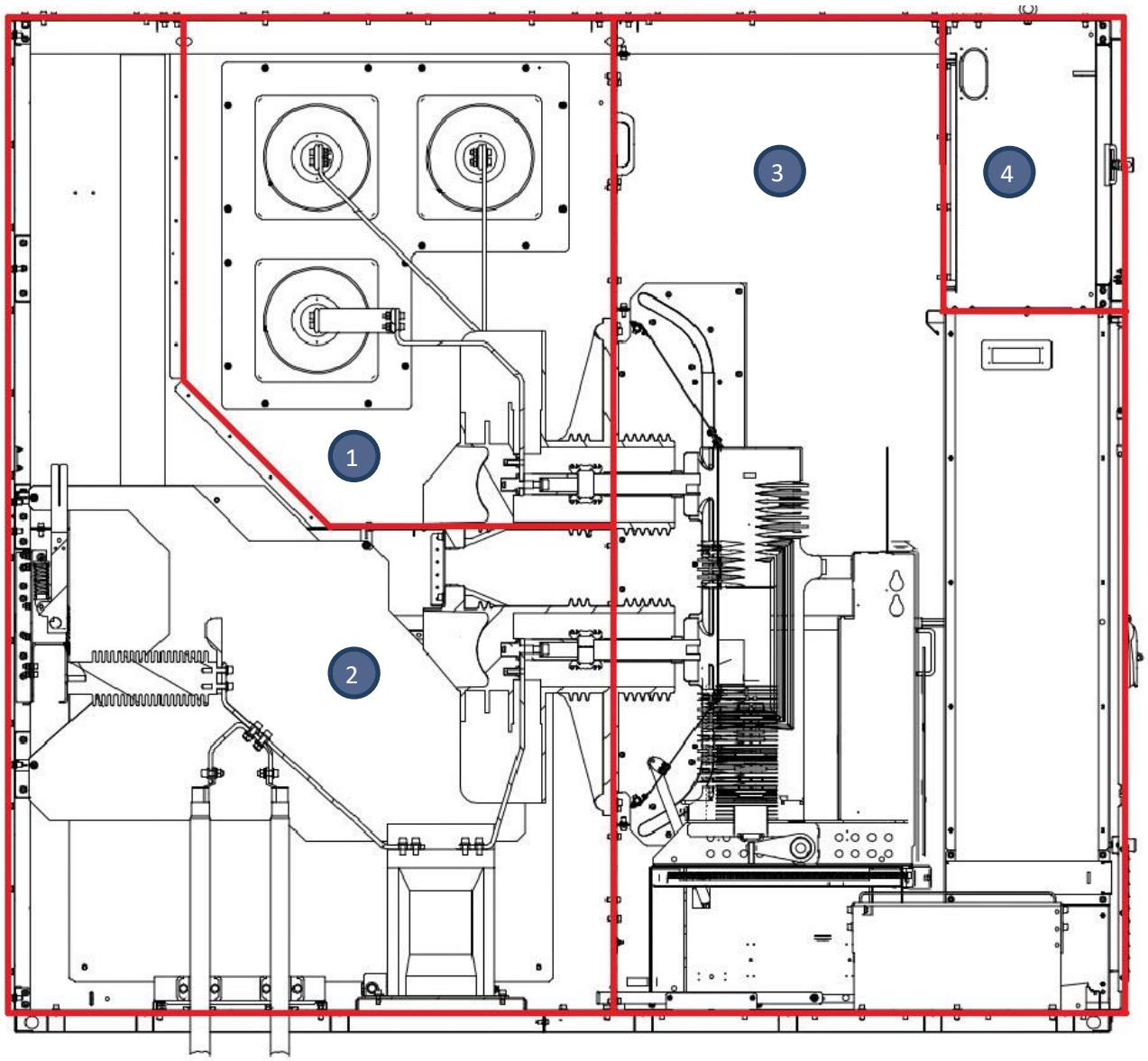
Castell exchange box (example)

Fig.2.2. Castell trapped key system

3. Design

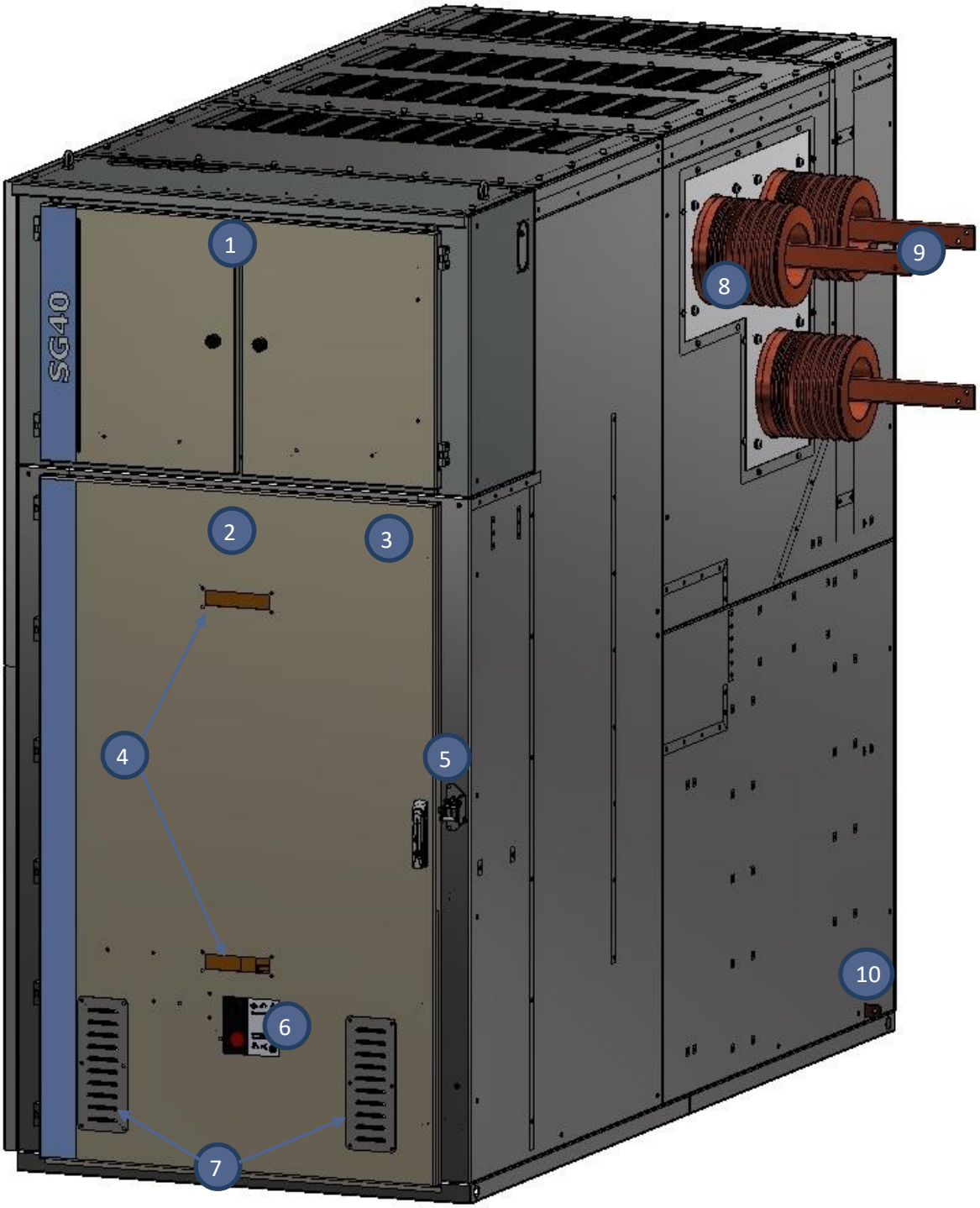
3.1. General

The SG40_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 (refer to Fig.3.1) which are separated from each other by means of earthed metal partitions. Within the aspects of IEC 62271-200 related to the definition of Loss of Service Continuity, the class is defined as LSC2B-PM. The switchgear can be equipped with the floor truck type vacuum circuit breaker or voltage transformers (metering panel).



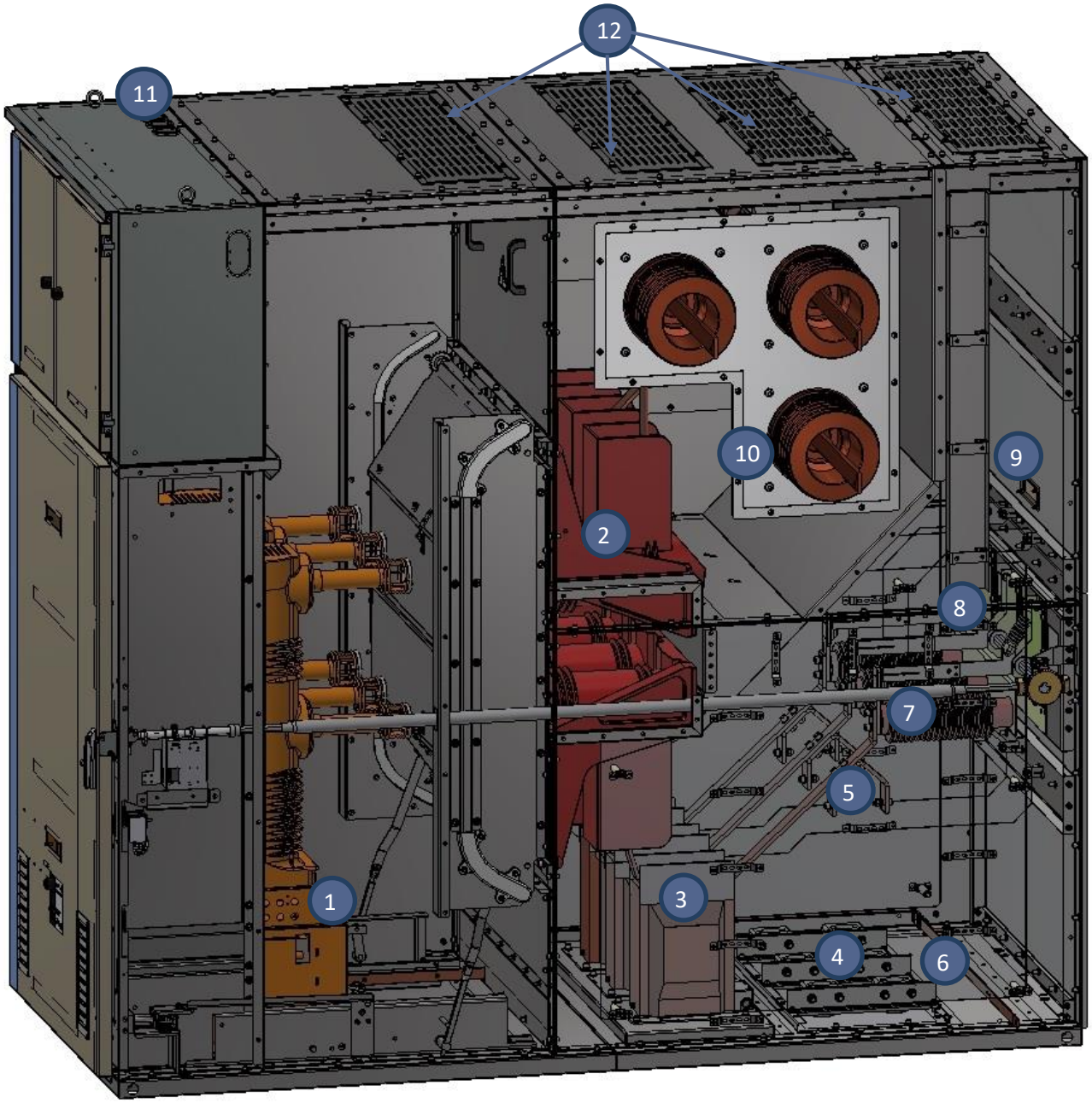
1	Busbar compartment	3	Circuit breaker compartment
2	Cable compartment	4	Low voltage compartment

Fig.3.1. SG40_MILE compartments



1	Low voltage compartment	6	Truck racking-in/out interface
2	Circuit breaker compartment	7	Ventilation grills
3	Nameplate	8	Through insulators
4	CB compartment inspection windows	9	Main busbars
5	Earthing switch operation interface	10	Earthing busbar

Fig.3.2. SG40_MILE design overview



1	Withdrawable vacuum circuit breaker	7	Capacitive support insulators
2	Contact box	8	Earthing switch
3	Current transformers	9	Rear inspection window
4	Bottom inlets for power cables	10	Through insulators and main busbars
5	Cable connection busbars	11	Top inlets for secondary cables
6	Main earthing bar	12	Pressure relief flaps

Fig.3.3. SG40_MILE design overview (side cover removed)

3.2. Busbar compartment

The busbar compartment (refer to Fig.3.1, item 1) 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 and covered with heat shrinkable insulation sleeves. The maximum rating of busbar system is 3150A. 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.

Table 3.1 Busbar ratings

Type	Rated current, A	Busbar size, mm
Main busbars	1250	1x10x60
	1600/2000	2x10x60
	2500	3x10x80
	3150	3x10x100
Branch connection busbars	630	1x10x40
	1250	1x10x60
	1600/2000	2x10x60
	2500	3x10x80
	3150	3x10x100

3.3. Cable compartment

The cable compartment (refer to Fig.3.1, item 2) houses the branch connections, earthing busbar, earthing switch, power cables, instrument transformers (current transformers, voltage transformers, zero-current transformers) and optionally surge arresters.

The cable compartment design allows up to 4 cables per phase connections. Cable fixing plate is suitable for any kind of cable. All three phases are separated by the isolating barriers made from non-flammable material.

The earthing busbar is made of electrolytic copper. The size is 10x30 mm. 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 withstand to guarantee personal safety against electric shock. The earthing busbars are capable of peak current 31.5kA and peak value 82kA for 3 seconds.

The inspection window is available on the back of the switchgear panel (refer to Fig.3.3).

3.4. Circuit breaker compartment

The circuit breaker compartment (refer to Fig.3.1, item 3) houses the circuit breaker, contact boxes 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. The bushings are single-pole type and are made of cast resin. Access to live parts is prevented with movable metal shutters.

3.5. Low voltage compartment

The low-voltage compartment (refer to Fig.3.1, item 4) 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 door. The size of low compartment is 1200x700x400 mm (WxDxH).

3.6. Pressure relief duct

The pressure relief flaps (refer to Fig.3.3, item 12) 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.

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:

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

The gas exhaust duct is fitted 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.

An exact solution for every installation is to be specified separately.

4. Equipment

4.1. Circuit breaker

SG40_MILE switchgear panels are equipped with LS Electric VH-36 series vacuum circuit breakers (refer to section 1.5 for rated characteristics). The circuit breakers are withdrawable floor truck type.

LS Electric Susol VH-36 series circuit breakers with embedded vacuum interrupters are premium products featuring sustainable technologies, compact size, high reliability and a variety of accessories for safe, stable and reliable power supply. These circuit breakers are the best choice for a wide variety of indoor applications and are used in primary and secondary distribution substations to control and protect transformers, motors, generators, capacitor banks and cable lines.

1	Low-body vehicle (floor truck)	8	VCB open pushbutton
2	Shutter actuators	9	VCB close pushbutton
3	Locking/release handles	10	Spring indicator (Charged/Discharged)
4	Rack-in/rack-out interface	11	Truck handles
5	Operations counter	12	Secondary connector plug
6	VCB position indicator (Open/Close)	13	VH series vacuum circuit breaker
7	Manual spring charge interface	14	Primary contacts (tulip type)

Fig.4.1. Withdrawable circuit breaker (floor truck type)

4.2. Earthing switch

Each panel is fitted with an earthing switch (refer to Fig.3.3, item 8) for cable or busbar earthing (metering panel or bus coupler) depending on the configuration. The earthing switch is operated from the front of switchgear and can be manually or motor operated. The position of the earthing switch can be determined from the rear of the panel by means of mechanical position indication through an inspection window (refer to Fig.3.3, item 9). Each support insulator is equipped with the integrated voltage divider for detection of the presence of voltage. 5NO+5NC auxiliary contacts are available for position indication.

The earthing switch conforms with IEC 62271-102 and has 31.5kA short-circuit making capacity.

Fig.4.2. Earthing switch

4.3. Current transformers

The support type current transformers are used to provide measurements to protection relays, control systems and power metering devices. All active parts are solidly insulated with cast resin. All current transformers comply with IEC 61869-2: Instrument transformers - Part 2: Current transformers, GOST 7746-2015 and DIN 42600.

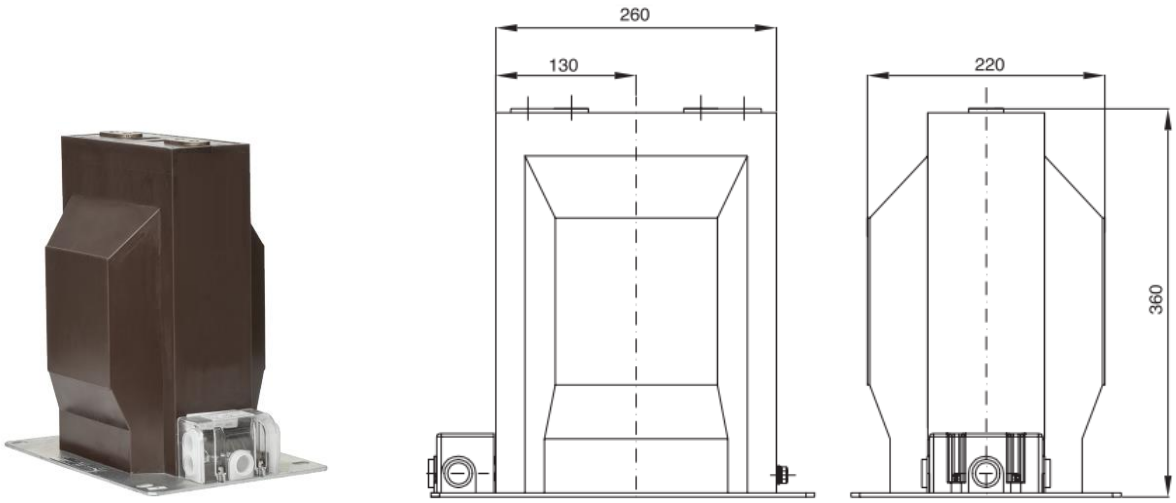


Fig.4.3. CT (example)

4.4. Voltage transformers

The voltage transformers are used to provide measurements 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. The transformers comply with IEC 61869 - 3: Instrument transformers - Part 3: Inductive voltage transformers, GOST 1983-2015 and DIN 42600.

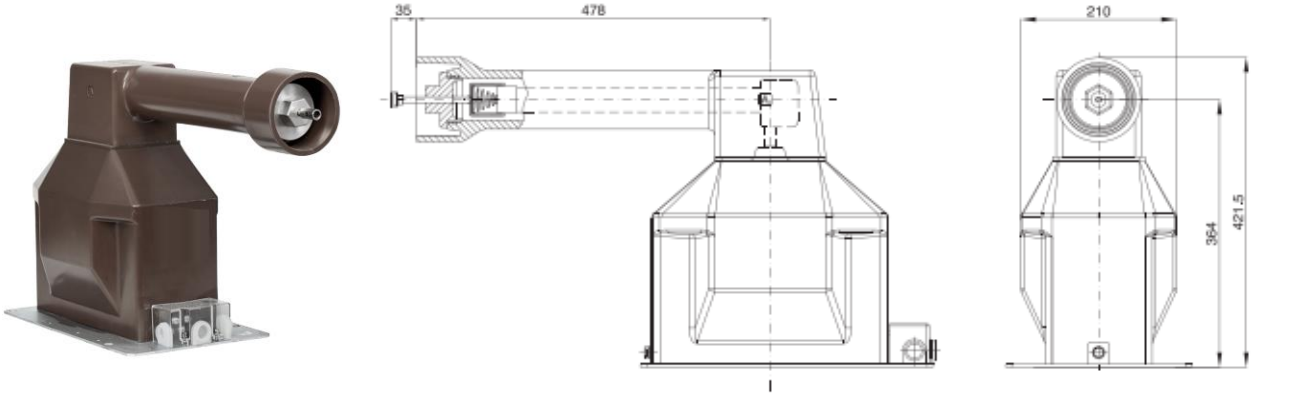


Fig.4.4. Withdrawable VT (example)

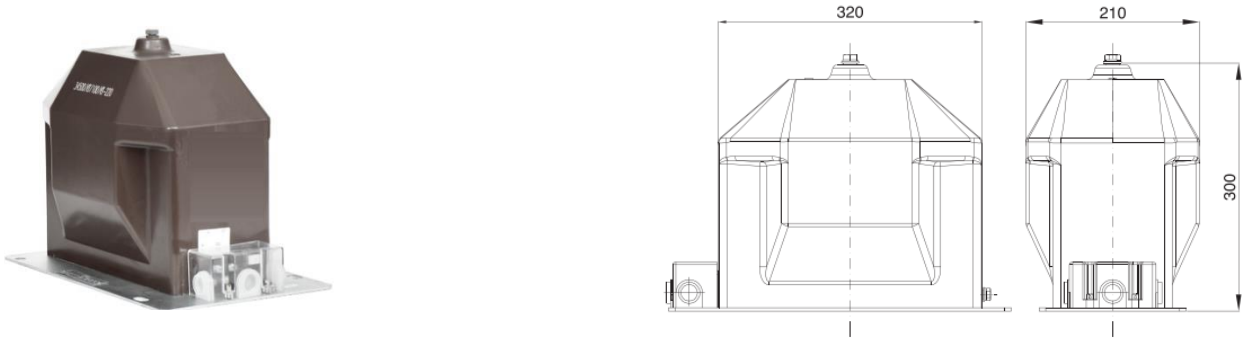


Fig.4.5. Fixed VT (example)

4.5. Zero sequence transformer

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.

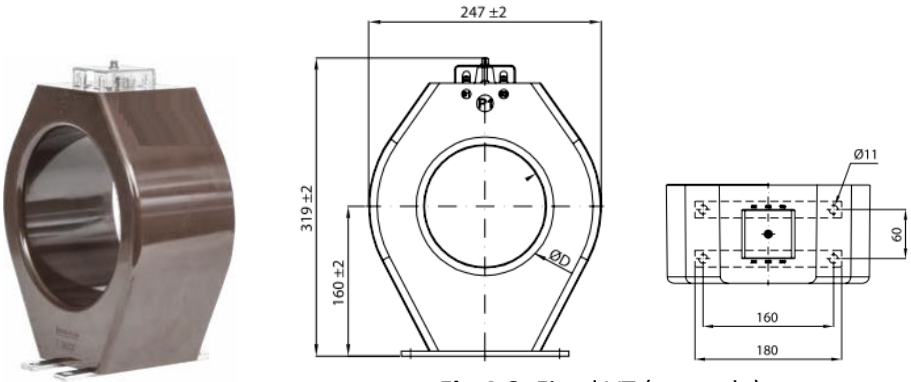


Fig.4.6. Fixed VT (example)

4.6. Voltage indicators

Voltage indicators are situated on the front of the switchgear. The switchgear is normally equipped with Voltage Detection System (VDS) according to IEC 61243-5.

Voltage indicators have flashing LED diodes ensuring a bright signalling for each phase, connection points for phase balance checking and two relay outputs.

Fig.4.7. Voltage indicator CPI plus (example)

4.1. 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 - Part 4: Metal-oxide surge arresters without gaps for a.c. systems and GOST R 52725- 2007 standards.

4.1. Relays and metering

The switchgear can be equipped with a wide range of feeder protection relays and metering equipment (digital and analogue meters, power analysers, etc.) from various manufacturers depending on the client's requirement. Alternatively, the switchgear can also be delivered prepared for protection relays installed by the client (with cut-outs in LV-compartment, auxiliary wiring and electrical drawings).

5. Selection

5.1. Available panel configurations

The range is available in extensible format. Available standard configurations are illustrated in Fig.5.1.

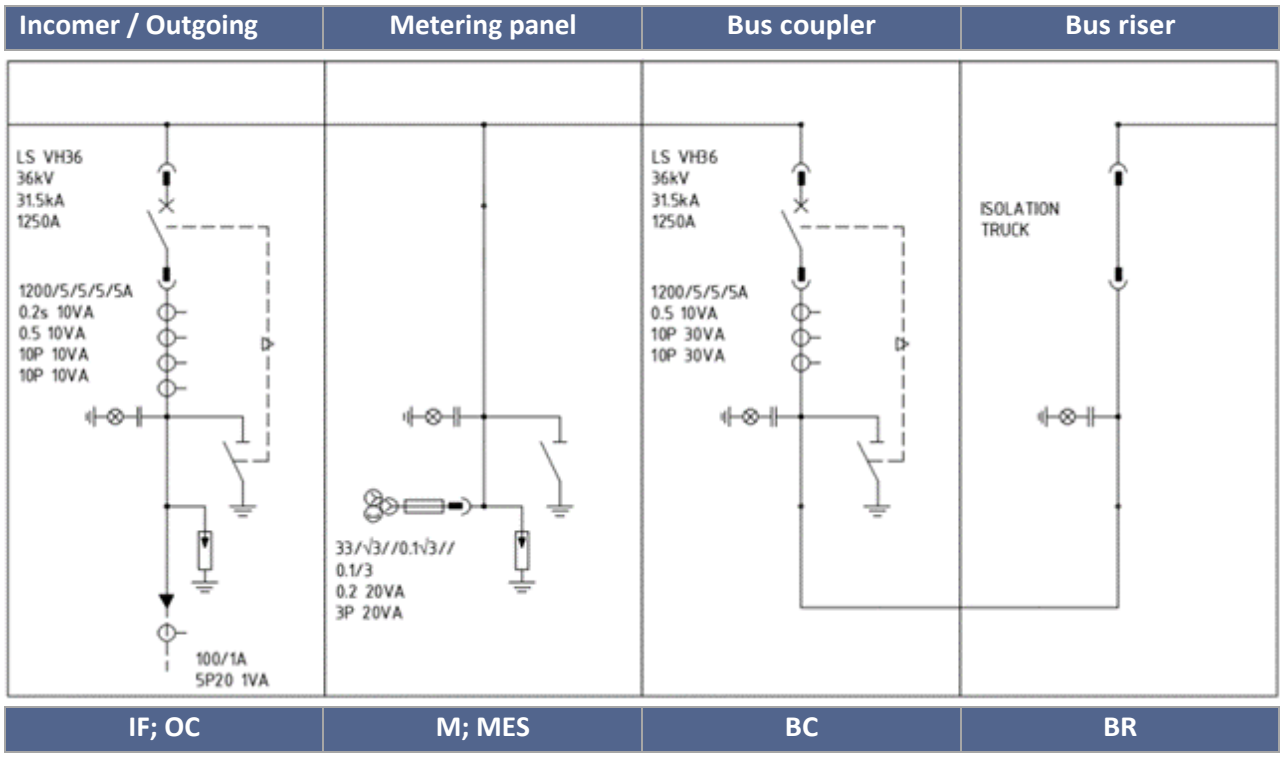


Fig.5.1. Available panel configurations

Custom configurations can be provided on request. Contact your TE Energy representative for more details.

5.2. Ordering details

The SG_SG40_MILE Switchgear is available in two different options:

- SP (Switchgear panel) – fully assembled and routine tested panel.
- PB (Power block) – semi-assembled and routine tested panel supplied without LV equipment.

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 SG40_MILE series switchgear are presented below:

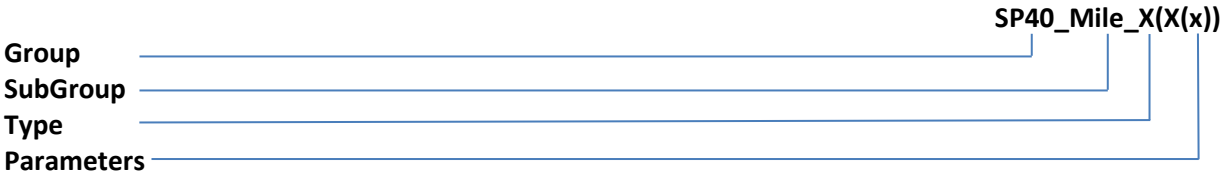


Table 5.1 Ordering details

Classifier Group	Abbreviation	Description	
GROUP	**SP40**	Fully assembled panel	
	PB40	Semi-assembled panel without LV equipment	
SUBGROUP	**MILE**	MILE series switchgear	
Type	**IF**	Incomer	
	OF	Outgoing feeder	
	BC	Bus coupler	
	BR	Bus riser	
	M	Metering panel	
	MES	Metering panel with busbar earthing switch	
PARAMETERS	**Abbreviation**	**Description**	
	W(1200)	**(1)** Panel width	1200mm
	M(1250)	**(2)** Main busbar rated current	1250A
	M(1600)		1600A
	M(2000)		2000A
	M(2500)		2500A
	M(3150)		3150A
	BR(630)	**(3)** Branch connection busbars	630A
	BR(1250)		1250A
	BR (1600)		1600A
	BR (2000)		2000A
	BR (2500)		2500A
	BR (3150)		3150A
	X(x)	**(4)** Panel custom attachment	Contact your TE Energy representative for available options
	LVStd(1)	**(5)** LV compartment	Standard size
	PBmet1(1_1200)	**(6)** Enclosure type	Standard metal enclosure 1200mm, IP4X (total ordering q-ty ≤3)

Classifier Group	Abbreviation	Description	
	PBmet1(3_1200)		Standard metal enclosure 1200mm, IP4X (total ordering q-ty ≥3)
	CTx(x)	**(7)** Phase **c**urrent transformers	Contact your TE Energy representative for available options
	CTx(0_x)	**(8)** Zero current transformer	Contact your TE Energy representative for available options
	VTx(x)	**(9)** Voltage transformer	Contact your TE Energy representative for available options
	Ins40(1250)	**(10)** Bushing insulators	1250A
	Ins40(1600)		1600A
	Ins40(2000)		2000A
	Ins40(2500)		2500A
	Ins40(3150)		3150A
	ES40(300_0)	**(11)** Earthing switch	Without electromagnet
	ES40(300_1)		110VDC electromagnet
	ES40(300_2)		220VDC electromagnet
	ES40(300_3)		24VDC electromagnet
	ES40(300_4)		48VDC electromagnet
	VS40(R_7)	**(12)** Voltage indication	Capacitive support insulators with VDS (2 relay outputs). Cable length 7m
	Lock40(IND)	**(13)** Locks	Standard kit
	X(x)	**(14)** Protective relay	Contact your TE Energy representative for available options
	IF(x) **MP(x)**	**(15)** Auxiliary wiring and equipment	Contact your TE Energy representative for available options
	BusIns(40)	**(16)** Busbar insulation	Heat-Shrink Insulation, incl. barriers as per GOST or IEC
	Wire(1)	**(17)** Cable harnesses	Cable harnesses (CT-LV; ES-LV)
	Wire(2)		Cable harnesses (CT-LV; ES-LV; Fixed VT-LV or CT0-LV)
	Wire(3)		Cable harnesses incl. limit switches at gas relief flaps for arc protection
	Fast1(40)	**(18)** Fasteners and fittings	Standard kit
	CF(1)	**(19)** MV cable connections	1 cable per phase
	CF(2)		2 cables per phase
	CF(3)		3 cables per phase
	CF(4)		4 cables per phase
	MachP(40)	**(20)** Machining details	Standard kit
	SP(Asm0-SecAsm-all1-RT)	**(21)** Assembly work and routine testing	Fully assembled and tested panel (≤1 relay)
	SP(Asm1-SecAsm-all1-RT)		Fully assembled and tested panel with attachment (≤1 relay)

Classifier Group	Abbreviation	Description	
	SP(Asm2-SecAsm-all1-RT)		Fully assembled and tested panel with gas duct (≤1 relay)
	SP(Asm3-SecAsm-all1-RT)		Fully assembled and tested panel with attachment and gas duct (≤1 relay)
	SP(Asm0-SecAsm-IF-RT)		Fully assembled and tested IF panel (≥1 relay)
	SP(Asm1-SecAsm-IF-RT)		Fully assembled and tested IF panel with attachment (≥1 relay)
	SP(Asm2-SecAsm-IF-RT)		Fully assembled and tested IF panel with gas duct (≥1 relay)
	SP(Asm3-SecAsm-IF-RT)		Fully assembled and tested IF panel with attachment and gas duct (≥1 relay)
	SP(Asm0-SecAsm-OFBC-RT)		Fully assembled and tested OF/BC panel (≥1 relay)
	SP(Asm1-SecAsm-OFBC-RT)		Fully assembled and tested OF/BC panel with attachment (≥1 relay)
	SP(Asm2-SecAsm-OFBC-RT)		Fully assembled and tested OF/BC panel with gas duct (≥1 relay)
	SP(Asm3-SecAsm-OFBC-RT)		Fully assembled and tested OF/BC panel with attachment and gas duct (≥1 relay)
	PB(Asm0-SecAsm-all1-RT)		Power block
	PB(Asm1-SecAsm-all1-RT)		Power block with attachment
	PB(Asm2-SecAsm-all1-RT)		Power block with gas duct
	PB(Asm3-SecAsm-all1-RT)		Power block with attachment and gas duct
	PB(Asm4-SecAsm-all1-RT)		Power block without busbars
	SA40(x)	**(22)** Surge arresters	Contact your TE Energy representative for available options
	GET(B)	**(23)** Arc duct	Without outlet (standard module)
	GET(L)		Outlet at the left of switchboard
	GET(R)		Outlet at the right of switchboard
	GET(T)		Outlet at the middle of switchboard
	Con40(3_1250)	**(24)** Primary isolating contacts	1250A, 3 pcs.
	Con40(6_1600)		1250A, 6 pcs.
	Con40(3_1600)		1600A, 3 pcs.
	Con40(6_1600)		1600A, 6 pcs.
	Con40(3_2000)		2000A, 3 pcs.
	Con40(6_2000)		2000A, 6 pcs.
	Con40(3_2500)		2500A, 3 pcs.
	Con40(6_2500)		2500A, 6 pcs.
	Con40(3_3150)		3150A, 3 pcs.
	Con40(6_3150)		3150A, 6 pcs.
	LBS40(x)	**(25)** Load break switch	Contact your TE Energy representative for available options
	HT(x)	**(26)** House transformer	Contact your TE Energy representative for available options

Ordering code example:
SP40_MILE_IF(W(1200)_M(1250)_BR(1250)_0_LVStd(1)_PBmet1(1_1200)_CTA(3)_CTA(0_ 1)_0_
Ins40(1250)_ES40(300_1)_VS40(R_7)_Lock40(IND)_Fanox(SIL-G)_MP(Heat_0)_BusIns(40)_Wire(1)_
Fast1(40)_CF(2)_MachP(40)_SP(Asm1-SecAsm-all1-RT)_0_GET(B)_Con40(6_1250)_0_0)

Table 5.2 Ordering code example

SP40	Fully assembled and routine tested panel up to 36kV
MILE	SG40_MILE series switchgear
OF	Outgoing feeder
W(1200)	Panel width 1200mm
M(1250)	Main busbar rated current 1250A
BR(630)	Branch connection busbars 630A
0	Without attachments
LVStd(1)	Standard size LV compartment
PBmet1(1_1200)	Standard metal enclosure 1200mm, IP4X (total ordering q-ty ≤3)
CTA(3)	ALCE AB36 current transformers with 3 secondary cores
CTA(0_ 1)	ALCE KAT zero-sequence current transformer
0	Without voltage transformer
Ins40(630)	Bushing insulators 630A
ES40(300_1)	Earthing switch with 110VDC electromagnet
VS40(R_7)	Capacitive support insulators with VDS (2 relay outputs). Cable length 7m
Lock40(IND)	Standard locks
Fanox(SIL-G)	Fanox SIL-G feeder protection relay
MP(Heat_0)	Standard auxiliary wiring including heaters
BusIns(40)	Heat-Shrink Insulation, incl. barriers as per GOST or IEC
Wire(1)	Cable harnesses (CT-LV; ES-LV)
Fast1(40)	Standard fasteners
CF(2)	4 MV cables per phase (cable clamps included)
MachP(40)	Standard machining details
SP (Asm1-SecAsm-all1-RT)	Assembly work. Fully assembled and tested panel (≤1 relay)
0	Without surge arresters
GET(B)	Arc duct (standard module)
Con40(6_1250)	Primary isolating contacts 630A, 6 pcs.
0	Without load-break switch (LBS)
0	Without house transformer

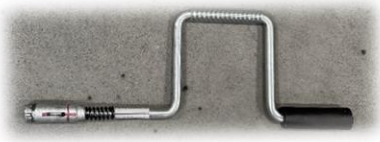
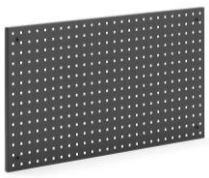
If any option is not included, it is displayed as “0” in the ordering code.

5.1. Accessories and spare parts

Every switchboard is supplied with the minimum number of tools (keys, operation handles, grease) needed for commissioning and servicing. Spare tools and accessories can be supplied on request.

A spare parts list is available on request and depends on the switchgear configuration and apparatuses used. It would normally include mechanical parts that are subject to wear and strategical spares such as fuses, circuit breaker close/trip coils, interlock solenoids and auxiliary relays.

Table 5.3 Standard tools

Ordering code	Description	Picture
SGcomp_Lever_Double-Bit5-Key(204-0108.00-00000)	Standard double bit key	
SGcomp_Lever_Mile(LS_DOUHandle)	Racking-in/out operating handle	
SGcomp_Lever_Mile(LS_Spring-Handle)	Circuit breaker manual spring charging handle	
SGcomp_Lever_Scell(COSHandle)	Earthing switch operating handle	
SGkit_Lever_Toolboard(1)	Wall-mounted toolboard for handles, keys and other tools.	
SGkit_Lever_Toolboard(2)	Wall-mounted lockable cabinet for handles, keys and other tools.	
Material_Grease_2(E_50)	Electrical contact grease, 50 ml	

Contact TE Energy's Sales support for a complete list of all available accessories.

6. TRANSPORTATION AND STORAGE

6.1. Packaging

The MILE panels are dispatched in appropriate individual packages (seaworthy crates or wrapped in foil depending on the destination country and requirements) designed to provide maximum protection to the equipment during shipment and storage and at the same time, to provide convenient handling.

Prior to dispatch, the MILE panels are factory-assembled and routine tested. The earthing switch is OPEN and the doors are closed. The withdrawable parts are packed separately in their individual packages. The remaining materials such as main connecting busbars fasteners, tools and accessories are packed separately.

6.2. Receiving

Until the switchgear is ready for installation and commissioning, it is recommended not to remove it from its packaging. If the unit is to be placed in storage, maximum protection can be obtained by keeping it packed as originally shipped (refer to section 6.4).

In case of damage and/or loss discovered by the consignee after delivery, immediately notify the carrier/forwarding agent and manufacturer of the damaged delivery as soon as possible. Document the damage with as much detail as possible. Always take photographs/videos to document any damage.

6.3. Handling and transportation

Packaging is designed to be handled by a pallet truck/fork lift truck.
The exacts weights and dimensions of each package are listed in the shipping documents.

To unpack, proceed as follows:

- Carefully remove all packaging materials used for protection during shipment and any fasteners and banding straps securing the MILE panels and withdrawable parts (if applicable) to the wooden pallet.
- Remove any additional packing materials and internally packed documentation.

Ensure all packaging materials are disposed of in accordance with Environmental Regulations and wherever possible, ensure materials are recycled.

To lift and handle the panel (refer to Fig.6.1, item 1), proceed as follows:

- Use two transportation rods (refer to Fig.6.1, item 2) included in the shipment.
- Use the crane and round slings (refer to Fig.6.1, item 3). The minimum length of slings must be 10 m.
- The slings must engage with two transportation rods running through the base of the panel.
- Unhook the lifting accessories and remove the transportation rods.

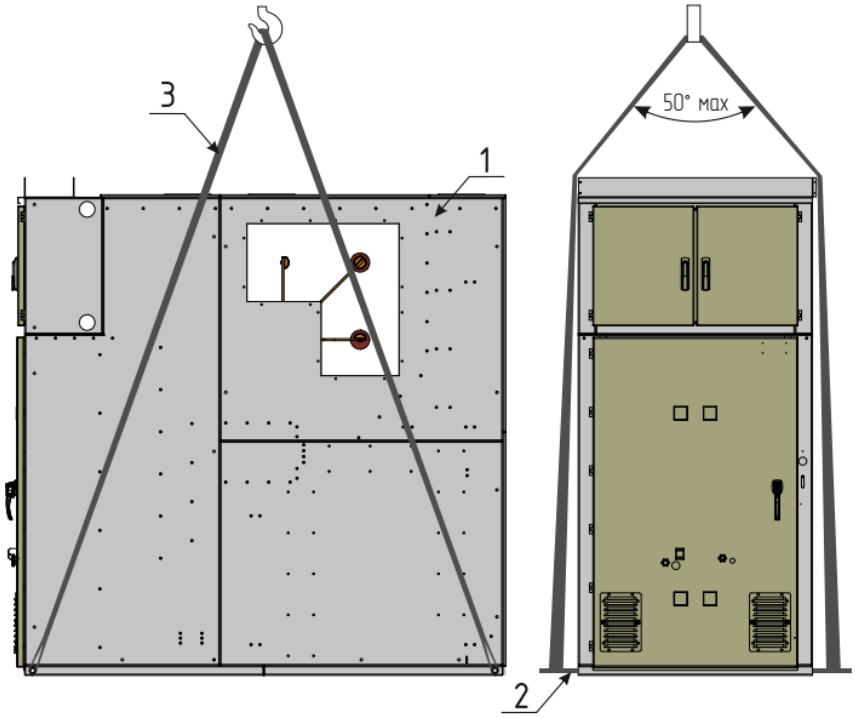


Fig.6.1. Lifting panel

To lift and handle the withdrawable part (refer to Fig.6.2, item 1), proceed as follows:

- Use the crane and round slings (refer to Fig.6.2, item 2). The minimum length of slings must be 2 m.
- Secure the slings by hooks using the lifting points (refer to Fig.6.2, item 3) in the main frame.
- Unhook the lifting accessories from the frame.

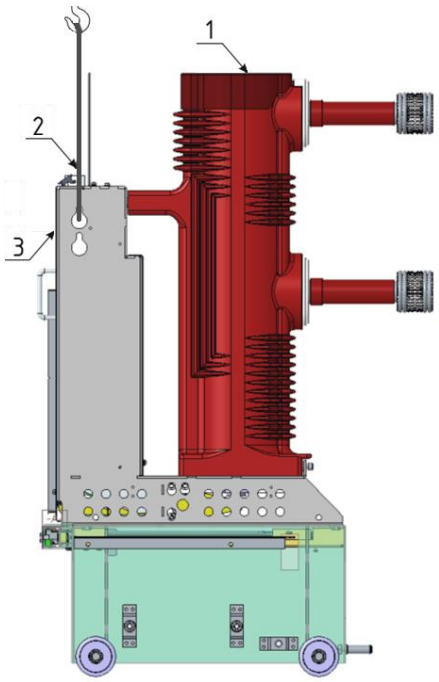


Fig.6.2. Lifting withdrawable truck circuit breaker

6.4. Storage

If the MILE panel or withdrawable parts (if applicable) are to be placed in storage, maximum protection can be obtained by keeping the original packaging. Use the following storage requirements:

- The units must be stored indoor.
- The store room temperature must not fall below -5 °C.
- The store room must be dry and well-ventilated. Check regularly for any condensation.
- Check and periodically replace the drying agents inside the package.
- The units must be stored upright.
- The packages must not be stacked.

Before placing the MILE panel or withdrawable parts in storage, checks should be made to make sure that it is free from shipping damage.

7. INSTALLATION

7.1. General

The installation shall be performed by trained and experienced personnel familiar with the switchgear, taking into account the international safety standards (e.g. IEC/BS), local regulations and codes of practice.

The building shall comply with the normal service conditions according section 1.4 “Normal service conditions”. Before starting the installation, the switchgear room must be completely finished, provided with power supply and lighting, ventilation facilities. Floor, ceiling and walls of the building must be finished with materials, which do not raise or collect dust. All the necessary preparations, such as wall and floor openings, cable ducts and trenches must be ready.

The following requirements must be followed:

- The doorway opening shall have a height of no less than 3000mm, a width of no less than 1500mm, and shall not have thresholds.
- The service corridor between the back of the switchgear and the room wall must be at least 800 mm wide. Refer to Fig.7.1.
- The minimum distance in front of the switchgear must be at least 1800 mm for opening the front door and racking-out the VCB. Refer to Fig.7.1.
- The minimum distance between the top of the switchgear and the ceiling must be at least 800 mm for opening the pressure relief flaps mounted on top. Refer to Fig.7.1.
- The minimum distance between the top of the switchgear with the arc duct (provided on special request) and the ceiling must be at least 600 mm.
- The permissible floor load should be no less than 900 kg/m^2.
- The floor/foundation frame shall be according to section 7.2 “Foundation”.

Ensuring the integrity of mechanical connections is crucial for the optimal performance of the equipment. The following chart provides the recommended tightening torques for various bolt sizes and grades. Adhering to these specifications guarantees a secure fit while preventing damage from over-tightening.

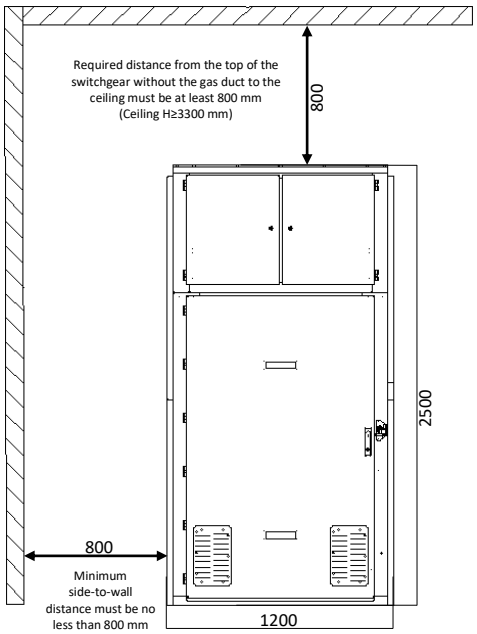
Table 7.1 Recommended tightening torques

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

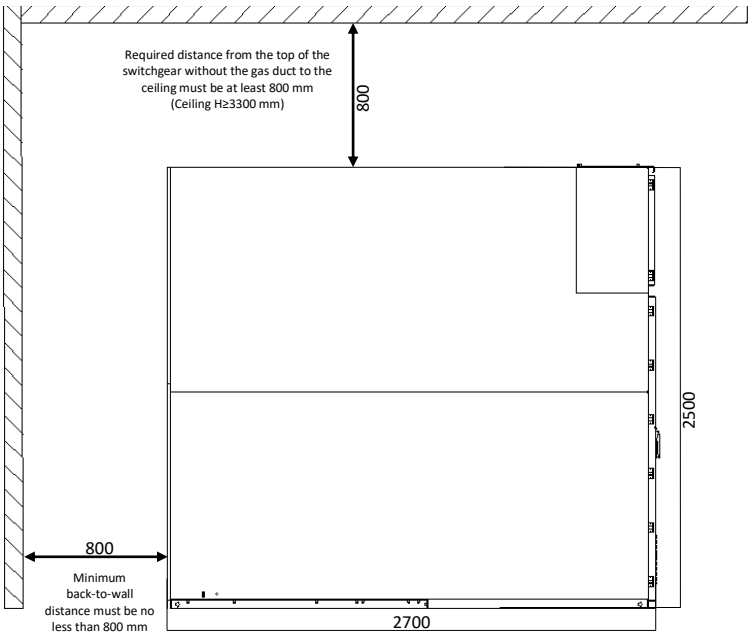
7.2. Foundation

The switchgear shall be erected on a flat concrete surface with the following flatness tolerance:

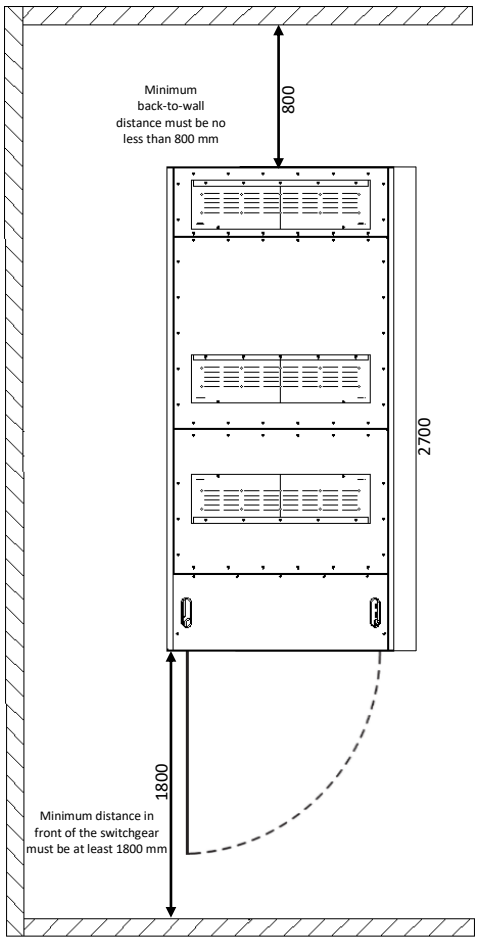
- ± 1mm/1m in all directions under the switchboard and 1m in front of the switchboard.
- No more than ±3mm over the entire switchboard length.



Front view



Side view



Top view (layout)

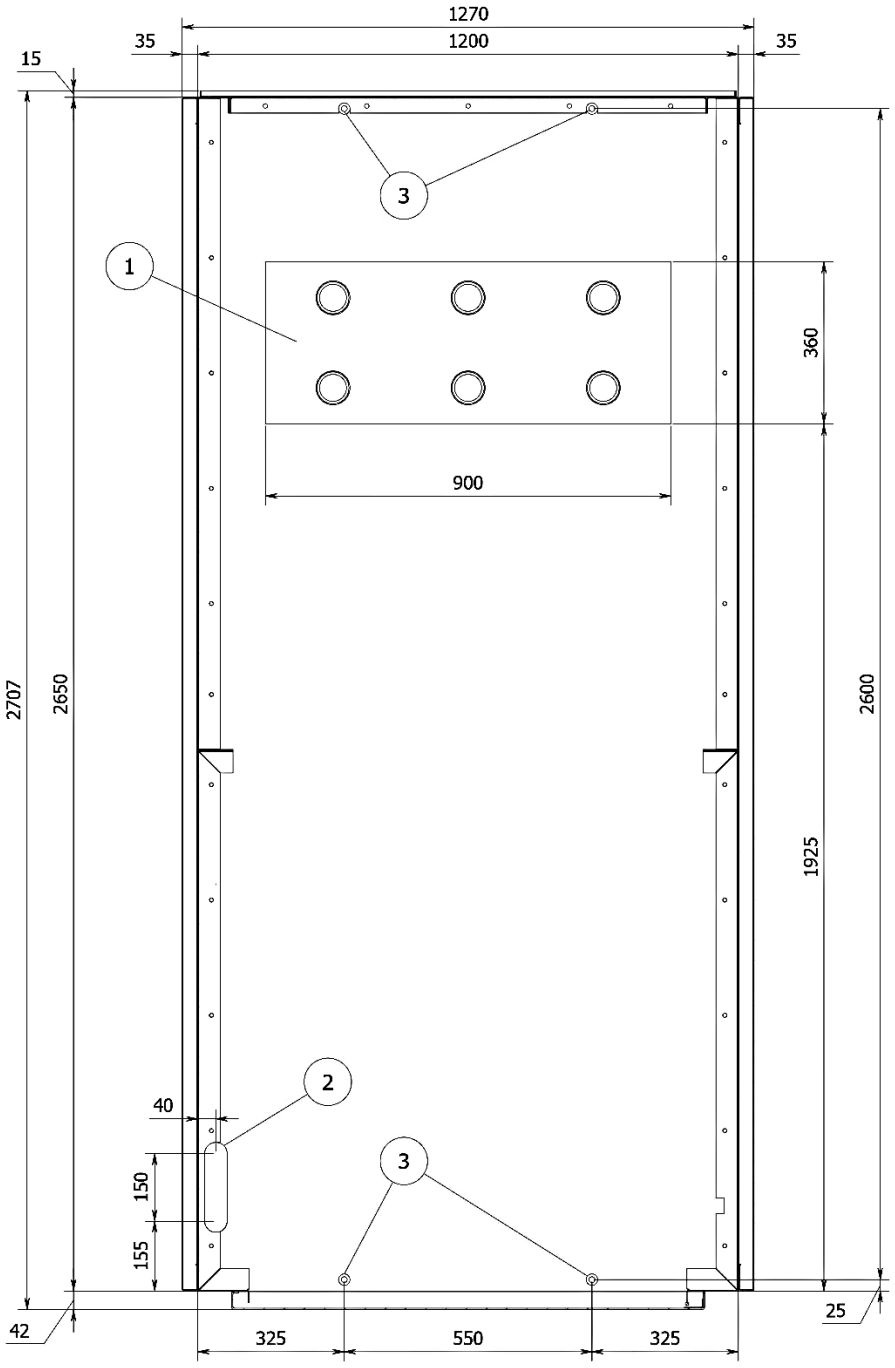
Fig.7.1. Installation general arrangement drawings

7.3. Floor mounting

Panels must be positioned in accordance with the developed and approved civil project and general arrangement drawing. Floor openings for medium-voltage cables must be provided.

The switchboard can be fixed directly to the concrete floor or using special foundation frames provided on request (such as Unistrut metal framing system). Four (4) fixing points are usually provided at the base of each switchgear panel (Fig.7.2, item 3).

Always verify the actual panel fixing points in accordance with the approved civil project and general arrangement drawings.



1 Medium-voltage cable openings
2 Low-voltage cable openings (optional)
3 Fixing points

Fig.7.2. Typical floor mounting drawing

7.4. Fixing anchoring bolts to floor

To fix the panels to the concrete floor with anchoring bolts:

- Level the floor according to section 7.2 “Foundation”.
- Clean the installation area.
- Mark the perimeter of all the panels making up the switchboard, taking into consideration the minimum clearances shown in Fig.7.1.
- Drill the floor at the designated fixing points, using the foundation drilling drawings.
- Insert suitable concrete anchor bolts in the holes.

7.5. Preparing panels

- Adhere to section 6.3 "Handling and Transportation" to transport the panels to the designated installation area, following the layout shown on the general arrangement drawing.
- Remove the lifting accessories and transportation rods after the panel is finally positioned.
- Fix the panels to the floor using anchor bolts

It is recommended to start positioning from the center of the switchboard if there are more than 10 panels. Otherwise, begin from the first panel, counting from the side opposite to the room entry.

7.6. Joining panels

- Make sure that all panels are perpendicular to the floor surface. Align the front-facing panels.
- Proceed with the layout of the other panels by repeating the same checks each time.
- Join the panels using M8 bolts at the designated fixing points.

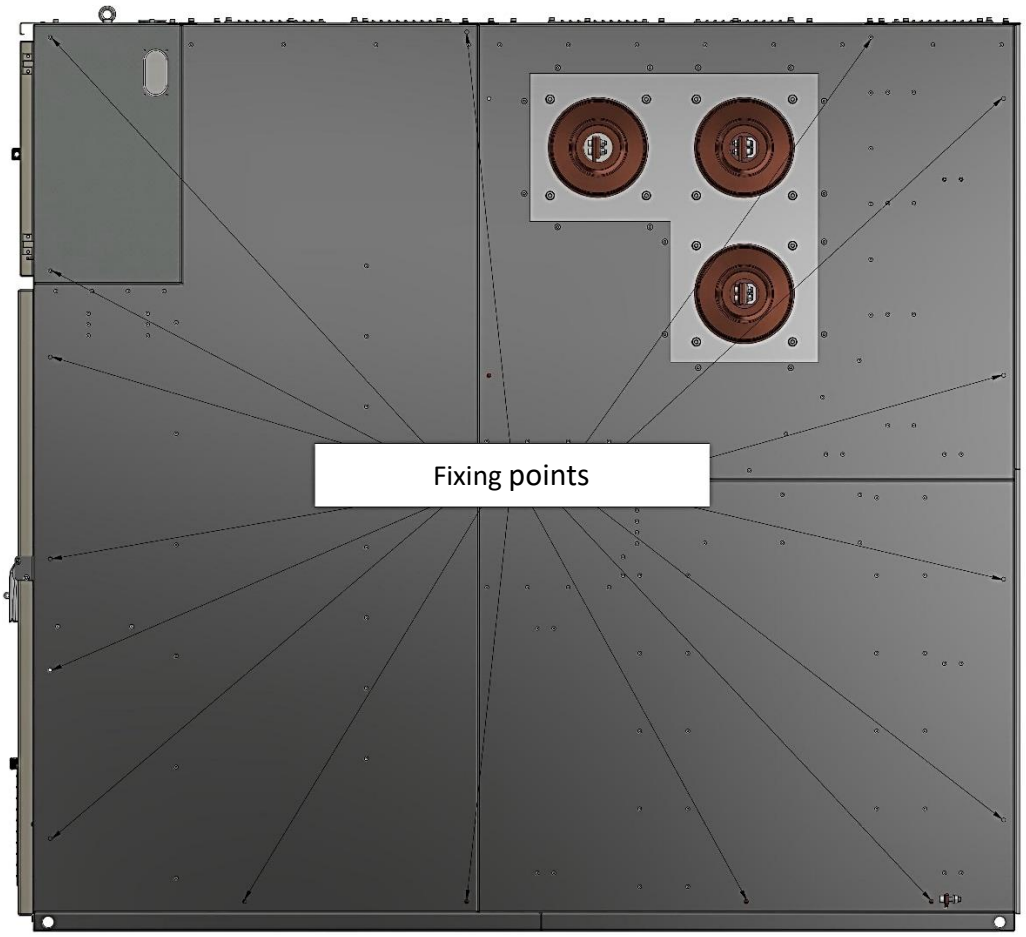


Fig.7.3. Panel joining points

7.7. Installing main busbar

- Clean the busbars with a soft, dry brush or microfiber cloth.
- Position the busbars supplied loose starting from the bottom continuing upwards.
- Fix the busbars with 4x M12x65 bolts using the bolt torque chart (Table 7.1).

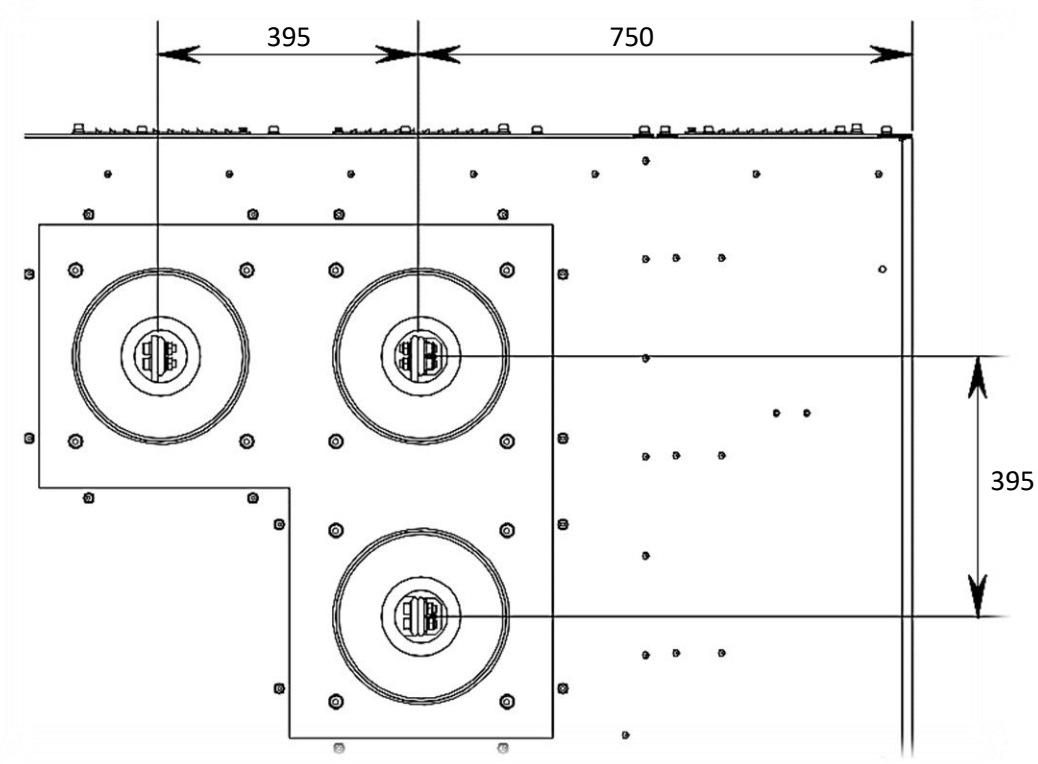


Fig.7.4. Busbar arrangement

Always follow the detailed assembly instruction drawings provided with each switchboard.

7.8. Connecting main earthing bar

- Clean the busbars with a soft, dry brush or microfiber cloth.
- Position the busbars supplied loose in the cable compartment and fix with M12x65 bolt using the bolt torque chart (Table 7.1). Refer to Fig.7.5.
- Connect the main substation earthing conductor to the main earthing bar of the switchboard. Refer to Fig.7.6

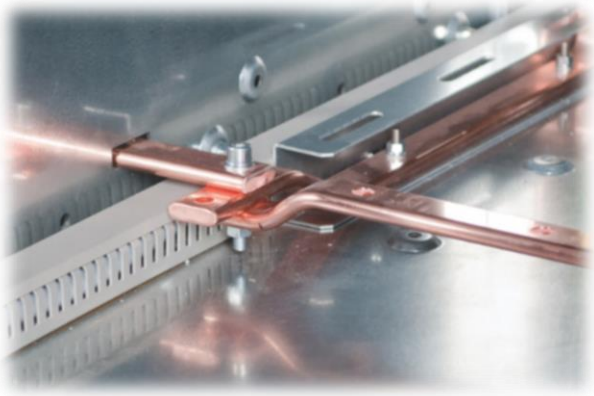


Fig.7.5. Earthing busbar inside switchboard

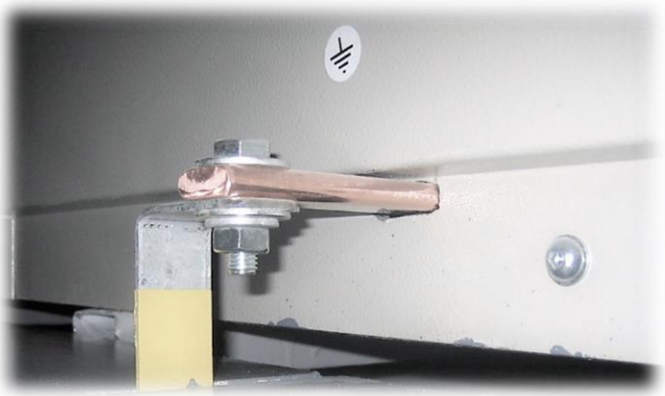


Fig.7.6. Substation main earthing busbar

Always follow the detailed assembly instruction drawings provided with each switchboard.

7.9. Interpanel wiring and control cable entry

- The interpanel wiring is done through the openings provided in the sidewalls of the low voltage compartment. Refer to Fig.7.7, item 1.
- External control cables (DC distribution board or SCADA) are usually laid into the panel through the openings provided in the top of the low voltage compartment (or from the bottom on special request). Refer to Fig.7.7, item 2.

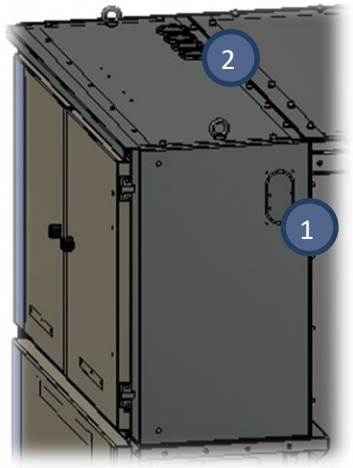


Fig.7.7. Low voltage compartment openings

Interpanel wiring and control cable connection are done according the project circuit diagrams.

7.10. Connecting power cables

The cables are laid through the bottom gland plate (refer to Fig.7.8).

It is assumed that connection is done with three-core plastic-insulated medium voltage cables (on special request up to a maximum of 6 cables 630 mm^2). Cables are fastened by means of appropriately sized cable clamps.

The cable compartment can also contain a zero-sequence current transformer installed inside the panel at the factory.

To connect the power cables:

- Insert the cables through the designated openings. Refer to Fig.7.8, item 1.
- Cut and strip the cables according to the cable manufacturer's instructions.
- Connect the cable lugs to the designated busbars. Refer to Fig.7.8, item 2.
- Connect the cable earthing to the main earthing busbar using the designated openings.
- Secure the cables with the cable clamps. Refer to Fig.7.8, item 3.

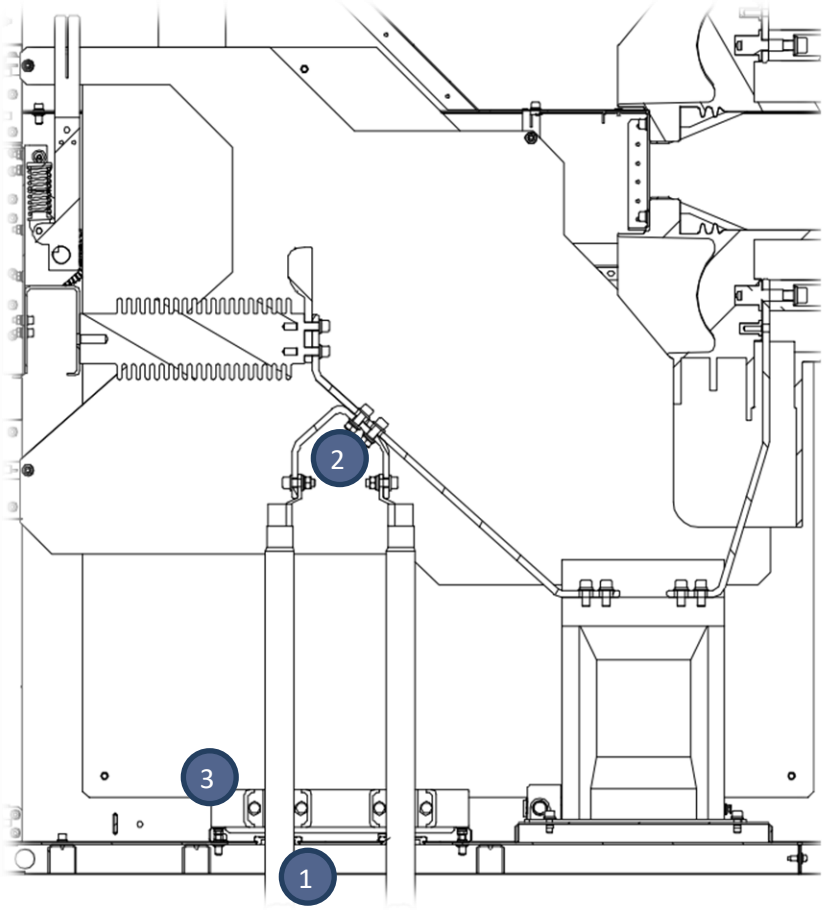


Fig.7.8. Bottom gland plate

Always follow the cable manufacturer's guidance during cabling installation.

7.11. Installing pressure relief ducts

The pressure relief duct (arc duct) is dismantled at the factory and packed into the individual units together with the necessary fasteners.

The detailed assembly instruction drawings are provided with each switchboard.

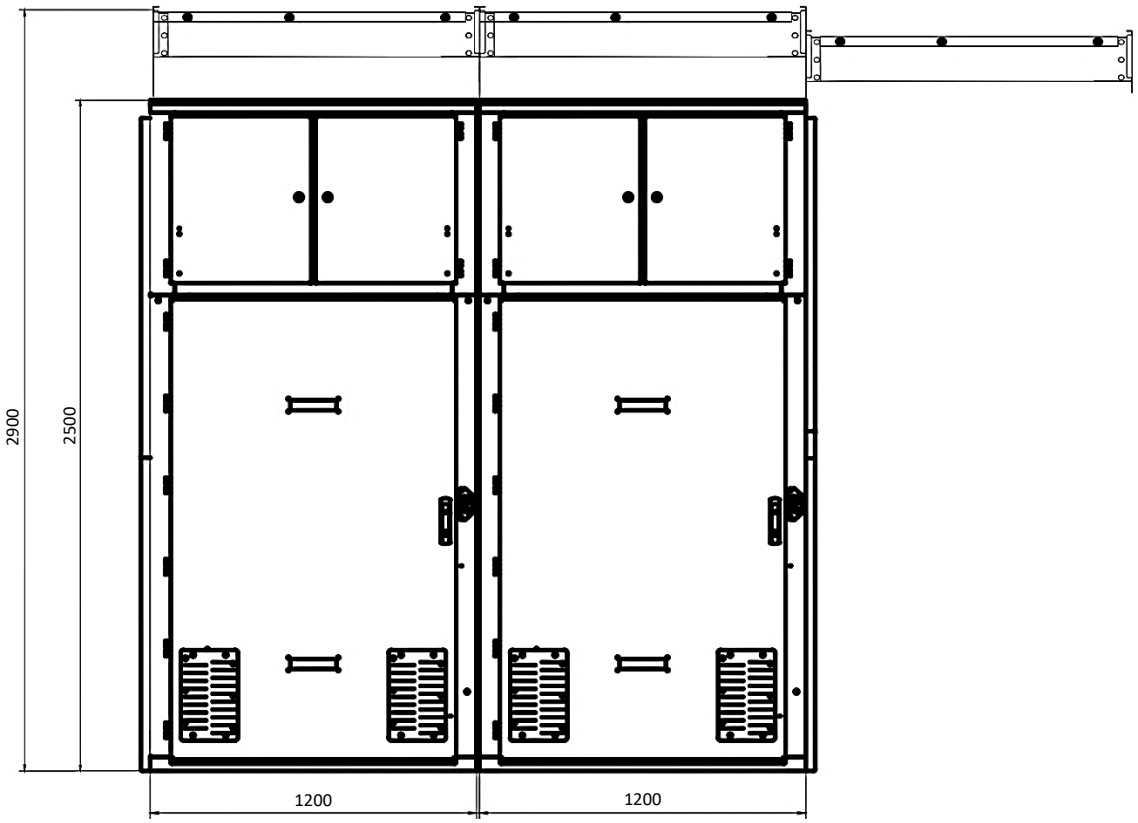


Fig.7.9. Example of switchgear arrangement with arc duct

7.12. Post-inspection checklist

The following checks shall be carried out upon completion of the installation:

Table 7.2 Post-installation checklist

Visually inspect the switchgear panel for any signs of damage received during the installation
Check all the bolt connections and tighten according to the bolt torque chart
Remove any residual materials (e.g., packaging and other foreign objects) and tools from the switchgear
Check connection to the main earthing busbar following your local safety regulations
Check connection of the power cables
Clean the switchgear
Place the withdrawable unit and guide rails inside the switchgear panel
Close and lock the doors

8. OPERATION

8.1. General

Prioritize safety at work:

The operating procedures shall be performed by trained personnel familiar with the switchgear, taking into account the international safety standards (e.g. IEC/BS), local regulations and codes of practice.

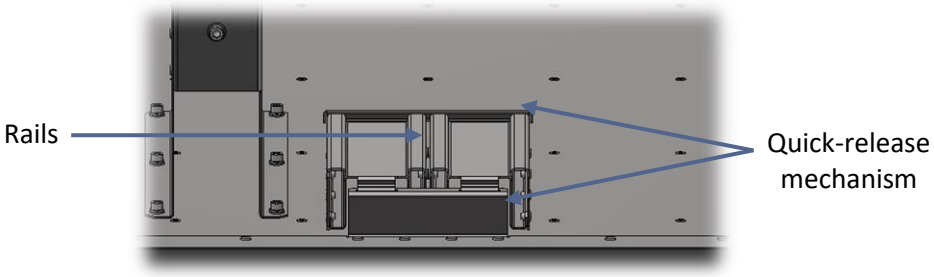
- It is recommended to carry out all switching operations with the front door closed.
- All switching devices and their interfaces are labelled with clear switching instructions. Please read carefully before attempting to use.

8.2. Withdrawable circuit breaker

8.2.1. Truck positioning

It is assumed that the truck is removed from the switchgear panel and the earthing switch is Open.

To rack in the truck and move the VCB to TEST position:

Use a double-bit key to unlock and open the CB compartment door
Unlock the rails. The rails are secured to the floor with a quick-release mechanism

Engage the rails that will guide the truck into the panel. Use two openings in the floor of the switchgear panel to secure and properly position the rails
Use the truck handles to move the withdrawable VCB towards the CB compartment
Position the truck with the guide rails and push forward to place it inside the panel

Ensure that the locking/release handles are secured at the rightmost position (truck is locked)

Secure the rails back to the floor with quick-release mechanism

Connect the secondary connector plug

Check the mechanical position indicator (“Arrow” symbol) through the inspection window on the front door. It must show “TEST”. The VCB is now in TEST position

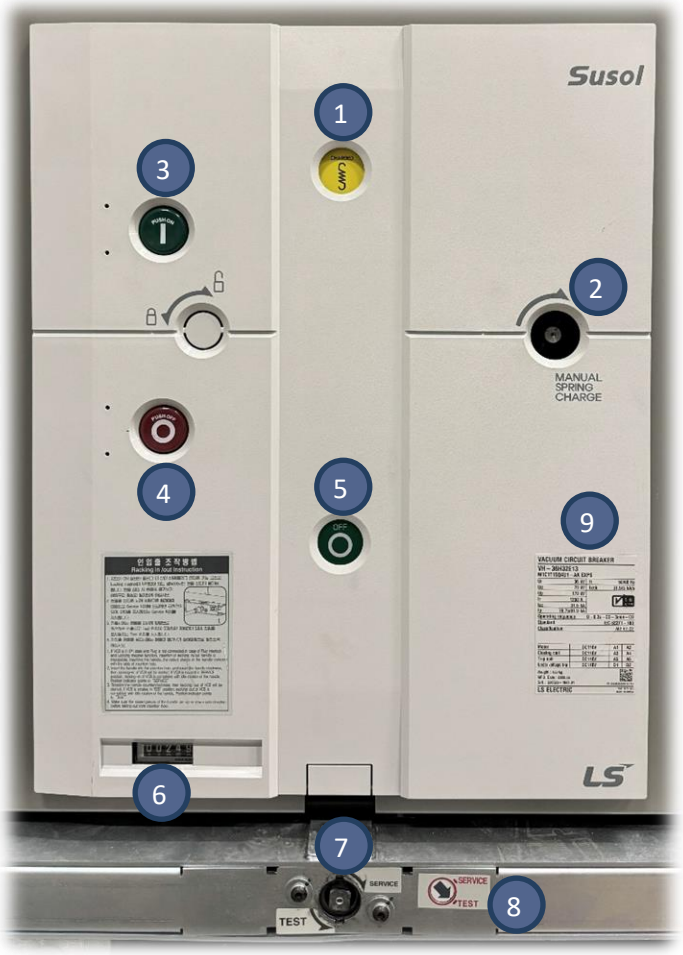
Close the CB compartment door

WARNING

CB compartment door can be opened:
- When the earthing switch is Open provided that the truck is outside the switchgear panel.
- When the earthing switch is Closed provided that the auxiliary supply is ON.

8.2.1. Withdrawable VCB interface

The withdrawable VCB interface (with the CB compartment door open) is shown below.



1. Spring indicator (Charged/Discharged)
2. Manual spring charge interface
3. VCB close pushbutton
4. VCB open pushbutton
5. VCB position indicator (Open/Close)
6. Operations counter
7. Rack-in/rack-out interface
8. Mechanical position indicator (Test/Service)
9. Rated data

Fig.8.1. Withdrawable VCB interface

8.2.2. VCB electrical operation

The VCB electrical operation is achieved by a spring-charging motor equipped with the opening and closing coils. If the supply voltage is applied, the closing spring is automatically charged by the motor.

The VCB closing and opening operations can be done remotely or locally via a protective relay, pushbuttons or CAM switches. The exact interface arrangement for operating the VCB may vary depending on the exact project requirements and relay type.

Refer to LS Electric VH36 for more details on the VCB electrical operation, operating sequences, etc.

8.2.3. VCB manual operation

The VCB can be operated manually during commissioning or in case of emergencies (e.g. auxiliary supply failure). The VCB closing/opening with the front door closed is achieved by inserting the special rod into the manual operation interface on the front door.

The VCB closing/opening can also be achieved with the door opened by using the pushbuttons on the VCB, but only in the TEST position.

To manually charge the VCB closing spring in the absence of auxiliary supply:

Open the CB compartment door
Engage the manual spring charging handle with the operation interface and start rotating clockwise to charge the spring. The charging indicator must show “CHARGED” when the spring is completely charged
 

To manually operate the VCB with the door open in the TEST position:

Push “ON” button to close the VCB. The charging indicator must show “DISCHARGED” and the Close/Open indicator must change to “CLOSED”	Push “OFF” button to trip the VCB. The Close/Open indicator must change to “OPEN”. In the presence of auxiliary supply, a geared motor will automatically charge the closing spring
	

To manually operate the VCB with the door closed:

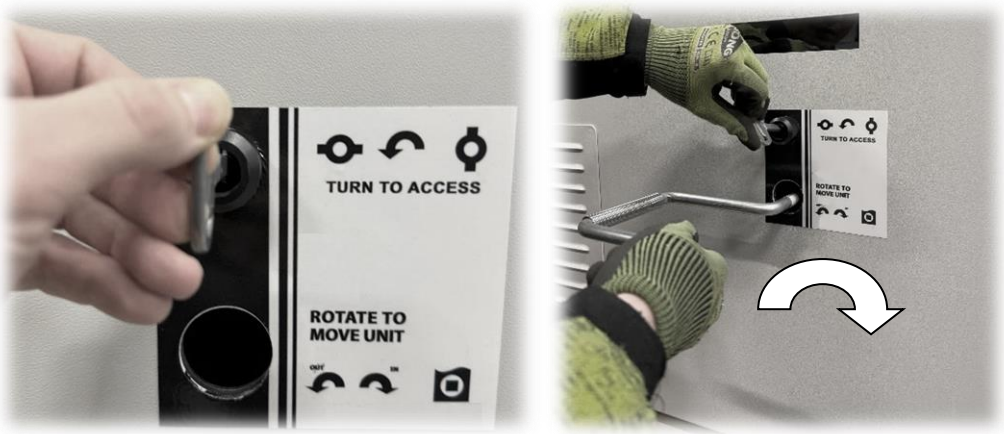
Follow the indication labels on the front door to access the manual operation interface
Remove the protective cover from the corresponding interface (“VCB ON” or “VCB OFF”)
Insert the special rod into the opening and press inwards to operate the VCB (To trip or close)
 

8.2.4. VCB racking in

Before racking in, ensure that:

- CB compartment door is Closed.
- VCB is Open. Refer to section 8.2.2 “VCB electrical operation” or 8.2.3 “VCB manual operation”.
- Earthing switch is Open. Refer to section 8.3 “Earthing switch”.

To move the VCB from TEST to SERVICE position:

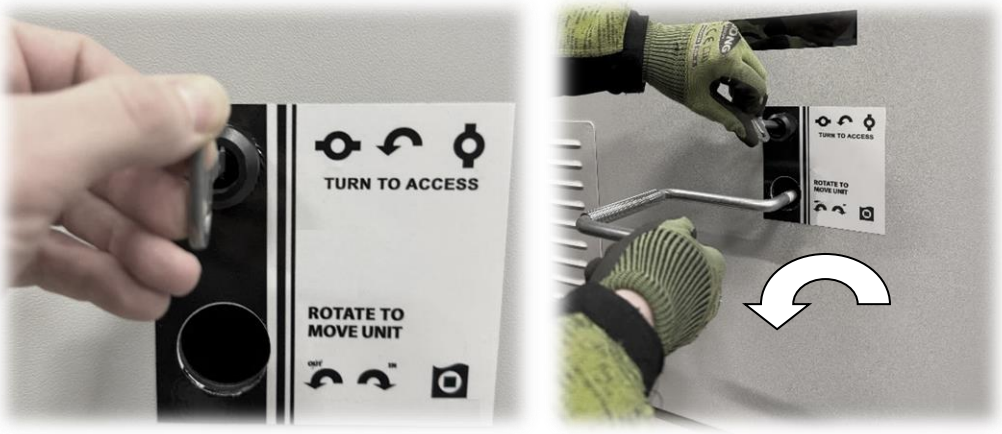
Access the truck racking-in/out interface by inserting a double-bit key and turning counterclockwise to ~90°
Engage the racking in/out operating handle with the operating shaft and start rotating the handle clockwise to reach the SERVICE position until it starts spinning freely with a ratchet sound

Check the mechanical position indicator (“Arrow” symbol) through the inspection window on the front door. It must show “SERVICE”. The VCB is now in SERVICE position and ready to close


8.2.5. VCB racking out

Before racking out, ensure that:

- CB compartment door is Closed.
- VCB is Open. Refer to section 8.2.2 “VCB electrical operation” or 8.2.3 “VCB manual operation”.

To move the VCB from SERVICE to TEST position:

Access the truck racking-in/out interface by inserting a double-bit key and turning counterclockwise to ~90°
Engage the racking in/out operating handle with the operating shaft and start rotating the handle counterclockwise to reach the TEST position until it starts spinning freely with a ratchet sound

Check the mechanical position indicator (“Arrow” symbol) through the inspection window on the front door. It must show “TEST”. The VCB is now in TEST position

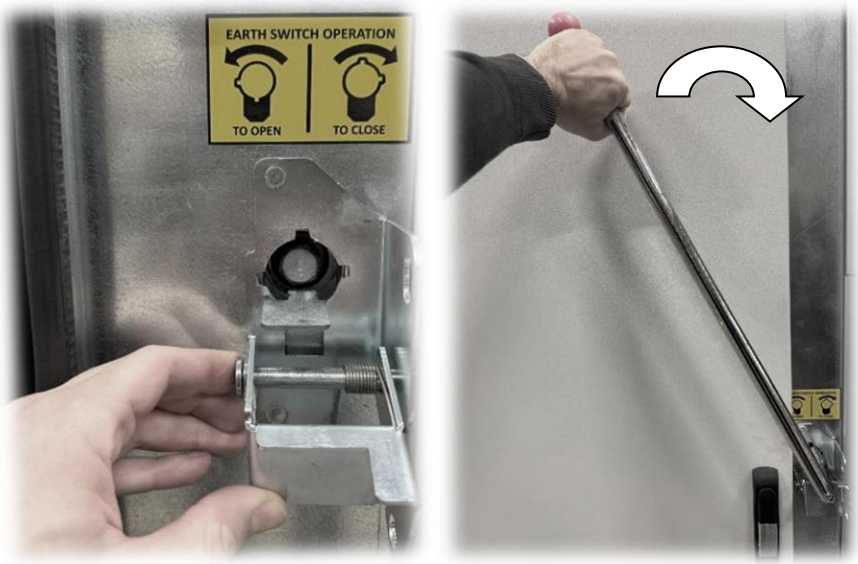
Close the earthing switch. Refer to section 8.3 “Earthing switch”
Open the CB compartment door.
Disconnect the secondary connector plug.
Engage the rails that will guide the truck outside the panel
Move the locking/release handles to the leftmost position to release the truck

Use the truck handles to move outside the CB compartment
Close the CB compartment door

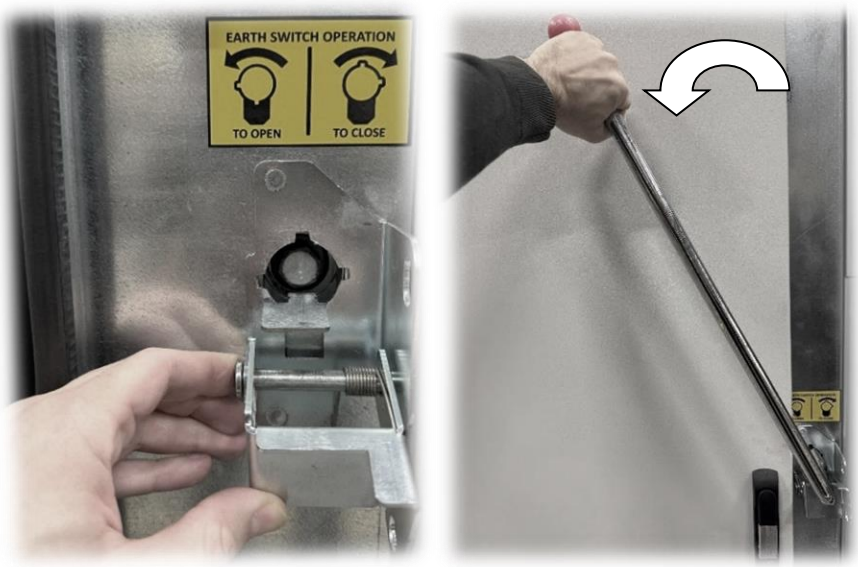
8.3. Earthing switch

Earthing switch cannot be closed when the truck is in intermediate or service position.

To close the earthing switch:

Trip the VCB and move it to TEST position. Refer to section 8.2.5 “VCB racking out”
Access the earthing switch operation interface by pressing down the blocking plate
Engage the earthing switch handle with the operating shaft and rotate ~180° clockwise to close it

Check the mechanical position indicator through the inspection window on the back of the switchgear panel. It must show “EARTHED”

To open the earthing switch:

Access the earthing switch operation interface by pressing down the blocking plate
Engage the earthing switch handle with the operating shaft and rotate ~180° counterclockwise to open it
Check the mechanical position indicator through the inspection window on the back of the switchgear panel. It must show “OPEN”


9. COMMISSIONING

9.1. General

Commissioning tests are mandatory prior to energization of the switchgear. The tests are carried out to ensure the switchgear meets the design requirements and is ready for energization.

Prioritize safety throughout the commissioning:

- Tests shall be performed and supervised by qualified personnel.
- Switchgear and test equipment must be properly earthed.
- Switchgear must be clean paying special attention to the insulating and current carrying parts.
- Unauthorized personnel must not enter the test area (especially during the high voltage tests).

Contact TE Energy's Technical support in case any non-conformities are observed during commissioning activities before putting the switchgear into service.

The exact test scope depends on the switchgear configuration, client requirements and local standards or codes of practice.

9.1. Pre-commissioning checklist

The following checks shall be carried out prior to commissioning:

Table 9.1 Pre-commissioning checklist

Visually inspect the switchgear and withdrawable part for any signs damage or defects
Remove any dust, dirt, and other foreign substances from the switchgear
Wipe down the insulating parts with a clean, dry, lint-free cloth
Remove any residual materials (e.g., packaging and other foreign objects) and tools from the switchgear
Check connection to the main earthing busbar following your local safety regulations
Check connection of the HV power cables

9.1. Functional tests

The following functional tests shall be carried out prior to energizing:

Table 9.2 Functional tests

Switch on the auxiliary supply and control voltage
Check the LV equipment indication acc. to the circuit diagram (LEDs, mimic display, annunciators, relays, meters, etc.)
Check VCB ON/OFF operation in TEST position
Check VCB mechanical position indicator
Check truck racking IN/OUT operation in TEST/SERVICE position
Check truck mechanical position indicator
Check earthing switch ON/OFF operation
Check earthing switch mechanical position indicator
Check mechanical interlock between VCB and earthing switch
Check mechanical interlock between circuit breaker compartment door and VCB
Check mechanical interlock between cable compartment door and earthing switch
Check safety padlocks facilities
Check doors, handles and locks for proper and smooth operation
Configure protection devices (e.g., protective relay) and check their functions using appropriate testing equipment

9.2. Insulation resistance test

Test procedure shall be followed as described below:

- Test leads shall be connected from the back of the switchgear panel through the opened rear cover.
- The VCB shall be CLOSED in SERVICE position.
- The earthing switch shall be OPEN.
- The front door shall be closed.
- Sufficient space shall be maintained around the switchboard.
- All relevant control circuits shall be isolated, CTs shall be shorted.
- 5kV valid calibrated instrument shall be used for the insulation resistance test.

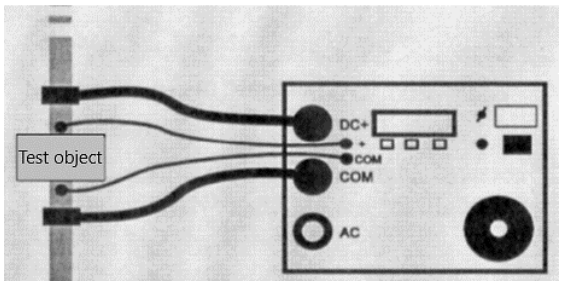
- The resistance value shall be recorded for Ph-E, Ph-Ph measurements would be done as per client requirements.
- The test voltage shall be applied for 1 minute.

Passing criteria: As per the routine test report (considering the actual atmospheric conditions), but no less than 1000 MOhm.

9.3. Measurement of the resistance of the main conducting circuits

Test procedure shall be followed as described below:

- The VCB shall be CLOSED in SERVICE position.
- The earthing switch shall be OPEN.
- The test leads shall be connected from beginning and end of vertical busbars of each panel.
- The resistance and mV drop test leads shall be connected as shown below:



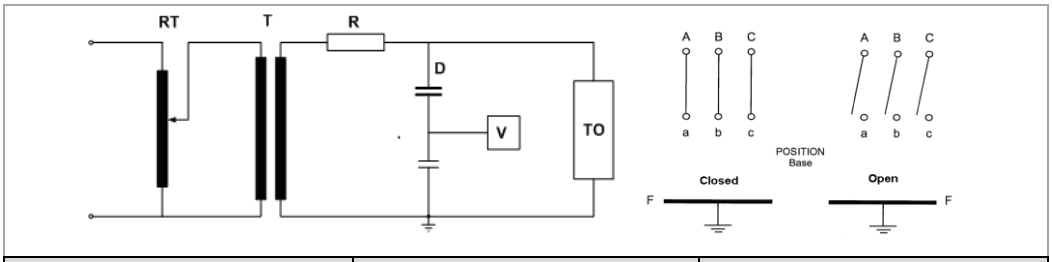
- 200A DC current shall be injected.
- The resistance value shall be recorded for each phase in micro-ohms.
- The test shall be conducted on each phase separately.

Passing criteria: As per the routine test report (minor deviations are allowed). Otherwise, all current conducting parts have to be tightened accordingly to recommended torque connection table.

9.4. Power frequency withstand voltage test

Test procedure shall be followed as described below:

- The VCB shall be CLOSED in SERVICE position.
- The earthing switch shall be OPEN.
- The front door shall be closed.
- Sufficient space shall be maintained around the switchboard.
- All relevant control circuits shall be isolated, CTs shall be shorted, VTs shall be disconnected.
- Connect the test equipment to the switchboard as shown below:



R – regulating transformer *T – High voltage transformer*	*TO – Tested object* *R – Current suppressing resistor*	*D – Capacity divider* *V – Voltage measurement*

- The test voltage must be chosen according to the table below:

Rated voltage, kV	Rated power-frequency withstand voltage, kV	80% test voltage for repeated testing (commissioning, maintenance), kV
36	70	56

Apply the test voltage for 1 min with the following conditions:

- Between phases and earth.
- Across the opened contacts.

Passing criteria: No disruptive discharge (sparkover, flashover or isolation puncture) during the test.

10. MAINTENANCE

10.1. General

Only authorized persons who have been familiarized and trained in the use of MILE switchgear are allowed to perform maintenance.

Routine maintenance depends on the conditions to which the switchgear is subjected to, and to the local relevant regulations and codes of practice (i.e., BS6626: The Standard for Maintenance of electrical switchgear and controlgear for voltages above 1 kV and up to and including 36 kV for UK).

The recommended maintenance schedule assumes typical standard environmental and operating conditions as outlined below:

- Humidity below 60%.
- Unit may be indoors or outdoors (within suitable enclosures), but must not be subjected to regular extremes of weather, i.e., dust storms, flooding, temperature cycles greater than 40°C or less than minus 5°C, dense coastal fog or acid rain.
- No regular or thick covering of debris.
- No contact with any chemical agents (e.g. salt).
- No infestation of animal or plant life.
- No earth movements.
- No mechanical damage to the unit of any kind.
- No mal-operation of any kind.
- No abnormally high number of operations (>2,000 per year).
- No abnormally high number of fault currents.
- No over-voltage or over-current (above switchgear rating).

- Local legislation may dictate maintenance schedules to be conducted with greater frequency, irrespective of site conditions. Operation outside of typical standard conditions may require the recommended maintenance schedule to be adapted accordingly.
- Refer to LS Electric VH36 for VCB dedicated maintenance schedules.

10.2. Maintenance schedule

Table 10.1 Maintenance schedule

Interval	Operation
1 year	Determination of substation environment and non-invasive inspection. Refer to 10.3.1
3 years	Visual inspection of the switchgear compartments and switching devices. Refer to 10.3.1
	Functional tests. Refer to 10.3.2
	Greasing of moving and accessible current conducting parts. Refer to 10.4
5 years	Insulation resistance test. Refer to 9.2
	Measurement of the resistance of the main conducting circuits. Refer to 9.3
	Power frequency withstand voltage test. Refer to 9.4

10.3. Maintenance checklist

10.3.1. Visual inspection

Annual inspection of the substation and equipment is recommended to establish the environmental conditions to which the units are subjected, to allow a suitable maintenance schedule to be determined. Consideration should be given to:

- Humidity/condensation.
- Dust/air circulation.
- Ambient temperature.
- Contact with any chemical agents (e.g. salt).
- No infestation of any animal life (e.g. insects).
- No contact with any plant life (e.g. mould).
- No earth (seismic) movements.
- Potential for mechanical damage.

During the determination of the environmental conditions, the opportunity should be taken to conduct the following non-invasive checks:

- Check all covers/fixings in situ.
- Check all appropriate labelling (front and rear, if applicable) is attached.
- Check all mimic (if fitted) LEDs are functioning.
- Check all thermostats (if fitted) are set correctly.
- Check all meters (if fitted) are reading correctly.
- Check display on all protective devices for correct indication.
- Check for undue noise/vibration.
- Check all safety padlocks fitted, where appropriate.
- Check condition of any ancillary equipment (service trolleys, tools and other accessories).

The switchgear compartments and withdrawable part should be accessed and inspected at least every three years.

Table 10.2 Visual inspection taken every 3 years

Compartment	Action
Low voltage compartment	Visually inspect for any contamination, damage or condensation inside
	Check the condition of closing/tripping circuits
Circuit breaker compartment	Visually inspect for any contamination, damage or condensation inside
	Check the condition of primary isolating contacts
	Check for any abnormal visible signs (i.e., PD activity, overheating, oxidation)
Cable compartment	Visually inspect for any contamination, damage or condensation inside
	Check HV power cable and LV cable sealing facilities
	Check for any abnormal visible signs (i.e., PD activity, overheating, oxidation)

10.3.2. Functional tests

The switchgear equipment should be subjected to the following functional tests at least every three years.

Table 10.3 Functional tests taken every 3 years

Action
Check VCB ON/OFF operation in TEST position
Check VCB mechanical position indicator
Check truck racking IN/OUT operation in TEST/SERVICE position
Check truck mechanical position indicator
Check bushing insulator shutter mechanism
Check earthing switch ON/OFF operation
Check earthing switch mechanical position indicator
Check mechanical interlock between VCB and earthing switch
Check mechanical interlock between circuit breaker compartment door and VCB
Check mechanical interlock between cable compartment door and earthing switch
Check safety padlocks facilities
Check doors, handles and locks for proper and smooth operation
Check tightness of HV power cable connections
Check tightness of main earthing contact
Check lamp test circuit (if applicable)
Check panel space heater circuit (if applicable)

10.4. Greasing

Three types of recommended lubricants are allowed to be used during maintenance period.

Table 10.4 Recommended lubricants

Lubricant	Application
Ensto SR1	Contact surfaces (earthing contacts, isolating contacts, etc.)
Wurth HHS 5000	Mechanical parts (gears, sliding mechanisms, etc.)
Isoflex Topas L32	Mechanical parts (gears, sliding mechanisms, etc.)

Usage of WD4/WD40 grease and its equivalents is prohibited.

Table 10.5 Greasing

Compartment	Action
Low voltage compartment	Greasing of compartment door hinges and locks (if necessary)
Circuit breaker compartment	Greasing of compartment door hinges and locks (if necessary)
	Greasing of bushing insulator protective shutter mechanism (if necessary)
	Apply contact lubricant on truck main earthing contact
	Apply contact lubricant on withdrawable part primary isolating contacts
	Greasing of worm gear mechanism
Cable compartment	Apply contact lubricant on earthing switch fixed contacts
	Greasing of earthing switch bevel gear
	Greasing of earthing switch operation socket

11. TROUBLESHOOTING

11.1. Switchgear troubleshooting

Table 11.1 Switchgear troubleshooting

Problem	Possible issue	Action
Cannot open the CB compartment door	Earthing switch is Open	Check the mechanical position indicator. Close the earthing switch
	Withdrawable part is in Service position	Check the mechanical position indicator. Move the withdrawable part into the Test position
Cannot rack in/out the VCB	VCB is Closed	Check the mechanical position indicator. Trip the VCB.
Cannot rack in the VCB	Earthing switch is Closed	Check the mechanical position indicator. Open the earthing switch
	CB compartment door is open	Close the CB compartment door
Cannor close the VCB	Withdrawable part is in Intermediate position	Check the mechanical position indicator. Move the withdrawable part into the Test/Service position
	Secondary connector plug damaged	Check the connector plug
	No auxiliary power supply available	Check the power supply circuit
	Close coil failure	Replace the close coil
Cannot close the earthing switch	Withdrawable part is in Intermediate or Service position	Move the withdrawable part into the Isolated position
Cannot open the earthing switch	CB compartment is Open	Close the door

12. PRODUCT LIFECYCLE

12.1. Environmental policy

Product quality and environmental management are the key components of our policy.

The MILE panels are manufactured in compliance with the requirements of international standards for the quality management system according to ISO 9001 and environmental management system according to ISO 14001.

12.2. Lifetime and disposal

The expected lifetime of the MILE type switchgear is 30 years or more. However, the lifetime depends on the application and environmental conditions in which it is operated. The lifetime can be extended as follows:

- Regular inspection and maintenance.
- Continuous monitoring with sensors (e.g. thermal monitoring).
- Arc flash mitigation.

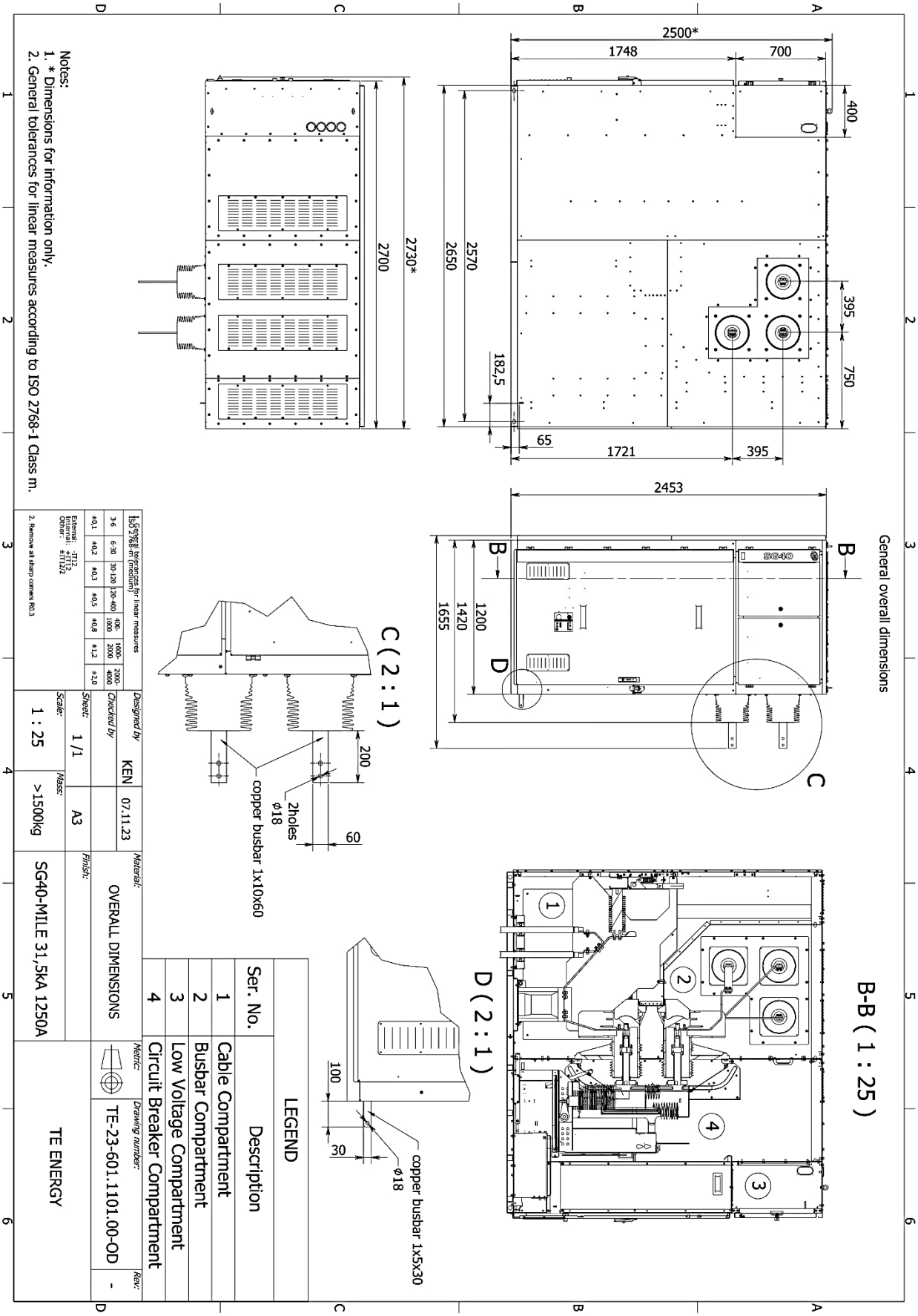
When the switchgear has reached the end of its lifetime, it must be decommissioned, recycled or disposed. The following methods of disposal are recommended:

Table 12.1 Recommended method of disposal

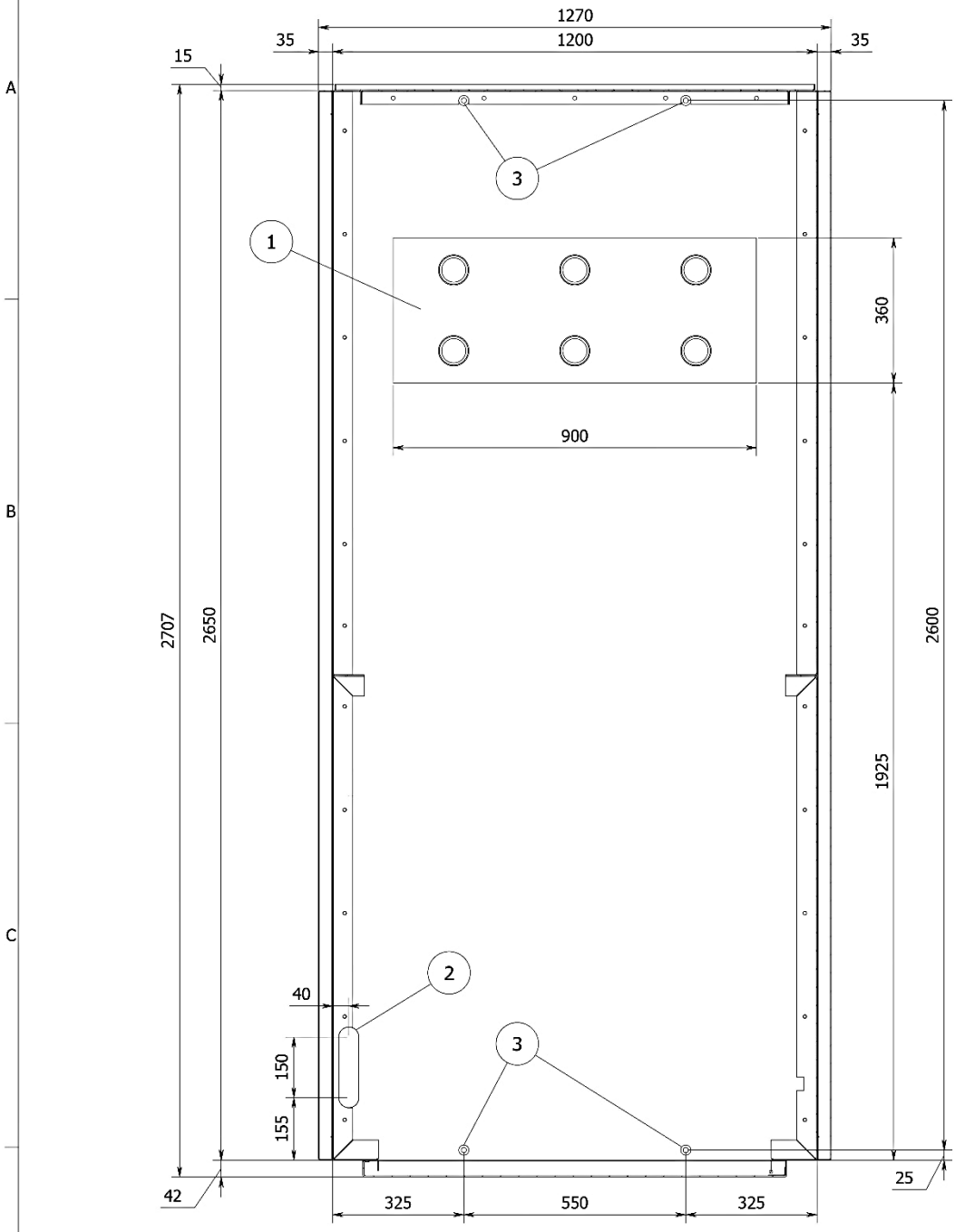
Material	Recommended method of disposal
Plastic	Recycling or disposal
Metal	Separation and recycling
Epoxy resin	Disposal
Rubber	Disposal
Package (wood, foil)	Recycling or disposal
Electronics	Check with the original equipment manufacturer / supplier

- The equipment and materials applicable in the MILE series switchgear do not contain any hazardous materials that require special methods of disposal.
- Always act in accordance with local legal requirements for disposal.

Appendix 1. General arrangement drawings. Switchgear panel



Appendix 2. Floor mounting drawing



1. General tolerances for linear measures ISO 2768-m (medium)						
3-6	6-30	30-120	120-400	400-1000	1000-2000	2000-4000
±0,1	±0,2	±0,3	±0,5	±0,8	±1,2	±2,0

External: -IT12
Internal: +IT12
Other: ±IT12/2

2. Remove all sharp corners R0.3

Designed by: GAO		Material:	Metric:	Drawing number: SP35.1101.00	Rev: -
Checked by:					
Sheet: 1 /1	A3	Finish:			
Scale: 1 : 10	Mass: N/A	SG35			

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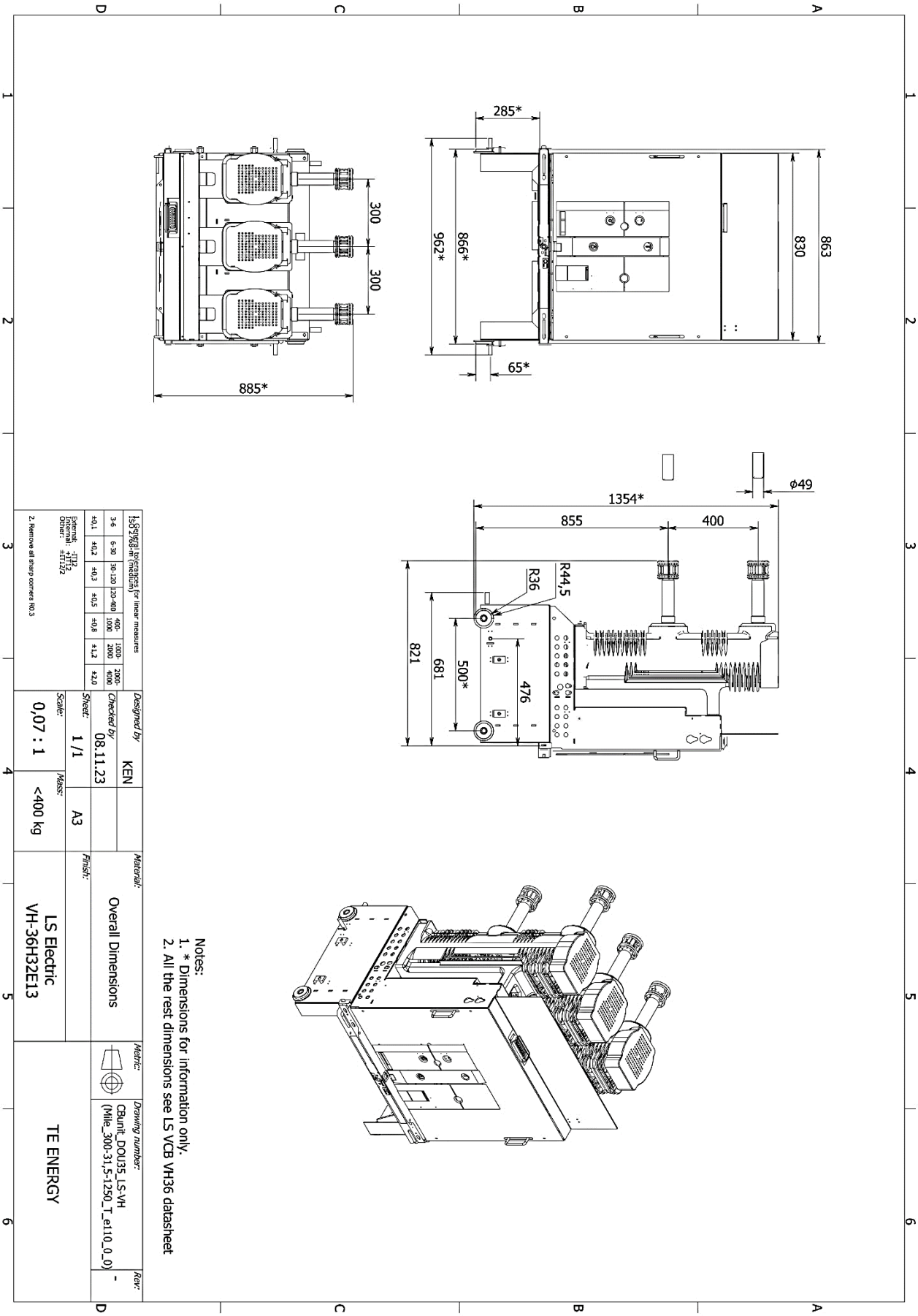
Appendix 3. General arrangement drawings. Withdrawable circuit breaker



Amendment list

Date	Page, clause	Scope
22.03.2024		Initial version

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