MEDIUM VOLTAGE PRODUCTS

UniGear ZS2

Installation, operation and maintainance instruction manual



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ABB’s UniGear ZS2 is a three-phase, metal enclosed, air- insulated switchgear and all units are factory-assembled, type tested and suitable for indoor applications up to 36 kV. The switchgear is designed with a withdrawable type vacuum / SF6 circuit breaker and fitted with a single busbar system.

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1. Your safety first - at all times

To emphasize on safety, our installation, operation, and maintenance manual begins with the following recommendations:

Only install switchgear in closed rooms suitable for electrical equipment. Ensure that installation, operation and maintenance is only carried out by qualified competent electricians only and the responsibilities after the ex-works delivery are clarified. Fully comply with the legally recognized standards (IEC or local), the connection conditions of the local electrical utility and the relevant safety at work regulations.

Observe the relevant information in the instruction manual for all actions involving switchgear. Using of safety clothes like safety gloves according to EN 388 Blade cut resistance class 5, long sleeved work jacket or safety sleeves, safety shoes is recommended during all activities done with the switchgear.



DANGER!

Pay special attention to the hazard notes in the instruction manual marked with this warning symbol.

- Make sure that the specified criteria are not exceeded under switchgear operating conditions.
- Ensure the instruction manual is accessible to all personnel involved in installation, operation, and maintenance.
- The user’s personnel must act responsibly in all matters related to safety at work and correct handling of the switchgear.
- Ensure that the switchgear or switchboard and accessories are stored in closed room, free of dust and moisture till erection.
- Ensure that installation, operation, and maintenance are carried out by only trained, qualified and authorized personnel

- Fully comply with the legally recognized standards (IEC or local), regulations of the local electrical authority and stipulated safety requirements
- Ensure that activities related to switchgear are carried out as per relevant instructions and guidelines given in this manual, and applicable local safety standards and work practices



WARNING

- 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.
- Do not override safety interlocks, either electrical or mechanical, during operation and/or maintenance



WARNING

If you have any further questions about this instruction manual, ABB's field service team will be pleased to provide the required information. We reserve all rights to this publication. Misuse, including in particular, duplication and making this manual – or extracts thereof available to third parties is prohibited. We do not accept any responsibility for the information provided, which is subject to change.

2. Summary

2.1 General

ABB's UniGear ZS2 is a three-phase, metal enclosed, air- insulated switchgear and all units are factory-assembled, type tested and suitable for indoor applications up to 36 kV. The switchgear is designed with a withdrawable type vacuum / SF6 circuit breaker and fitted with a single busbar system.

This manual does not contain any instruction relevant to customer specific documents. In case of special switchgear and apparatus configurations, it is strongly recommended to consult both this manual and relevant project specific technical documents.

2.2 Standards and specifications

UniGear ZS2 switchgear complies with standard and specifications prescribed on IEC publications 62271-200 and 62271-1 for factory-assembled, metal enclosed and type tested high voltage switchgears.

Additionally, the switchgear offers IP4X and IP2X degrees of protection for the enclosure and for partitions respectively, as prescribed by the IEC publication 60529.

All other corresponding IEC publications, national and local safety at work regulations, and safety regulations for production materials must be followed during erection and operation of these systems.

Above and beyond this, customized order specific data furnished by ABB must also be taken into account.

2.3 Operating conditions

2.3.1 Normal operating conditions

UniGear ZS2 switchgear is basically suitable for normal operating conditions for indoor switchgear in accordance with IEC 62271-200. Among other considerations, the following limiting values apply:

Ambient temperature	
Maximum	+ 40°C
Maximum 24-hour average	+ 35°C
Minimum (according to "minus 5 indoor" class)	- 5°C
The maximum site altitude is 1000 m above sea level.	

Note: For higher altitude & ambient, please consult ABB

2.3.2 Special operating conditions

The switchgear is suitable for operation in the Wda type of climate according to IEC 60721-2-1. Special operating conditions must be discussed with the ABB in advance.

For example:

- At altitudes above 1000 m, effects of the reduction in dielectric strength of air on the insulation level must be taken into account (please refer to graph in Fig.1).

- Increased ambient temperatures must be compensated for, in the design of busbars, branch conductors and withdrawable parts. Otherwise, the current carrying capacity will be limited. Heat dissipation in the switchgear can be assisted by fitting additional ventilation facilities.

Note on any special climatic operating condition:

When switchgear is operated in areas with high humidity and/ or with major rapid temperature fluctuations, there is a risk of dew deposits, which must remain an exception in normal operating conditions for indoor switchgear. Preventive action (e.g. suitable ventilation and proper air conditioning of the building or housing, use of dehumidifying equipment, etc.) must be taken into consideration in consultation with ABB to avoid this condensation phenomenon and any resulting corrosion
or other adverse effects.

Details like number of heaters, location and temperature settings depend on the project, and those details must be taken from customer order document.

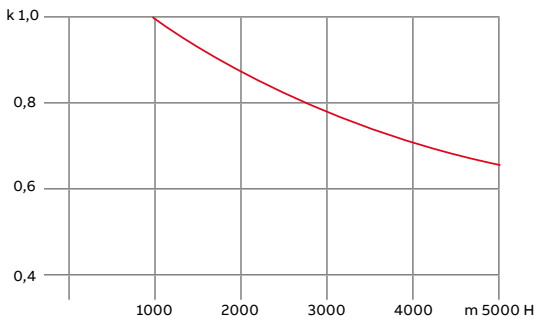


Figure 1
Curve for determination of the altitude factor k in relation to altitude H

3. Technical data

3.1 Electrical data

Table 1 : Main parameters for switchgear with circuit breaker

Rated voltage (Ur)	kV	36
Rated power frequency withstand voltage (Ud)	kVrms	70
Rated lightning impulse withstand voltage (Up)	kVpk	170
Rated frequency (fr)	Hz	50
Rated current (Ir) of busbars	A	upto 3150
Rated current (Ir) of circuit breaker branches	A	upto 2500, 3150 (FC**)
Rated peak withstand current (Ip)*	kA	78.75
Rated short-circuit breaking current of circuit breaker	kA	31.5
Rated short-time withstand current (Ik)*	kA	31.5
Rated duration of short circuit (tk)*	s	3

* The short-circuit withstand capacity of components must be taken into account separately. For individual circuit breaker data, see the Instruction manual for the relative circuit breaker
** Forced Cooling

3.2 Resistance to internal arc faults

The fault withstand capacity is 31.5kA for 1s with gas duct- IAC AFLR 31.5kA,1s 14kA for 1s with absorber assembly - IAC AFLR 14kA 1s

Table 2 : Dimensions of 36kV units
(Refer notations in section 4.1)

Dimension	Notation	Metrics in mm
Height	A	2161# 2662 ##
Width - Feeder switchgears up to 2500 A/ 3150A FC (up to 31.5kA)	B	1000/1200
Depth	C	2200 / 2400 / 2600 / 2800/###
Height of the basic part of Switchgear	D	2024
	E	1700

Height of the standard LV Compartment is 460 mm
Including the height of the Gas duct
Variable as per project requirement

Table 3 : Dimensions of 36kV units; including withdrawable circuit breaker parts

Rated Current in A	Mass in kg Approximate)
upto 1250	1300
1600	1500
2000	1500
2500/3150	1700

Table 3.1 : Variant Configurations - for Feeder

Current Rating in Amps	Copper Version	Aluminium Version
630	Yes	
1250	Yes	Yes
1600	Yes	
2000	Yes	Yes
2500	Yes	Yes
3150 (FC)*	Yes	Yes

* with Force Cooling

Variant Configuration for ICOG

Current Rating in Amps	Copper Version	Aluminium Version
630	Yes	
1250	Yes	Yes

4. Switchgear design and equipment

4.1 Basic structure and variants

The basis for UniGear ZS2 switchgear is an incoming or outgoing feeder panel with circuit breaker. It is divided into circuit breaker compartment 1, busbar compartment 2, cable compartment 3, low voltage compartment 4 for secondary equipment. Apart from this, there are variants for various operating needs. Pictures in Fig. 3 to Fig. 12 show examples of possible configurations of a switchgear including electrical equipment.

For busbar sectionalizing, two switchgears are necessary, a coupling switchgear with withdrawable circuit breaker part and a bus riser switchgear (may be with busbar metering and earthing). In switchgear without busbar sectionalizing, a direct bar connection between the busbars will be established. Further details about installation and equipping the switchgear can be obtained from relevant order specific documents.

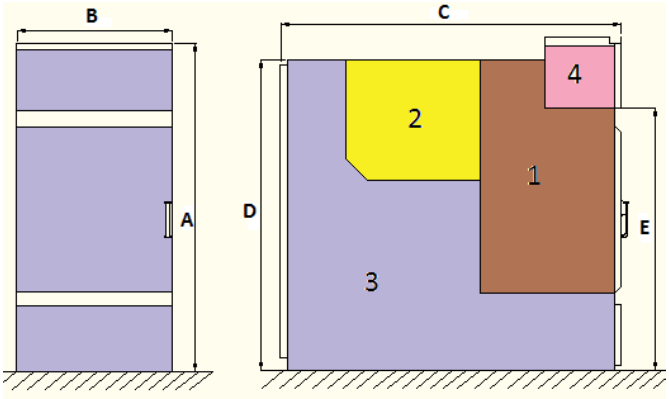


Figure 2 - Basic Structure of ZS2

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

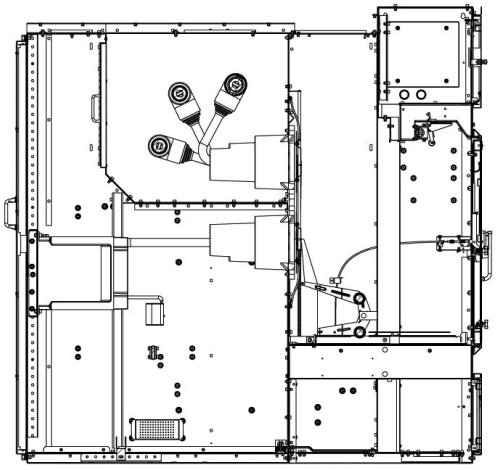


Figure 3 - Cross section of feeder unit 36kV, 630A - 1250A, 31.5kA, 2200 mm depth

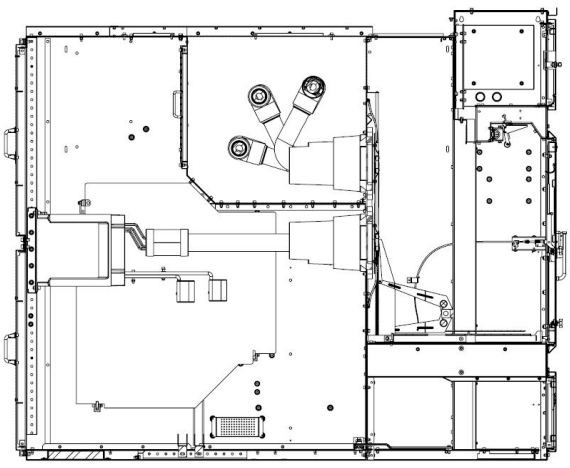


Figure 4 - CCross section of feeder unit 36kV, 1600A/2000A/2500A, 31.5kA, 2600 mm depth

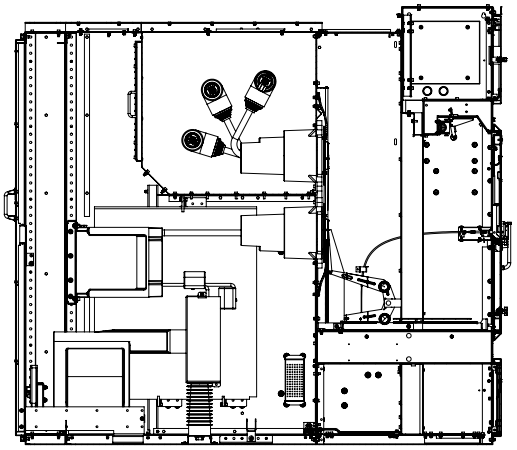


Figure 5 - Cross section of feeder unit 36kV, 3150A, 31.5kA with Forced Cooling, 2400 mm depth*

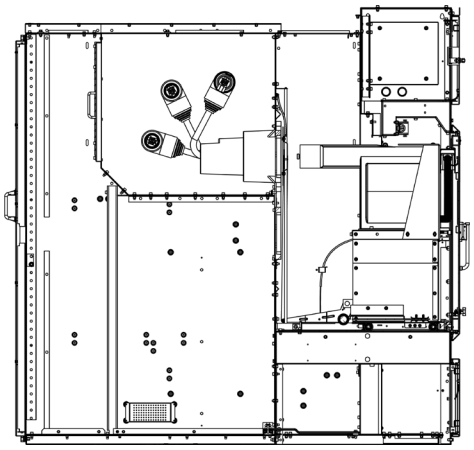


Figure 8 - Cross section of BusPT with measurement

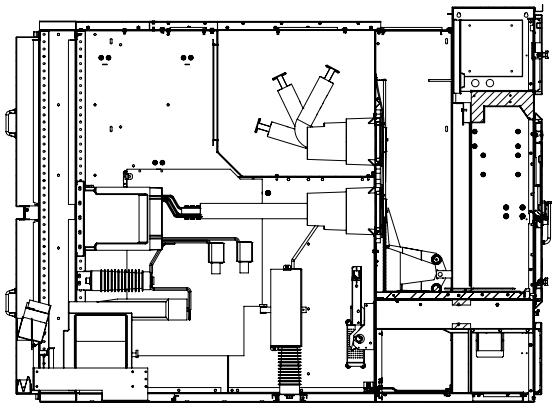


Figure 6 - Cross section of feeder unit 36kV, 3150A, 31.5kA with Forced cooling , 2600 mm depth*

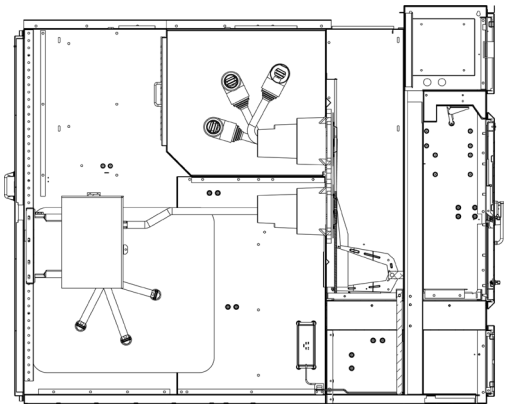


Figure 9 - Cross section of Coupler Unit 36kV, 630A - 1250A, 31.5kA

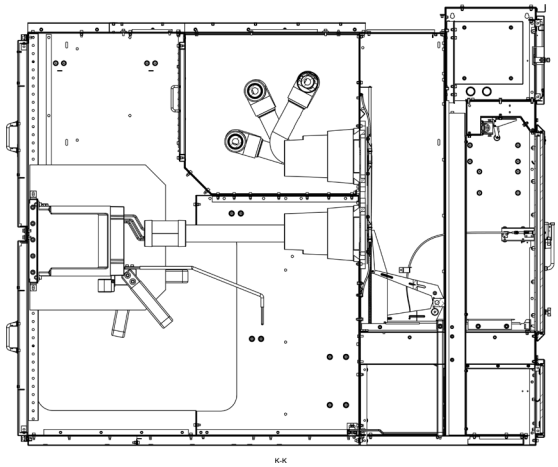


Figure 7 - Cross section of Bus-Coupler unit 36kV, 2500A-3150A , 31.5kA

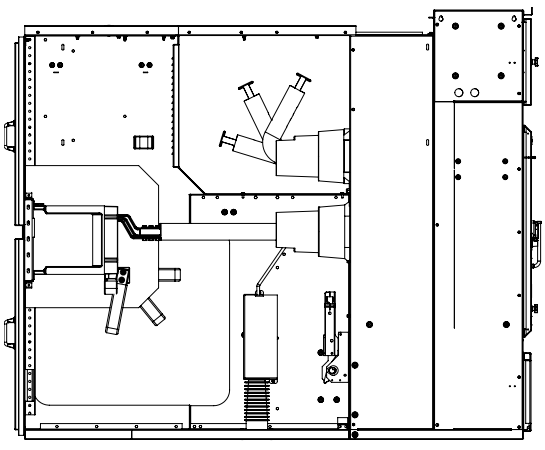


Figure 10 - Cross section of Bus Riser with NC 1250-2500A (1000 mm), 36kV,31.5kA

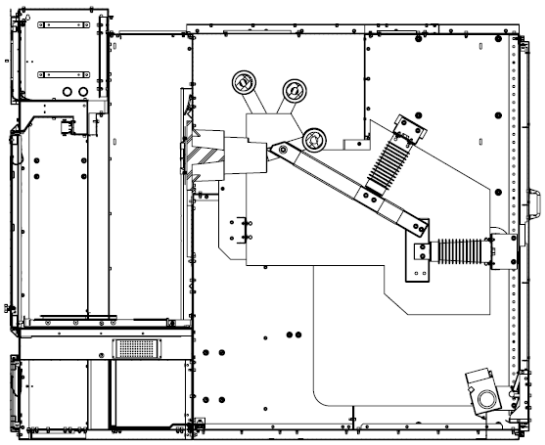


Figure 11 - Cross section of Bus Riser with forced Cooling 3150A (1000 mm), 36kV,31.5kA

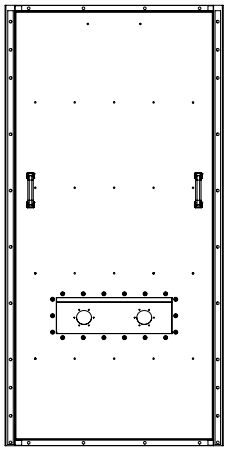


Figure 13 - C/S with IR Window details as optional feature

*=Can be varied as per customer requirement

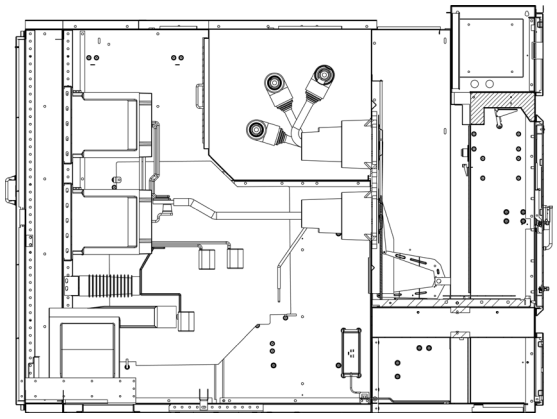
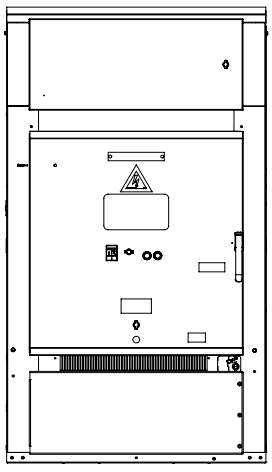


Figure 12 - Cross section of feeder unit with Line PT, 31.5kA, 2800 mm depth*



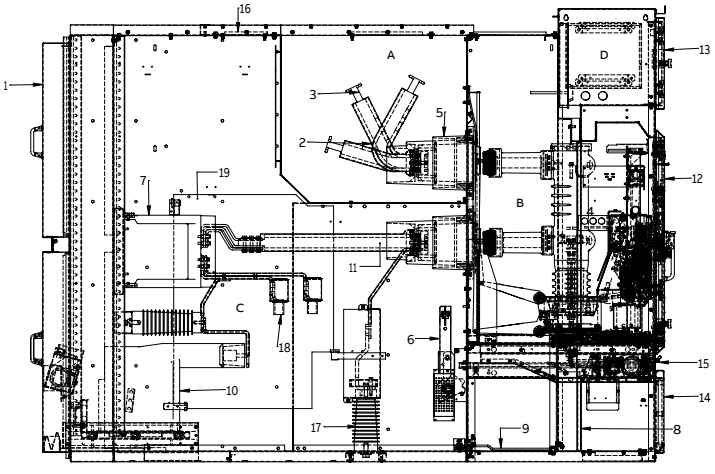


Figure 14

A. Busbar compartment
B. Circuit breaker compartment
C. Cable compartment
D. Low voltage compartment
1. Enclosure
2. Branch conductors
3. Busbars
4. Circuit breaker
5. Bushing
6. Earthing switch
7. Current transformer
8. Control wiring duct
9. Main earthing
10. Voltage transformer
11. Lower connection bar
12. Circuit breaker door
13. Metering door
14. Cable compartment door
15. Earth switch operating mechanism
16. Pressure relief flap
17. Support insulator
18. Incoming cables
19. Phase barrier

4.1.1 Enclosure and partitioning
The enclosure and internal partitions of UniGear ZS2 are made of 2 mm thick high quality Aluminium Zinc coated steel sheets. Three high voltage compartments (viz: busbar compartment, circuit breaker compartment and cable compartment) are equipped with top mounted pressure relief flaps fixed with steel bolts on one longitudinal side and breakable nylon bolt on the other side. These pressure relief flaps open; when over pressure happens in an event of any internal arc fault. Pressure relief flaps are made of sheet steel with wire mesh or plain sheet steel according to the rated branch conductor current.

The circuit breaker compartment door is of pressure resistant design for internal arc fault and is also padlockable. It is provided with security glass for inspection purposes which is also tested for Internal arc. Sidewalls of each switchgear serve as partition between adjacent switchgears.

Please refer table below for cable and Busbars access in FRCB & Cassette type structures

Access for	FRCB Structure	Cassette Structure
Cable compartment	Rear	Front & Rear
Busbar compartment	Rear & Top	Rear & Top

The low voltage compartment for secondary equipment is completely protected from the high voltage area.

Compartmentalization is made by the following internal partitioning: (Refer Fig. 14)

- The rear wall of the busbars compartment
- Intermediate wall between cable and circuit breaker
- Mounting plate with metallic shutters
- Horizontal partition

The internal partitioning makes safe access to circuit breaker and cable compartments possible even when bus bars are live (LSC2B-PM).

End covers at lateral sides ensure good appearance and are arc fault proof both mechanically and thermally, in the event of an internal arc fault at end switchgears.
Doors, end covers and rear covers are made of high quality steel sheets, which undergo thorough cleaning through 7 tank process before powder coating. The finishing coat is of standard RAL 7035 color shade. (Special color shades on request and by mutual agreement).

The circuit breaker compartment and cable connection compartment doors are pressure resistant and has manual closing system or can be fitted with screws respectively.

4.1.1.1 Ventilation of the switchgears
Ventilation is ensured in the switchgear through pressure relief flaps, which offers IP4X degree of protection. For use of UniGear ZS2 switchgear for ambient temperatures above 40°C systems, additional ventilation system is to be provided.

4.2. Compartments in UniGearZS2
4.2.1 Busbar Compartment
The busbar compartment has three copper busbars of tubular cross-section laid in sections between switchgears. They are held in place by tubular branch conductors. Diameter and thickness of busbars vary according to the current rating.

Busbars and branch conductors are insulated and connections are shrouded.

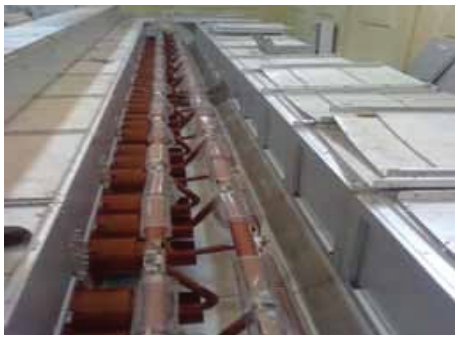


Figure 15A - Busbar compartment top view without top sheet



Figure 15B - Interpanel Busbar assembly

M16X45 Hex Bolt	1
M16 Conical Washer	1

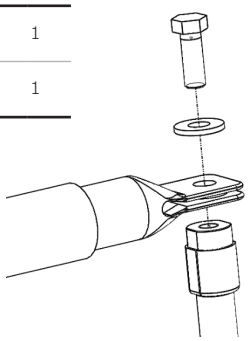


Figure 15.1 - Top Jumper of 630A with Busbar of 1250A

M16X80 Hex Bolt	2
M16X50 Hex Bolt	1
M16 Conical Washer	5
M16 Hex Nut	2

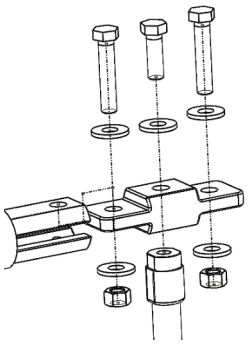


Figure 15.2 - Top Jumper of 630A with Busbar of 2500A

M12X70 Allen Bolt	2
M12 Conical Washer	4
M12 Hex Nut	2

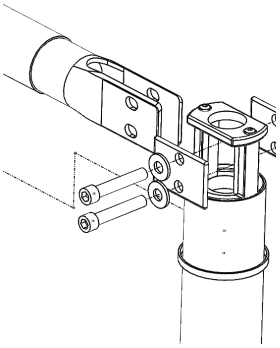


Figure 15.3 - Top Jumper of 2000A with Busbar of 2000A

M12X80 hex Bolt	1
M12 Conical Washer	2
M12 Hex Nut	1

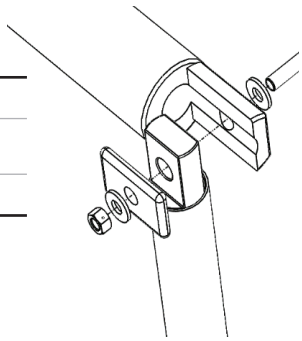


Figure 15.4 - Top Jumper-1250A with Busbar 2500A for Al solution

M12X80	2
M12 Conical Washer	4
M12 Hex Nut	2
M16 Hex Nut	2

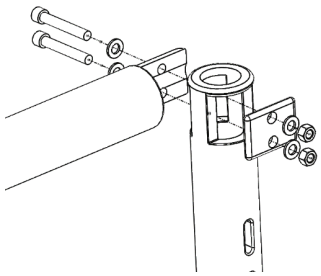


Figure 15.5 - Top Jumper-2000A with Busbar 2500A for Al Solution

M12X60 Allen Bolt	2
M12 Conical Washer	4
M12 Hex Nut	2
M16 Hex Nut	2

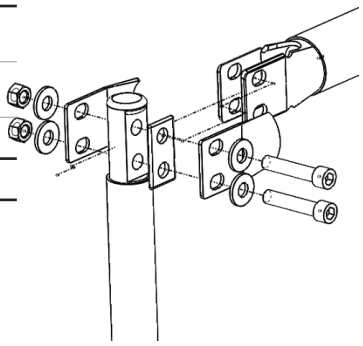


Figure 15.6 - Top Jumper & BB 1250A

M16X90 Allen Bolt	1
M16 Conical Washer	2
M16 Nut	1

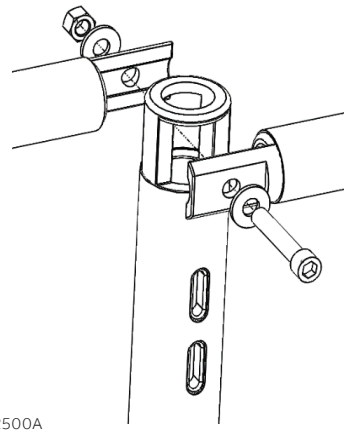


Figure 15.7 - Top Jumper-2500A with Copper Busbar 2500A

4.2.2 Circuit breaker compartment

The circuit breaker compartment contains all the necessary arrangements for the rack-in and rack-out operation of the withdraw-able part inside the switchgear. Like the busbar compartment, it is metallic partitioned on all sides.

The socket for the control wiring is firmly mounted inside the circuit breaker compartment.

The tulip isolating contacts together with the fixed isolating contacts are located on H-frame and fixed through spout bushing. The shutters are opened by means of lever assembly (Fig.16) when inserting circuit breaker into the service position and are closed when the circuit breaker is removed. In the test/disconnected position of the withdrawable part, partitioning by separation from service to test position is thereby established in the main current circuit. Auxiliary plug and socket with control wiring are to be connected, when circuit breaker in the test/ disconnected position.

In the test position, the breaker would be completely inside the switchgear with door closed. The ON / OFF indication and CHARGED / DISCHARGED condition of the closing spring of circuit breaker can be observed through the inspection window.

The switching operations are carried out with the door closed. Emergency trip of the circuit breaker is possible when circuit breaker is in the service condition. (Emergency Trip arrangement).

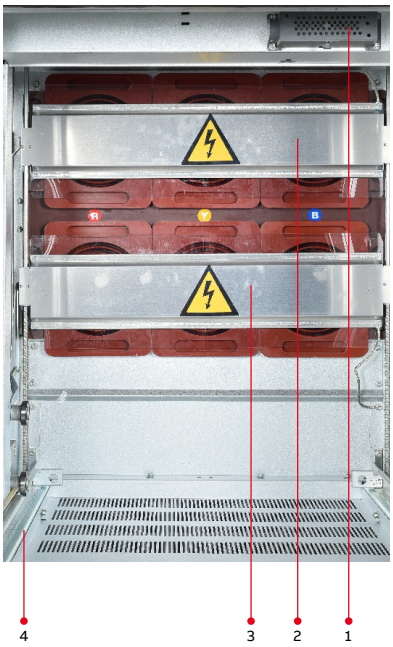


Figure 16 - View into the circuit-breaker compartment.
1 Control wiring socket
2 Top shutter
3 Lower shutter
4 Left-hand travel rail



Figure 18 - Shutter Assembly and Lever mechanism



Figure 17 - Circuit breaker compartment with withdrawable part in Service position



Figure 19 - Circuit breaker compartment with withdrawable part in Test position

4.2.3 Withdrawable parts

4.2.3.1 Withdrawable circuit breaker parts

The withdrawable assembly with the circuit breaker and the switchgear are coupled via a multi-pole control wiring plug connector.

The racking mechanism establishes mechanical connections between the switchgear and circuit breaker. The circuit breaker can be moved between Test and Service positions by means of the handle provided, with front door closed. Service and Test positions are set precisely by means of lead bolt arrangement to ensure that the breaker reaches the final position. The Test and Service position indication can be observed on the low voltage compartment.

The moving part with the circuit breaker is moved either manually or by a motor by means of a spindle, between the service or test positions with the front door closed. Service and test positions are set precisely by means of auxiliary switches, which register the final position reached and the angular position of the spindle.

The earthing connection between circuit breaker and the switchgear is established throughout; from Test position to Service position by means of finger contact bolted with circuit breaker and a travel rail connection arrangement which is bolted on to the switchgear refer Fig.20.

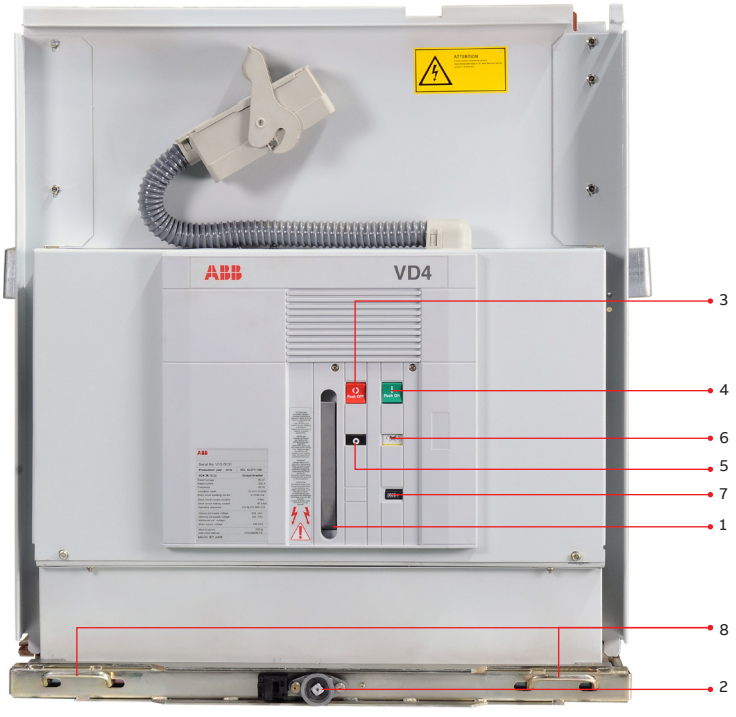
Separate earthing provisions for circuit breaker in Test and Service positions are available on request.



Figure 20 - Scribe Earthing

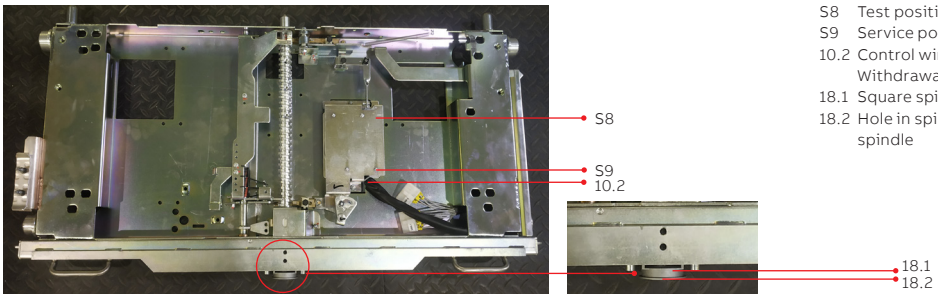
The control wiring plug and socket are also coded to prevent any erroneous connection between incompatible withdrawable part and the switchgear, though their dimensions appear similar.

Thanks to the coding fitted in the control wiring plug and socket!



1. Lever for manually charging the closing spring.
2. Coupling lever for racking in /out operation
3. Opening push button
4. Closing push button
5. Signaling device for circuit breaker open/closed.
6. Signaling device for closing spring charged/ discharged.
7. Operation counter.
8. Handles for operating the truck locks (only for withdrawable circuit breakers).

Figure 21 - VD4 Circuit breaker operating element.



S8 Test position indicator
S9 Service position indicator
10.2 Control wiring plug connector for Withdrawable assembly
18.1 Square spigot
18.2 Hole in spindle for insertion lever spindle

—
Figure 22 - Withdrawable assembly for circuit breaker, with auxiliary switches

4.2.3.2 Other withdrawable parts

The withdrawable part can also be fitted with following trucks:

- Metering potential transformers trucks with fuses. (Refer sec.: 7.3.4)
- Earthing truck without making capacity (for main busbar system and power cables)

These earthing trucks are intended for fail-safe temporary earthing in cubicles for UniGear ZS2 type indoor switchgear. This earthing truck is suitable to earth a circuit which is in OFF condition. This earthing truck can sense the voltage even if put into a live circuit, which will prevent further racking-in by means of an interlock thereby ensuring safety of the operator. It is recommended that the circuit to be earthed be switched OFF before using this earthing truck.

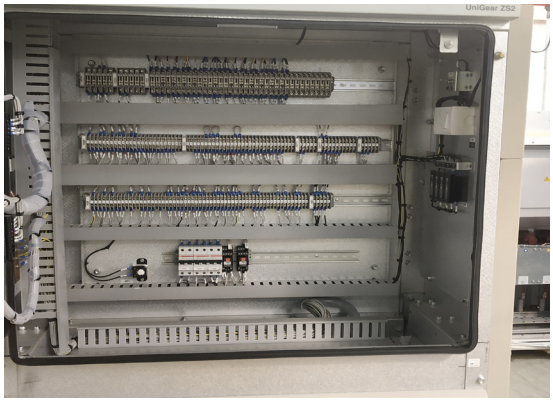
Earthing trucks are available in two versions:

- For earthing the main busbar system
- For earthing power cables

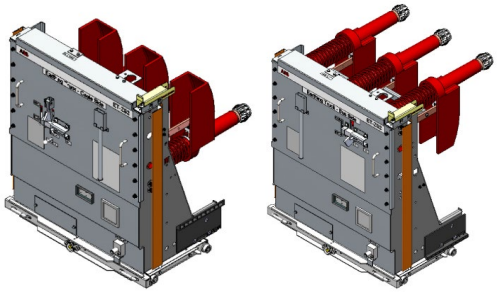
For ensuring maximum safety to the operator and highest plant reliability against accidental switching on the circuit, during scheduled or unscheduled maintenance, it is highly recommended to withdraw the circuit breaker entirely out the switchgear and shorting the circuit with main earthing by means of earthing truck.



—
Figure 23 - Low Voltage compartment



—
Figure 24 - Low Voltage compartment internal wiring



4.2.4 Cable compartment
The cable compartment contains current transformers, and fixed or withdrawable potential transformers, and earthing switch depending on requirements of the customer. The EK6 ST-E type earthing switch can be used with either a manual or mechanism. Its switching position will be indicated both mechanically and electrically by means of the auxiliary switch.

UniGear ZS2's cable compartment can accommodate installation of current transformers and other equipment like surge arrestors, voltage detecting insulators (VDI), etc. The fixed type potential transformers are connected with suitable connectors on the primary side, while the removable or withdrawable type potential transformers are fitted with HRC fuses.

The UniGear ZS2 Digital panel‘s cable compartment is constructed for installation of 1 set of current sensors.



Figure - Current Sensors

The voltage sensors are connected on the primary side with copper bar. Should voltage sensors not be required, 2 set of insulators will be installed in their place, using the similar installation and connection procedures (Figure-voltage sensors).



Figure -Voltage Sensors

- KEVA 36 B2x – voltage sensor with ratio 10000:1
- KECA 80 C260-ZS2 – current sensor with ratio 150mV@80A

4.2.4.1 Cable connections
UniGear ZS2 switchgear can accommodate up to three numbers of parallel single-core cables, of maximum cross-section of 630 sq.mm, as standard arrangement. Other options may be made available on special request.

4.2.5 Low Voltage compartment
The low voltage compartment is an independent sheet metal box mounted on the switchgear for housing control and protection equipment. It is suitable for both conventional as well as microprocessor control technology. The standard height of the low voltage compartment is 460 mm, and upto 824 mm height can be made available on request.

If secondary devices are not intended for door installation, they are mounted inside the low voltage compartment.

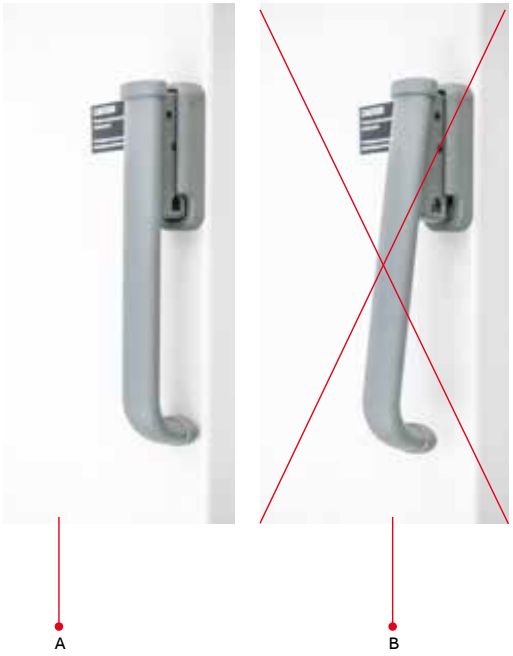
Provisions for inter-panel wiring are made inside walls of the low voltage compartment.

IMPORTANT NOTE

In the case of any non standard cable connections an agreement must be reached between the customer and ABB during the technical preparation stage of the order.

4.3 Interlocks and protection against erroneous operations
4.3.1 Standard safety Interlocks
UniGear ZS2 has series of interlocks provided as described below to prevent hazardous situations, erroneous operation to protect both personnel and equipment:

- The circuit breaker can be moved into Test or Service position only when the circuit breaker and earthing switch are in OFF condition. In intermediate positions, the circuit breaker is mechanically and electrically interlocked against ON and OFF operations.
- With circuit breaker OR instead of AND earthing switch closed, insertion of the circuit breaker towards the Service position is locked and only half a turn of the crank in the clockwise direction is possible.
- In the Service or Test positions, the circuit breaker can only be switched OFF manually when no control voltage is applied and it cannot be closed (electromechanical interlock)
- Interlock will not allow racking of the circuit breaker in absence of auxiliary power supply
- Connection and disconnection of the control wiring plug from its socket is possible only when the withdrawable part is in Test position and with the door opened (Fig. 79)
- The earthing switch can be closed only if the withdrawable part is in the Test/Disconnected position or outside of the panel (mechanical interlock)
- Details of other interlocks can be obtained from customer specific order related documents



—
Figure 25 -
A) Closed position of door's handle;
B) Not closed position of door's handle.

4.3.2 Door interlocking

UniGear ZS2 is equipped with the following door interlocks:

- The circuit breaker can be racked in from Test to Service position only when door is closed. (Fig. 25.1)
- The circuit breaker compartment door cannot be opened if the circuit breaker is in Service or in any undefined positions (Fig 25.2)
- The compartment door cannot be opened if the earthing switch is open.

4.3.3 Interlocks between switchgears

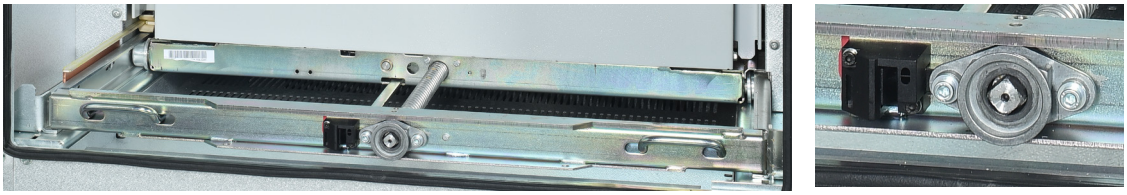
The interlock between the switchgears can be achieved by using the electrical schematic controls.

	Lock		Condition
1	A	Apparatus racking-in/out	Apparatus closed
	B	Apparatus closing	Undefined truck position
2	A	Apparatus racking-in	Apparatus control wiring connector unplugged
	B	Apparatus control wiring connector plug-out	Truck in service or undefined position
3	A	Earthing switch closing	Truck in service or undefined position
	B	Apparatus racking-in	Earthing switch closed

Note: Apparatus are circuit breakers



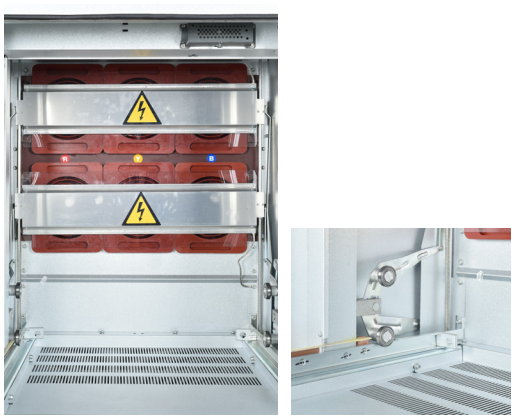
—
Figure 25.1 - Circuit breaker compartment door enabling device



—
Figure 25.2 - Circuit breaker truck enabling slot



—
Figure 25.3

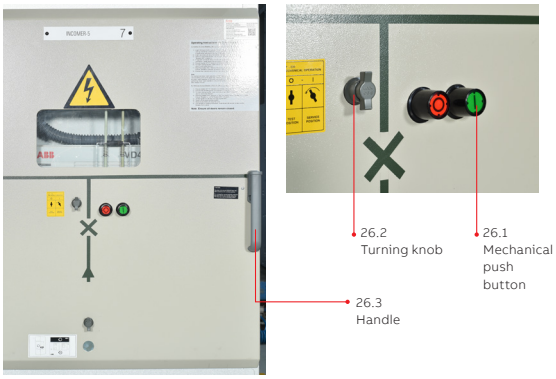


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Figure 25.4



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Figure 25.5 - CB/Cable compartment door enabling device

Electromechanical door interlock for CB and cable compartment



—
Figure 26 - Push button for mechanical ON/OFF breaker operation with the door closed.

If the withdrawable part is in the service position, operation is carried out using the knob which swings a push rod extension out.

26.1 Mechanical pushbutton
26.2 Turning knob
26.3 Handle

4.3.4 Locking devices

- The main circuit's metallic shutters can be padlocked independently when the withdrawable circuit breaker has been removed from switchgear. (Fig 25.4)
- Access to the circuit breaker racking slot can be restricted with a pad lock.
- Access to the circuit breaker compartment can be restricted with a padlock.
- Access to the operating-shaft of the earthing switch can be restricted with a key lock. (optional feature on request)

Note: For any padlock provision, padlock of Ø6mm can be used.



—
Figure - E&S Lock Arrangement

—

Types of interlocks

Standard safety interlocks (mandatory)			
Type		**Description**	**Condition to be fulfilled**
1	A	Apparatus racking-in/out	Apparatus in OFF position
	B	Apparatus closing	Defined truck position
2	A	Apparatus racking-in	Apparatus multi-contact plug plugged
	B	Apparatus multi-contact plug unplugging	Truck in test position
3	A	Earthing switch closing	Truck in test position
	B	Apparatus racking-in	Earthing switch in OFF position, Earthing sw. Operating handle cover in closed position.
4	A	Apparatus compartment door opening	Truck in test position
	B	Apparatus racking-in	Apparatus compartment door closed
5	A	Feeder compartment door opening	Earthing switch in ON position
	B	Earthing switch opening	Cable compartment door closed

Note: Apparatus is circuit-breakers.

Keys (on request)		
6	Apparatus racking-in lock	Can only be removed with the truck in the racked-out position
7	Earthing switch closing lock	Can only be removed with the earthing switch open
8	Earthing switch opening lock	Can only be removed with the earthing closed
9	Insertion of the apparatus raking-in/out crank lever	Can always be removed
10	Insertion of the earthing switch operating lever	Can always be removed

Padlocks		
11	Apparatus compartment door opening	
12	Cable compartment door opening	
13	Insertion of the apparatus raking-in/out crank lever	
14	Insertion of the earthing switch operating lever	
15	Shutters opening or closing	

It is necessary to use padlocks with 5-8 mm hasp diameter

Locking magnets (on request)		
16	Apparatus racking-in/out	Magnet energized
17	Earthing switch ON/OFF	Magnet energized

Accessory devices		
18	Shutters fail-safe	The device locks the shutters in the closed position when the apparatus is removed from the compartment. The operator cannot open the shutters manually. The shutters can only be operated by the apparatus truck or the service trucks.
19	Apparatus-switchgear unit compatibility matrix	The apparatus multi-contact plug and relative switchgear unit socket are equipped with a mechanical matrix, that disables apparatus racking-in into a switchgear unit with an inappropriate rated current.
20	Circuit-breaker mechanical operating mechanism	The apparatus compartment is equipped with a mechanical device, that enables circuit-breaker closing and/or opening directly by means of the front operating mechanism Push Buttons, keeping the door closed. The controls can be operated with the circuit-breakers in the operation and racked-out position.

4.4 Control wiring plug connector coding

The connection between low voltage compartment and circuit breaker is established by a multi-pin control plug and socket. It is recommended to ensure connecting the secondary plug and socket before rack-in of the circuit breaker from test to service position.

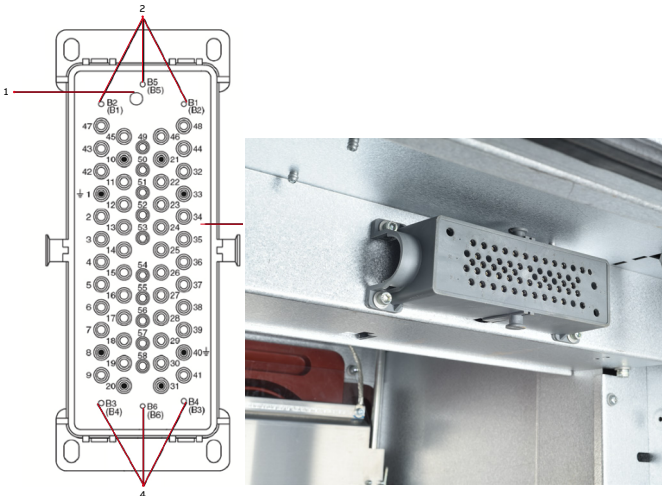
The control wiring plug and socket are also coded to prevent any erroneous connection between incompatible withdrawable part and the switchgear, though their dimensions appear similar.

Thanks to the coding fitted in the control wiring plug and socket!



—
Figure 27 - Push button assembly for emergency ON/OFF arrangement

View of the push rod extension swung out by the knob at the front, with the withdrawable Circuit breaker part in service position and the door open



—
Figure 28 - Control wiring plug connector

1 Bore for actuating pin of the control wiring plug for controlling the auxiliary switch
2,4 Centering striking tabs
3 Control wiring socket

Table 4: Control wiring plug connector coding table

Panel rated current	Revets position assembly in apparatus						Hole open position in panel					
	B1	B2	B3	B4	B5	B6	B1	B2	B3	B4	B5	B6
1250A VD4 circuit breaker	0							0				
1600A/2000A VD4 circuit breaker				0	0				0		0	
2000A VD4 circuit breaker					0						0	
2500A VD4 circuit breaker	0					0		0				0
1250A VD4 isolating truck		0		0			0					
1600A/ 2000A VD4 isolating truck		0	0				0		0	0		
2500A VD4 isolating truck		0				0	0					0

4.5 Instructions for floor-rolling version circuit breaker

In floor-rolling circuit breaker version, the circuit breaker is mounted on a trolley equipped with nylon wheels those roll on the ground, and thereby making the handling of circuit breaker easier.

The door of circuit breaker compartment and cable compartment are unified to form a single door, instead of two separate doors.

The circuit breaker compartment door is of pressure resistant design for internal arc fault and is also pad lockable. It is provided with security glass for inspection purposes.

4.5.1 Handling of floor-rolling circuit breaker

4.5.1.1 Racking-in from Test to Service position

A ramp arrangement is provided in the switchgear, as an integral part, to facilitate easy insertion of the floor rolling circuit breaker into switchgear; with the circuit breaker in switched OFF condition. Refer Fig. 29.

The trolley must be pushed completely inside the switchgear as far as possible, till the Test position, and secured in place.
This is performed as follows:

- while pushing the circuit breaker, gently slide handles of the traverse towards the square spigot of the spindle mechanism at the center of the circuit breaker
- on reaching the Test position of the circuit breaker, release handles of the racking mechanism or traverse
- locking flanges at both ends of the traverse are to be aligned with slots provided on both guide rails mounted on sidewalls of the switchgear

Auxiliary power plug and socket with control wiring are to be connected when the circuit breaker is in Test/Disconnected position.
Manual insertion from the test/disconnected position to the service position:

- Close the front door

- Ensure that the circuit breaker is in OFF condition (in case of VCB)
- Fit hand crank on square spigot of the spindle mechanism inside the racking hole by turning the knob provided on the door. (Fig. 78)
- Turn the crank clockwise (30 turns) until the breaker or withdrawable truck reaches the Service position and stops
- Observe the position indicator on low voltage compartment
- Remove hand crank

4.5.1.2 Racking-out from Service to Test position

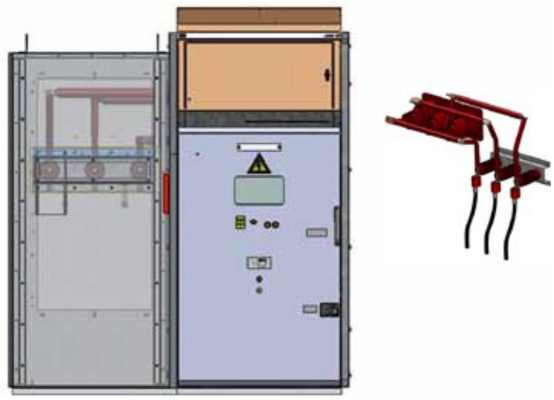
Manual withdrawal from the service position into the Test/ Disconnected position:

- Ensure that the circuit breaker is in OFF position
- Fit hand crank on square spigot of the spindle mechanism inside the racking hole by turning the knob provided on the door. (Fig. 78)
- Turn the crank anti-clockwise (30 turns) until the breaker or withdrawable truck reaches the Test position and stops.
- Observe the position indicator on low voltage compartment
- Remove hand crank

Note:

- The withdrawable part shall not be stopped at any intermediate position in the travel range between Service and Test / Disconnected position.
- The circuit breaker compartment door can be opened only when the circuit breaker is in test position.
- The Trolley can be removed from switchgear by sliding tracking mechanism handles towards the square spigot of the spindle mechanism at the center of the circuit breaker, and then pulling the whole trolley out of the switchgear.

4.6 ICOG- Incoming and outgoing type switchgear



4.7 Ith Limiter

Upon request, UniGear ZS2 switchgear can also be equipped with Ith limiters on the top of each unit to generate a fault signal, immediately, when the pressure relief flaps are open.

- Reaction time is less than 15 ms.
- The signals from Ith limiters can be sent directly to circuit breaker OFF trigger.

It is additional safety feature on the top of each panel. The microswitch generates an immediate fault signal when the overpressure flap is opened. Reaction time is less then 15 ms. The signal from the microswitch can be sent directly to trigger the circuit-breaker OFF.

It is necessary to adjust the centre of the switch knob of the auxiliary switch to the centre of the pressure relief flap's hole. Correct value of the adjustment of the auxiliary switches' height in the pressed position according to the particular type of the switch is indicated in following pictures.

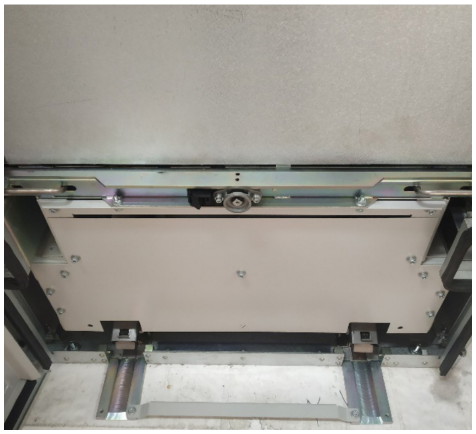


Figure 29 - Ramp for circuit breaker trolley



Figure 30 - Complete cubicle assembly



Figure 31 - Auxiliary Ith limiter switch. It may be necessary to move the auxiiary switches into their service position when the lifting eyebolts have been removed.



Figure 32 - FRCB trolley

5. Dispatch and Storage

5.1 Condition on delivery
Factory-assembled UniGear ZS2 switchgears are dispatched with withdrawable devices placed in their test position and with doors in closed condition. Busbars are not assembled in factory. The busbar material, fasteners and accessories are packed separately, unless mentioned otherwise.

UniGear ZS2 switchgears are checked at ABB works for,
- Completeness with reference to the terms on customer order.
- Correctness in structure and function by performing standard routine testing (normally without AC voltage testing of the busbars) with reference to IEC publication 62271-200.

5.2 Packing
Available packing methods:
- Polythene foil- storage time ½ year in clean and dry environment
- OSB Boards- storage time ½ year in outdoor environment according to IEC
- Wooden Boxes- storage time 3 months indoor environment in outdoor environment according to IEC

UniGear ZS2 panels are packed for transportation to the destination in following types:

5.2.1 Panels with basic packing
- Pallet with plastic wrapping

5.2.2 Panels with seaworthy packing:
- Sealed in polyethylene sheet
- Vacuum Packing
- Transport drying agent bags included

Observe the directions for use of the drying agent bags. The following applies:
- Colored Silica Gel indicator blue: contents dry.
- Colored Silica Gel indicator pink: contents moist (relative humidity above 40%).

5.3 Transport at site
The following precautions must be taken during storage, transport and erection at site.
- Transport switchgears upright.
- Take the high center of gravity into account.
- Carry out loading operations only after ensuring that all precautionary measures to protect personnel and materials are taken.
- Use crane, fork-lift truck and / or manual trolley jack.

5.3.1 Loading by crane
- Use lifting ropes of appropriate load capacity with spring catches with eyebolt diameter of 30 mm.
- Ensure angles above 60 degree from horizontal plane for the rope leading to crane hook.
- Remove the pallet
- Hang the switchgear using ALL lifting hooks!

5.4 Delivery
Responsibilities of the consignee when switchgear arrives at site include, and are not limited to, the following:
- Checking the consignment for completeness, and for identifying any damages including checking for moisture and its detrimental effects. In case of doubt, packing must be opened and then properly resealed after replacing saturated drying agent bags with new ones, when intermediate storage is necessary.
- If any material is noted to be falling short in terms of quantity or found to be defective or damaged during transport, this must be:
  - Documented on the respective shipping document.
  - Notified to the relevant carrier or forwarding agent, immediately, in accordance with the relative liability regulations.

Note: Always take photographs to document any major damage.

5.5 Intermediate storage
Optimum intermediate storage, where it is necessary, without any negative consequences depends on compliance with a number of minimum conditions for the switchgears and assembly materials.

5.5.1 Switchgears with basic packing
- A dry well-ventilated storeroom with a climate in accordance with IEC 62271-1
- The room temperature must not fall below –5 °C

- There must not be any other negative environmental influences
- Store the switchgears upright
- Do not stack switchgears
- Open the packing, at least partially

5.5.2 Switchgears with seaworthy or similar packing with internal protective sheathing

- Upon delivery, check the packing for any damage.
- Store switchgears protected from the weather, in a dry and safe place; away from damage.
- Check the drying agent on arrival of the consignment, and subsequently at regular intervals.
- When the maximum storage period starting from the date of packing (of 2 months) is exceeded, the protective function of the packing can no longer be guaranteed. So ensure suitable action for protecting the equipment if intermediate storage is to be extended further.

5.6 Unpacking

The switchgear must be lifted by crane and circular slings. Slings must be inserted according to lifting symbols marked on the crate. Weight and lifting opening angle must be taken into account when choosing circular slings.

Unpacking

- Remove the nails and crate lid, slides and straps
- Open the compartment door and loosen the bolts fixing the switchgear to pallet
- Lift the switchgear by crane following instructions given below -
  - position unloading shims
  - Put the switchgear on loading shims using crane

The packing is intended for transport and not for storing purpose. Upon receipt, the switchgear must be unpacked and installed under clean, dry, dust-free, indoor conditions and anti-condensation heaters shall be switched on.

Switchgear without vacuum packing, are normally fixed to the pallet.

If the packing includes vacuum bags, they might be used for storage indoors or under shelter for a period of time adapted to the ambient conditions. Packing for storage purpose can be supplied upon specific request.

CAUTION!

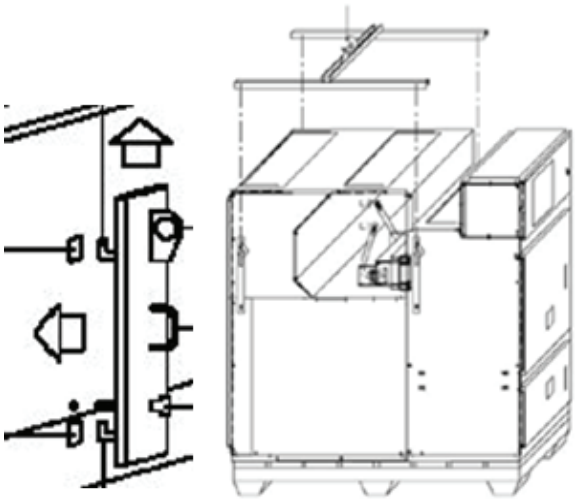


The center of gravity may vary according to apparatus installed in switchgears. Assure that the switchgear is not damaged, tilted or dropped.

The lifting arrangement shown in fig: 33 are not included in the delivery. Consider at least 1.5 ton lifting capacity for each switchgear.



Figure 33 - Lifting arrangement assembly



1VYN402901-BG (554685-801) Ordering number for the lifting hook assly

For each switchgear unit, instructive labels or sketch is fixed on the wooden crate

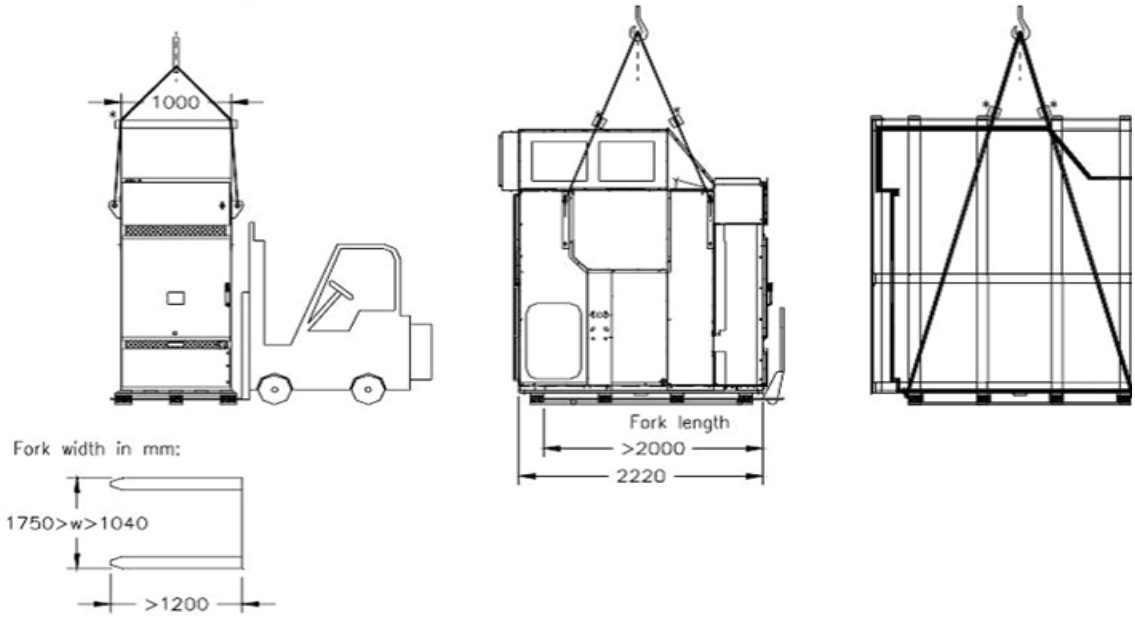


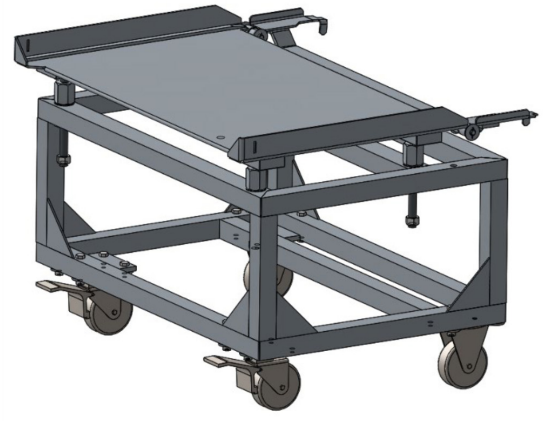
Figure 34 - Transportation Advices



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Figure 35 - Circuit breaker lifting arrangements



—
Figure 36 - Transport Trolley for apparatus. Fixed height.
(Order no: 1YTW572756-101)



—
Figure 37 - Adjustable Trolley
(Order No: 1VYN404301-FJ)

Lift the CB manually or using a suitable hoist, and place it on the trolley. Ensure Removal of CB lifting hook arrangement before inserting in the panel.

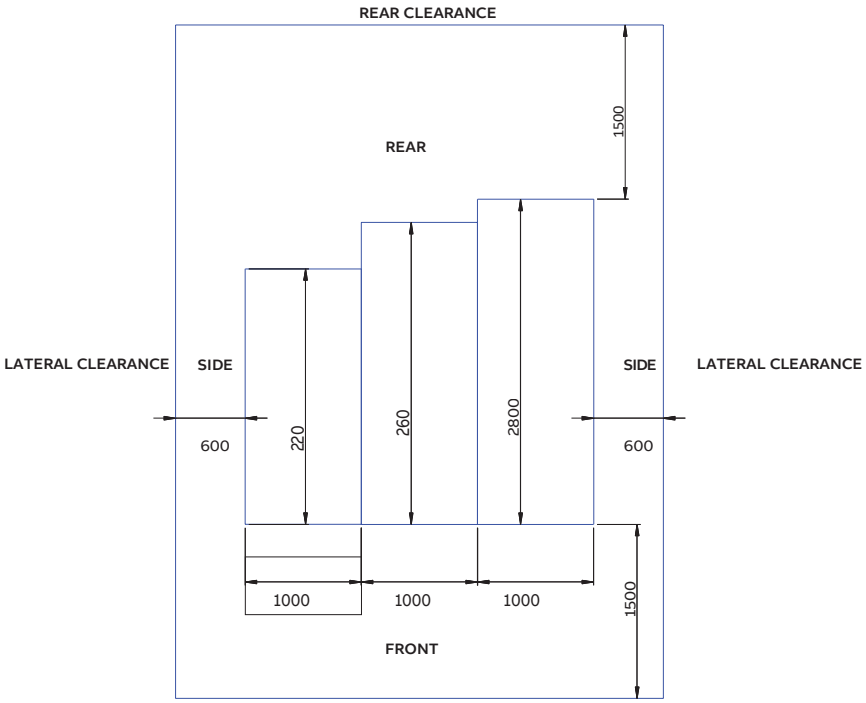
Assembly of the switchgear at site:
In order to obtain an optimum installation sequence and to ensure high quality standards, site installation of the switchgear should be carried out only by specially trained and skilled personnel, or at least supervised and monitored by authorized and persons responsible.

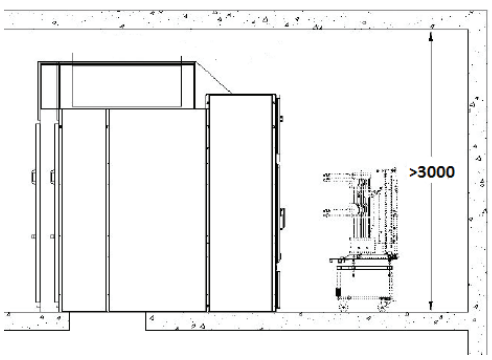
5.7 General site requirements & floor layout
On commencement of installation on site:

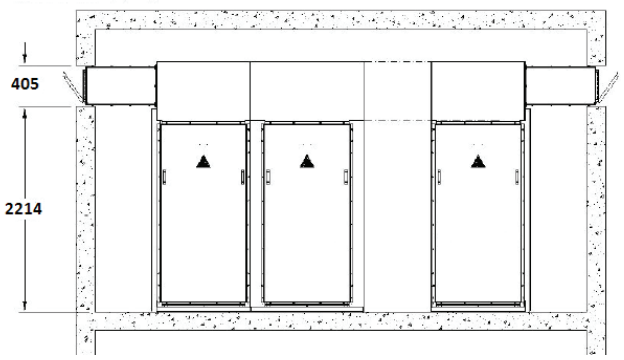
- The switchgear-room must be completely finished
- Provided with lighting and electricity supply
- Room shall be lockable, dry and with facilities for ventilation
- All the necessary preparations, such as wall openings, ducts, etc., for laying the power and control cables up to the switchgear must already be completed
- The ceiling must be high enough for assembly of pressure relief duct and exhaust duct

Compliance with the conditions for indoor switchgear according to normal service conditions as per IEC 62271-1 including the conditions for the “minus 5 indoor” temperature class must be ensured.

Floor layout







Front clearance	1500 mm min. (considering withdrawal of CB/VT Truck)
Rear clearance	1500 mm min. (considering withdrawal of Line PT)
Lateral clearance	Less than 200 mm or more than 700 mm.
Ceiling height	When the arc pressure relief ducts are not applied by the substation building Designer, a general precedent is min. 3500 mm for 25kA level and min 4000mm for 31,5kA level. The building designer may take more detailed drawings and advices from related ABB Office during order correspondence.

In case of installation with arc pressure relief ducts, it guarantees prevention of overpressure and gases being deposited inside the installation room in a rare event of internal arcing and with a minimum (3000 mm) ceiling height.

The duct may exhaust to the outside laterally. Care must be taken prevent access of people into the gas exit area. The gas exhaust louvers must prevent any water, dust, animals, or other foreign bodies from entering.

5.8 Foundations
The following three basic methods of installing switchgear in the switch room are identified:

Method A – installation on “C” profile base irons
As standard, it is recommended to install the switchgear on “C” profile base irons set into the concrete floor of the switchgear room. In this case, the units are fastened using the special bolt blocks (ABB delivers these on request).

Method B – installation on the levelled concrete floor
Installation directly on the levelled concrete floor makes much higher demands on the floor levelling, which must, in this case, fulfill the same tolerances as the base irons during method A installation.

Fastening is carried out by anchoring bolts in the concrete floor.

Method C – installation on a raised false floor
In this case, fastening of the units is carried out by welding outside panels to the steel floor frame in the places where the frame is larger than the base of the switchgear, i.e. on the outside lateral walls of the unit row. This method of installation is not recommended if seismic resistance is required.

Generally, the following procedure for switchgear anchoring can be recommended for any of the installation methods mentioned:

1. The switchgear panels are bolted together in the front and rear part to make one unit;

2. Further structural data guidelines given provide a rough calculation of the space required and the plan for designing the room for a switchgear project.

If seismic resistance is not required, it is not necessary to attach each switchgear panel to the floor or frame, but it suffices to fix outside panels in each row of switchgear only.

If seismic resistance is required, it is necessary to attach each switchgear panel to the floor or frame. To achieve seismic resistance the special fixing system is used. This system preferably uses a steel floor frame with “C” profile shape but moreover with an addition special fixing element – please contact ABB for details.

When the final building construction documents are drawn up, the binding data supplied by ABB for a particular case must always be taken into account!

5.8.1 Method of installation A – installation of the base irons
The general foundation drawing is given in figures below according to the parameters of the units.

- The “C" shaped base irons can be supplied by ABB together with the switchgear. Their installation is usually carried out by personnel on site and, if possible, should be performed under supervision of an ABB specialist. The base irons must be installed in the slab before finishing the floor;

- Rest the irons in the specified position on the concrete floor as shown in the relevant foundation drawing and mark out the places for drilling the holes. Then drill the holes for anchoring bolts, i.e. for plugs for fixing the base irons in the floor. Then put the plugs in the holes and attach the base irons to the floor loosely with bolts, without final tightening so that any required levelling is possible.

- Carefully level the base irons both longitudinally and transversally over the entire length and to the correct height by putting strips of suitable thickness under them and using a levelling instruments.

Tolerances for laying the floor frame are
Evenness tolerance: ± 1 mm over a measuring length of 1 m Straightness tolerance: 1 mm per 1m, but not more than 3 mm over the entire length of the frame.

- After levelling the base irons, tighten bolts. The adjusted position of the base irons on the concrete floor must not be changed during this operation! Check again and, if necessary, correct any deviations;

- Weld individual parts of the base irons together inside the “C" profile at the seams so that there is a mutual conductive connection.

- Take any necessary measures for perfect earthing of the base irons with galvanized steel strips with minimum dimensions of 30 x 4 mm. Two earthing connections are recommended for a panel row longer than approx. 5 panels;

- When the floor top covering is applied, carefully backfill the floor frame, leaving no gaps. The top edge of the floor frame should be 2 mm above the finished floor surface; the tolerance of this value is within the limits of 0 to 5 mm. This facilitates erection and alignment of the switchgear panels. In some cases, this means that the material thickness of an additional floor covering to be fitted later must be taken into account separately;

- The base irons must not be subjected to any harmful impact or pressure, particularly during the installation phase. If these conditions are not respected, problems during assembly of the switchgear and possibly with movement of the withdrawable parts, as well as opening and closing of the doors cannot be ruled out.

Attachment of the units to the “C" shape base irons

The switchgear is attached to the base irons by special bolt blocks, which can be supplied on request.

- Place the individual units of the switchgear in sequence onto correctly levelled and installed base irons and level them according to the relevant foundation drawings;

- Level the units and then bolt them together in the front and rear part;

- To attach them to the base irons, insert specially prepared bolt blocks in the fixing holes in the bottom of the units and tighten them.

5.8.2 Method of installation B – Fixing and anchoring bolts to concrete floor

The general foundation drawing is given in figures below according to the parameters of the units.

- Clean the switchgear installation area carefully.

- On the slab, visibly trace the perimeter of all the units making up the switchgear according to the relevant drawing, taking the minimum wall and obstacle clearances into account

- Level the floor both longitudinally and transversally, evenness tolerance is ± 1 mm over a measuring length of 1 m but not more than 3 mm over the entire length of switchboard.

- Drill the floor at the intended fixing points, referring to the slab drilling drawings. To make the holes, use a hammer drill with a bit according to the steel plugs used;

- Insert the plugs in the holes and put the individual panels on the traced perimeters of the units to create the switchgear;

- Level the units and then bolt them together in the front, middle and rear part;

- Fix the units with bolts with special washers (the coupling material is supplied on request);
- In the case of a metal floor, use the attachment according to the figure.(Fig-39) To make the holes, use a drill with a suitable bit for the type of fixing to be made (through or threaded hole).

5.8.3 Method of installation C – fixing to raised false floors

The general foundation drawing is given in figures below according to the parameters of the units. In most cases,the floating floor is created by a steel structure in which the welded steel frame is installed. A frame produced using suitable steel profiles are used. ABB does not supply this frame.

Evenness tolerance: ± 1 mm over a measuring length of 1 m Straightness tolerance: 1 mm per 1m

- Clean the installation area
- After installation of the frame, take any necessary measures for perfect earthing of the frame with galvanized steel strips with min. dimensions 30 x 4 mm. Two earthing connections are recommended for a panel row longer than approx. 5 panels.

- Place the units on the frame according to the relevant foundation drawings, taking the minimum wall and obstacle clearances into account.

- Level the units and then bolt them together in the front and rear part.

- Carry out attachment by welding the outside panels to the steel floor frame in the place where the frame juts out from the switchgear bottom, i.e. on the outside lateral walls of the unit row. This method of installation is not recommended if seismic resistance is required.

- In the case of a metal floor, use attachment according to the figure. To make the holes, use a drill with a suitable bit for the type of fixing to be made (through or threaded hole).

5.8.4 Checking of foundation

Check the foundation with respect to the foundation drawing supplied. The foundation frame on which switchgears are to be installed shall be properly leveled and level difference shall be less than 2mm over a span of 1m. Level is to be checked using an appropriate water level based indicator. If pre- foundation is done with MS channel or angles, use properly sized ISMC channels with good quality cutting and fabrication. Also ensure that all channels are straight to maintain the future requirement of surface level. Ensure the good quality of welding and workmanship for fixing the foundation frame. Refer Fig. 38.

5.8.5 Mounting of first cubicle on foundation frame

Switchgear installation can be begun from any one side of the switchboard. Remove withdrawable parts from switchgear panels and store them with suitable protection. As the switchgear delivered from factory is pallet mounted, it should be unloaded from the pallet as close as possible to its foundation frame's location to ensure minimal movement of switchgear on the ground. From the ground, the switchgear is to be gently pushed, manually, on to its foundation frame.

If the use of crowbar is unavoidable, the crowbar could be inserted either at sides or at rear of the switchgear.

The crowbar shall never be used in the front side of the switchgear. Please ensure that the switchgear is vertical when mounted on its frame. If necessary, use shims to make the switchgear vertical. The first switchgear on the frame is to be welded to its foundation frame after the switchgear is properly mounted. Every subsequent switchgear shall be pushed on to its respective foundation frame and then be installed; aligned and adjusted to the previous one. Tighten the coupling M8x25 bolts between adjacent switchgears; into the threaded holes provided at their lateral sides. Remaining switchgears shall be erected in the same way as per the general arrangement drawing or documents. As the final steps, after assembling busbars in all switchgears mounted on their foundation frames, weld all the switchgears to their foundation frames. In case of switchboards planned with more than 10 numbers of switchgears, installation may also be begun from the middle switchgear of the switchboard.

CAUTION!



Use proper personal protective equipment like hand gloves, helmets and etc., while handling switchgears.

5.8.6 Mounting of second, third and further switchgear on the frame

Follow the procedure described in 5.2.2. when the second switchgear is placed on the foundation, it must be pushed as close as possible to the first switchgear so that two switchgears touch each other from top to bottom.

Do not weld other cubicles on frame till all cubicles are erected and busbars are coupled.

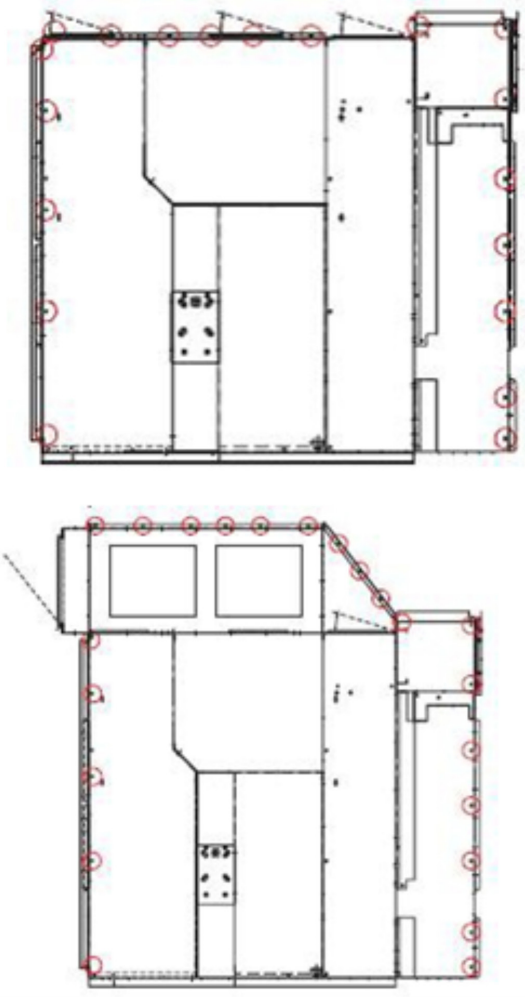
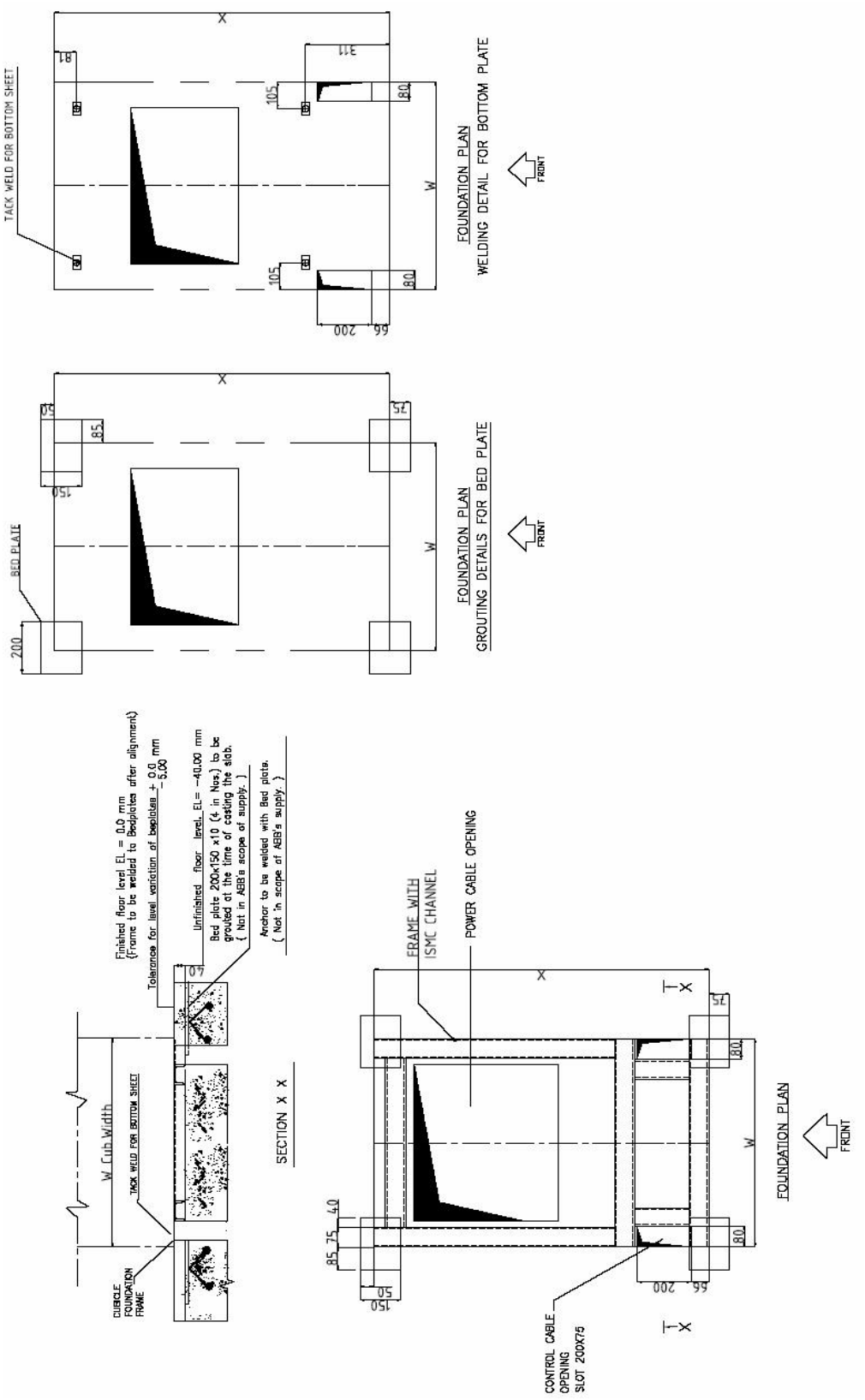


Figure 38 - Hole positions to couple adjacent switchgears



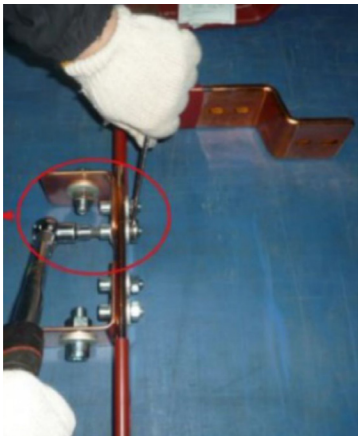
—
Figure 39 - Details of Foundation

6. Assembly of the switchgear panels

Use screws of tensile class 8.8. The maximum recommended tightening torques based on each type of connection are given in the following tables:

1. Tightening torques for copper/Aluminium bars or combined Flat Busbar connections.

Thread (2)	Max. recommended tightening torque Nm (1)
M5(3)	2.5
M6(3)	10
M8	25
M10	50
M12	85



2. Tight. Torques for copper/Aluminium bar connections combined with CTs.

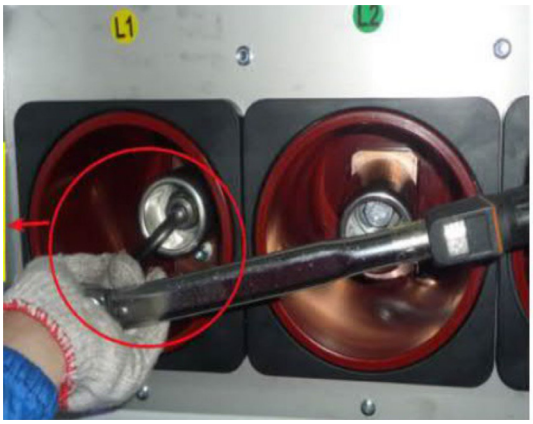
Thread (2)	Max. recommended tightening torque Nm (1)
M12	70
M10	50

3. Tight. Torques combined with Insulating parts (Epoxy resin, BMC, SMC, ABS, PC etc.)

Thread (2)	Max. recommended tightening torque Nm (1)
M8	15
M10	32

4. Tightening torques for Fixed Contacts inside bushing and Insulator supports

Thread (2)	Max. recommended tightening torque Nm (1)
M8	25
M10	50
M12	85
M20	220



5. Tightening torques for Epoxy Insulators

Thread (2)	Max. recommended tightening torque Nm (1)
M16	110
M20	220





6. Tightening torques for Cable connections with Flat copper orientation

Thread (2)	Max. recommended tightening torque Nm (1)
M16	120

7. Tightening torques for Cable connections with Flat Aluminium orientation

Thread (2)	Max. recommended tightening torque Nm (1)
M16	90

8. Plastic nut and bolts:
All plastic screw connections should be fasten by human hands, and the gap between screws and fastened parts must be less than 0.1mm.

Note: Thread and head contact surface lubricated. [/Index Value]
1. The recommended maximum tightening torques are based on a coefficient of friction for the thread of 0.14 (without lubrication) or 0.10 (with lubrication).
2. The tightening torques are recommended for screws ISO 4014-4018 and ISO 4762 (tensile class 8.8). If using other types of screws please contact ABB for clarification.

Any tightening torques that deviate from those in the general tables (e.g. for contact systems or device terminals) must be taken into account as stated in the detailed technical documentation.

6.1 Installation of busbars









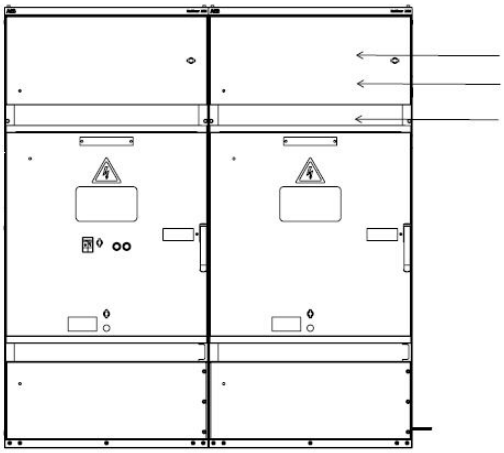
CAUTION

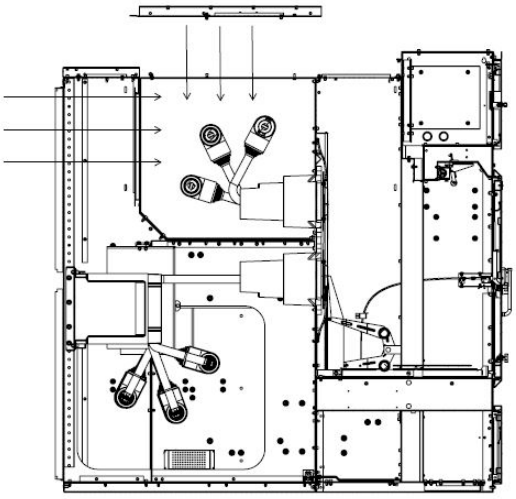
Use proper personal protective equipment like hand gloves, helmets, safety shoes, etc. while handling switchgears. Accesses for the main busbars installation are from sides and from top of the UniGear ZS2 switchgear.

It is recommended to carry out busbar assembly along with erection of individual switchgear; utilizing the advantage offered by access from sides of the main busbar compartment. Insulated main busbars and droppers, and shrouds are delivered as loose items.

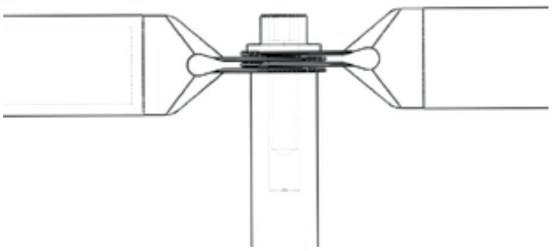
Care shall be taken to protect the insulation against damage during storage and handling. When opted for insulated busbars, damaged insulation shall be renewed. An air cushion type PVC protective covering will protect the insulated parts from damage during transportation and installation. It is recommended to keep them wrapped on busbars as long as possible, until commissioning. Busbar assembly work calls for cleanness as the dielectric strength will be detrimentally affected by foreign objects like metal dust, loose threads and oil patches.

Ensure that contact surfaces of busbars and connector parts are clean. Use only the strong type of conical spring-washers (ABB standard 9ADA334, DIN 6796) for all bolted connections. This will help maintain required contact pressure of the switchgear and minimizes the risk of problem due to overheating. Torque meter shall be used during erection, Recommended tightening torques are as tabulated in Table 5.

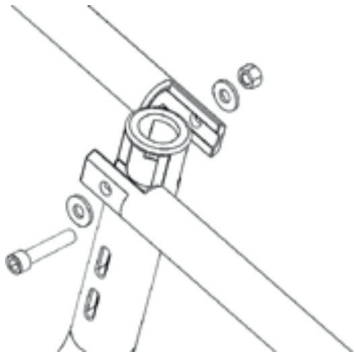




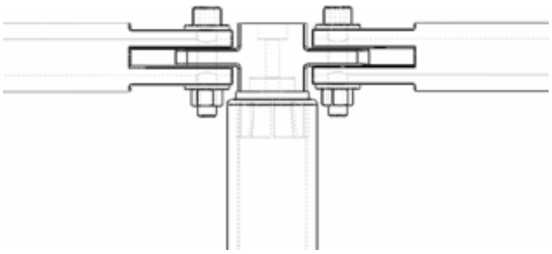




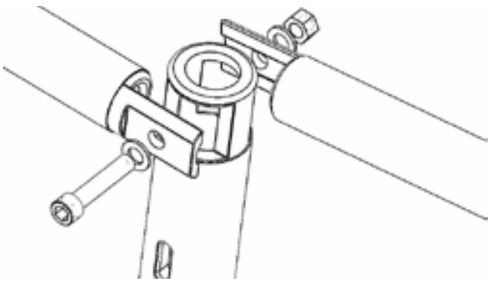
630A/1250A Dropper-630A/1250A Busbar (Copper)



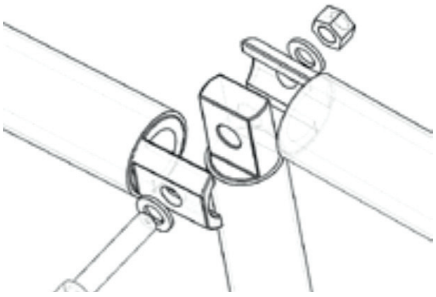
Busbar Assembly 2500A/3150A(FC) (Copper)



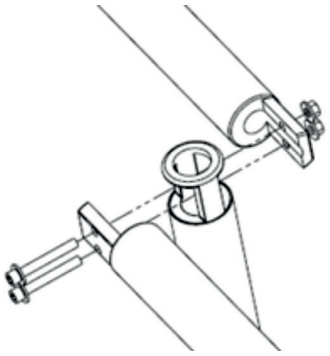
2000A Dropper-2500A Busbar (Copper)



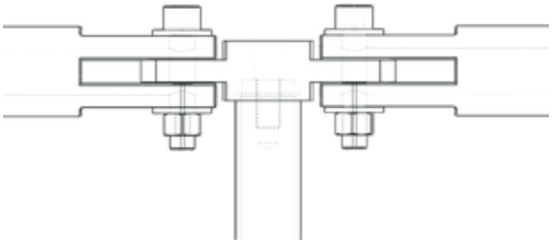
2000A Dropper-2000A Busbar(Aluminum)



1250A Dropper-1250A Busbar(Aluminum)



Busbar Assembly 2500A/3150A(FC) (Aluminum)



1250A Dropper-2500A Busbar(Copper)

Busbar Tee-boot or Shroud

Busbar shrouds are provided for all main busbar-dropper connections. Check the correct size for tee boots and mount them on the main busbar before assembling main busbar with the dropper. After assembly of busbars and checking for tightness and cleanliness, gently slide the two half sections of Tee-boots towards each other; to close. The coupled Tee-boot sections shall then be secured with a plastic strap around the dropper end.

For switchgears located at ends of switchboard, the busbar endings are to be insulated with end boots and shall then be secured with a plastic strap around the dropper end.

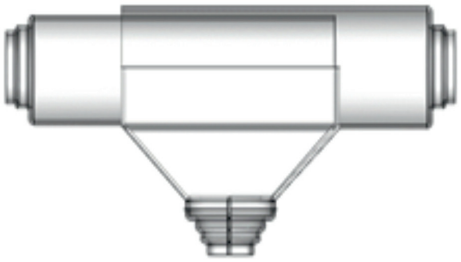


Figure 41 - Tee boot of transparent Polycarbonate

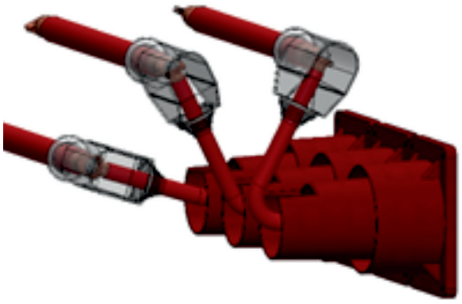


Figure 42 - Tee boot on main busbar right extremity

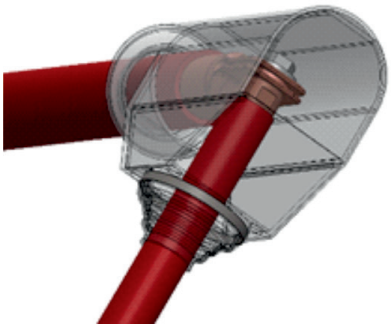


Figure 43 - Fasten with plastic strap after final assembly

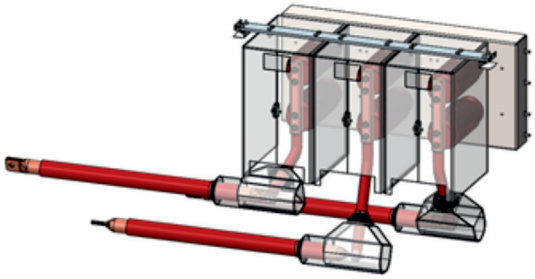


Figure 44 - Auxiliary busbars of Riser Busbar sectionalizing arrangement

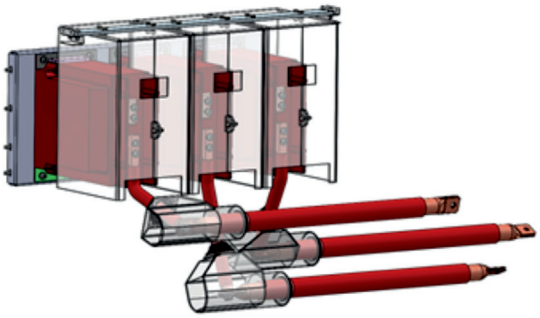


Figure 45 - Auxiliary busbars of Coupler

Note: The assembly of busbars is carried out with “stabilized connections”; meaning that quality of busbar joints does not significantly change over period of operating time and therefore it is not necessary to inspect tightness of busbar connections at frequent intervals, but upon the condition that correct assembly is carried out as described in preceding paragraphs and with paying due attention to the following:

- The overlapping surfaces are cleaned thoroughly with a brass wire brush to remove oxidized surface (skin).
- Wiped clean with metal free non-woven cloth.
- Greased evenly with a thin coat of SETRAL EK 339 or equivalent.
- Prescribed torque is applied during tightening of the joint using a calibrated torque wrench.

CAUTION!

Use proper personal protective equipment like hand gloves, helmets and etc., while handling switchgears.

UniGear ZS2 switchgears have a copper bar for the earth system. The main earth bar is of standard length and is located at the bottom of switchgear. While coupling UniGear ZS2 switchgears during erection, the earth bar shall also be connected with the earth bus of the adjoining switchgear using the copper link provided at the same location. Conical washers to ABB standard 9ADA334 are recommended to be used throughout the earth bar connections. The earthing busbar now connected and running through all switchgear shall be connected to the station's earth system. Copper bars used for earthing Aluminium Zinc coated steel plate must be greased (type E) to avoid galvanic corrosion.

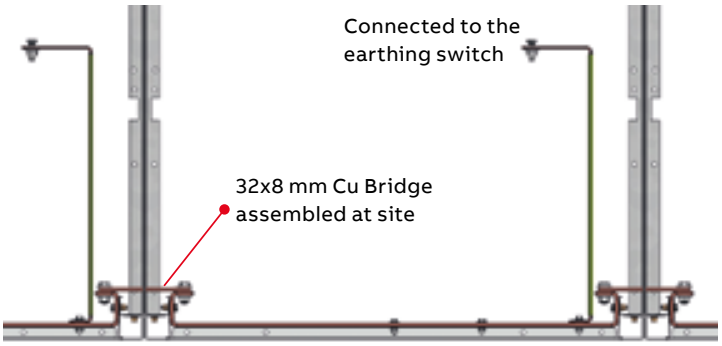


Figure 46 - Main earthing busbar assembly

6.2 Cable connection

6.2.1 Power cables

The standard method for terminating power cables in UniGear ZS2 switchgear is shown in Fig.47. Power cables are conveyed below through floor covering gland plate, which can be adapted to the required cable diameter. Cables can be securely fastened to the cable holding bracket in the switchgear by means of using clamps.

Cable termination kits are mounted on cable cores according to manufacturer's instructions considering cable termination height, and it also recommended to maintain uniform lengths of cable ends, including cable termination kits. Cable connection terminals from current transformers have different versions like: for different number of parallel cables, for different rated currents, and short circuit currents.

Current transformers connections are equipped with the holes for M12 bolts. The earthing of cable armour is carried out by connecting it to the cable holding bracket connected to earth potential.

The cable compartment can also be made to accommodate withdrawable type potential transformers fitted with HRC fuses or mounting of surge arresters. In these cases, the number of parallel cables that can be accommodated in cable compartment gets reduced.

Note: Cable glands or clamps and grommet are not considered in the scope of ABB.

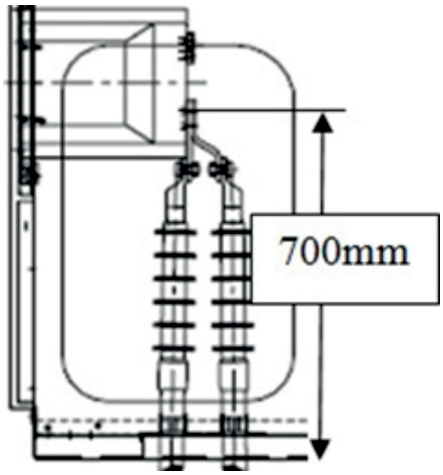


Figure 47 - Cable connection

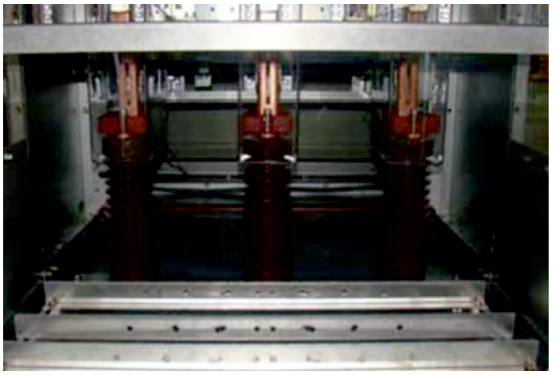


Figure 48 - Cable holding bracket

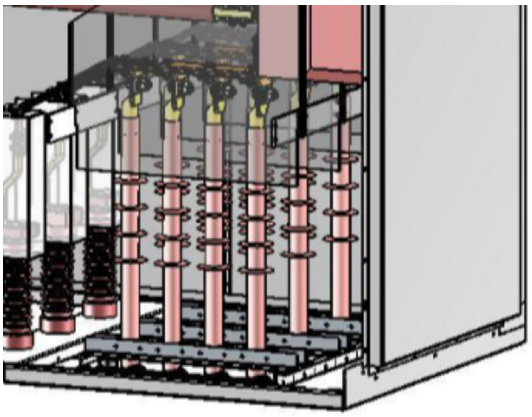


Figure 49 - Multiple cable arrangement

Mounting procedures for power cables

- Power cables must be inserted, cut to length and stripped.
- Reducer ring must be adapted to the cable diameter and fitted on to the cable.
- Cable sealing ends must be prepared and mounted on cable cores according to manufacturer's instructions.
- Cable lugs must be connected to the prepared bottom jumpers.
- Earthing of cables must be connected.
- Individual parts of the floor covering must be mounted.
- Cable gland must be moved down so that nuts in the rings fit into corresponding recesses in floor coverings. In this way the cable passages are sealed.
- Cable must be fastened in the prepared cable clamps.

Cable compartment can be accessed by removal of the rear cover. In such circumstances, cables earthing shall be performed before accessing the cable compartment.

6.2.2 Control cables

The control cables are terminated in low voltage compartment. When they enter from a trench they can be raised inside the switchgear near the front door. Control cables between switchgears can be run through provision at bottom portion of the low voltage compartment, to any intended switchgear.



Figure 50



Figure 51



Figure 53



Figure 52



Figure 54 - Sample switchboard

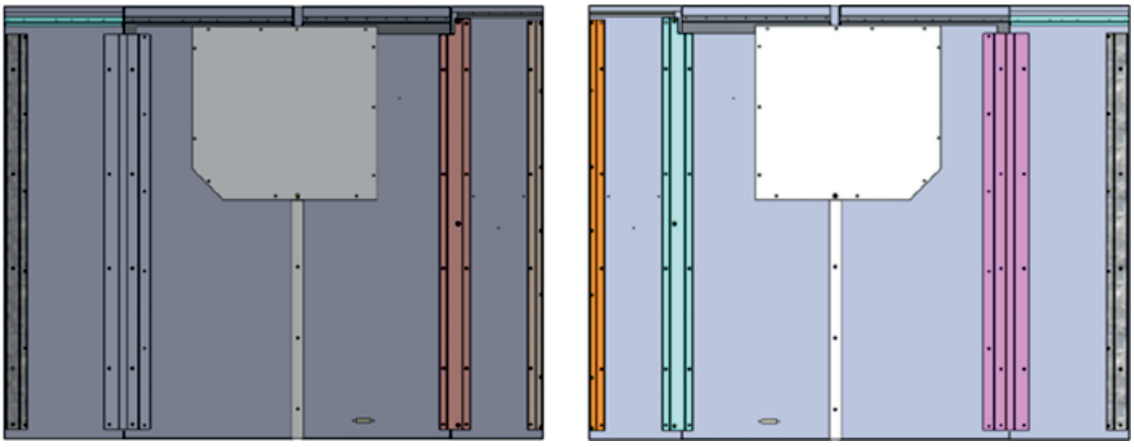


Figure 55 - End covers

6.3 End covers

End covers are provided to be assembled on the switchgear at extreme lateral ends of switchboard

6.4 Laying the inter-switchgear wires

Inter-panel wires are rolled as a bundle and placed inside the low voltage compartment. They are marked and fitted with ferrules at both ends. Provisions are made in sidewalls of the low voltage compartment for looping between switchgears.

5.14 Assembly photos



Left side end cover assembly



Right side end cover assembly

—

Figure 56 - End cover assembly



—

Figure 57 - Complete cubicle assembly



—

Figure 58 - Cubicle rear cover assembly

7. UniGear ZS2 Digital

The digital solution takes full advantage of wellproven components: current and voltage sensors, protection and control relays with IEC 61850 digital communication to ensure a reliable and efficient electrical network.

UniGear ZS2 Digital benefits

Safe and reliable

- Increased equipment reliability and safety in your substation
- Extended communication supervision functionality

Intelligent and ready for the future

- Implement changes easily as requirements change
- Flexibility towards varying load flows
- Late customizations and changes possible

Simple and efficient

- Minimized lifetime costs
- Saves space in your switchgear room by reducing switchgear footprint
- 30 % quicker delivery time from order to switchgear operation

* compared to a conventional UniGear ZS2
** compared to typical substation with 14 switchgear panels of UniGear ZS2

Lower environmental impact

- Lowers energy consumption up to 250 MWh** which represents saving of 13 000 EUR
- Saves up 150 tons of CO2**, that is equal to emissions produced by mid-size European car driven for 1 250 000 km

Global solution

- Available for projects according to IEC standards

UniGear ZS2 Digital

represents an advanced switchgear solution as it meets important requirements of the future:

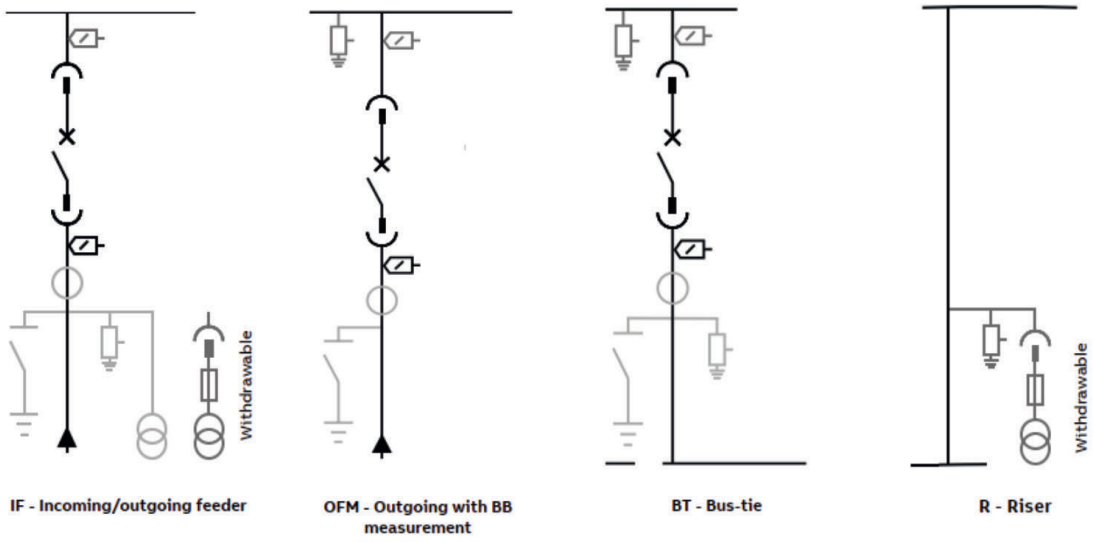
- Unprecedented flexibility
- ncreased process efficiency
- Lower cost of operation
- Maximized integration
- Reliability and safety

With UniGear Digital you avoid many of the practical challenges you face in today's complex applications, you simply have less to worry about in your electrical network.

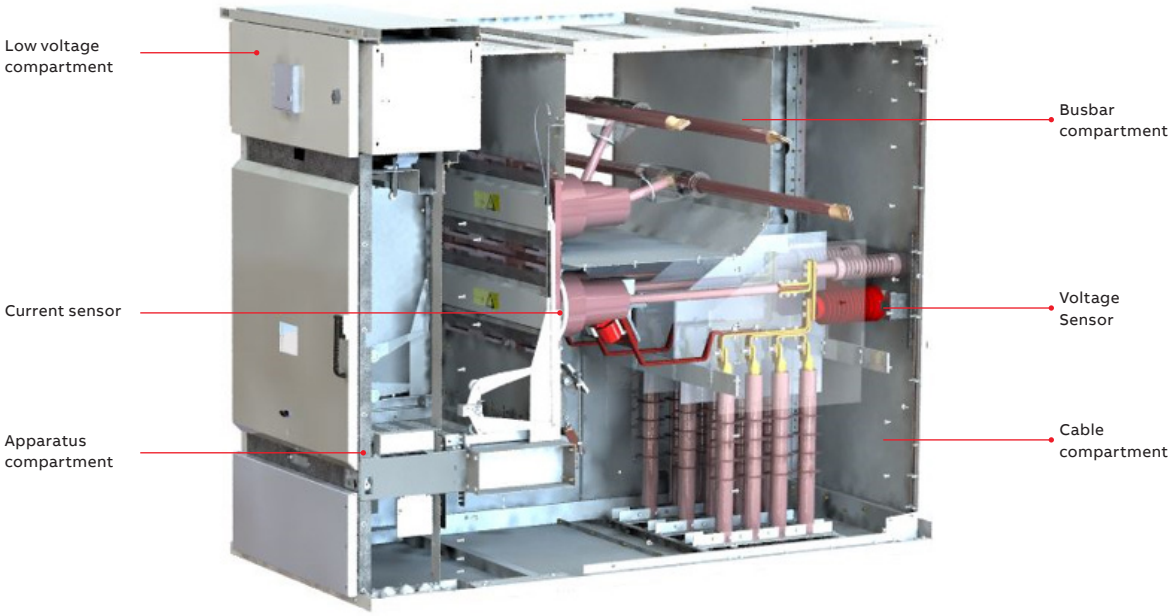
Specification

- Rated voltage up to 36 kV
- Rated feeder current from 1 250 A up to 2500 A
- Busbars up to 2500 A
- 31.5 kA 3 sec short-circuit current
- IAC classification: AFLR (31.5 kA / 1 s)
- LSC2B-PM





—
Single line diagram of typical units



8. Operation of Swtchgear

NOTE



Note on safety at work

The work and operating procedures must be carried out carefully by trained specialists familiar with the operation of UniGear ZS2 switchgear, taking into account all required safety regulations according to the IEC and other relevant professional bodies, as well as any local and work regulations and instructions. It is recommended to take proper training from ABB for operation of UniGear ZS2 switchgear.

8.1 Commissioning

While preparation for commissioning, the following work must be carried out prior to connection with the high voltage power supply:

- Check the general condition of the switchgear for any damage or defects.
- Inspect visually major items like switching devices, withdrawable parts, isolating contacts and insulating parts for any damage.
- Check connection of the main earthing bar to the system earthing conductor (follow the appropriate safety regulations)
- Check the painted surface for any damage, if so, do necessary touch up as described in section 7.4.
- Remove all residues of materials, foreign bodies and tools from the switchgear.
- Clean the switchgear and insulating parts with a soft, dry, clean and non-fraying cloth. Remove any greasy or sticky dirt.
- Correctly remount all covers removed during assembly and testing procedures.
- Ensure that all shorting wires/links used while testing are removed.
- Remove transport caps fitted on vacuum circuit breaker.
- Remove lifting eyebolts from vacuum circuit breaker.
- Perform AC voltage testing on main circuits according to IEC 62271-1. Pay due attention to potential transformers, cables, etc., during this procedure. Switch the auxiliary voltage ON.
- Ensure PTs are isolated and CT secondary is shorted while conducting high voltage test.
- Carry out testing operations on switching devices manually or by electrical control, and verify proper functioning of relative position indicators.
- Check mechanical and electrical interlocks for their proper functioning.
- Ensure all unwanted openings are properly closed to avoid entry of dust, foreign body, moisture, etc.

Set protective devices in the switchgear for the required values and check their functioning with test equipment.

8.2 Preparatory work

- Instruct local operators on basic details of regular handling of the switchgear.
- Check readiness for operation and switching status of both upstream and downstream electrical systems for the switchgear.

It may also be necessary to check the following equipment in areas adjacent to the switchgear depending on scope of work:

- power cables
- auxiliary cables
- auxiliary power source
- remote control system
- complete earthing system
- switchgear room equipment
- switchgear room conditions

8.2.1 Start-up

- Comply with all relevant safety regulations
- Ensure that circuit breakers in the system are in OFF condition
- Remove any existing earthing and short circuiting connections in the critical switching area
- Energize the feeder cables
- Connect the switchgear one after another observing signal and indicators
- Check that relative conductors are in phase, where necessary, when there are several incoming feeder cables and switchgear sections
- Carry out all measurements and check all functions which depend on the high voltage power supply being connected
- Watch for irregularities of any kind

8.3 Switching operation

Carry out switching operations only with the front doors closed.

8.3.1 Withdrawable apparatus

Manual insertion from the Test/Disconnected position to the Service position:

- Connect control wiring plug (Fig.79)
- Close the front door
- Ensure that the apparatus is in OFF condition (in case of VCB)
- Fit hand crank on square spigot of spindle mechanism inside the racking hole by turning the knob provided on the door. (Fig.77)
- Turn the crank clockwise (30 turns) until the breaker or withdrawable truck reaches the Service position and stops
- Observe the position indicator on low voltage compartment
- Remove hand crank

Manual withdrawal from the service position into the test/ disconnected position:

- Ensure that the circuit breaker is in OFF condition
- Fit hand crank on square spigot of spindle mechanism inside the racking hole by turning the knob provided on the door.
- Turn the crank anti-clockwise (30 turns) until the breaker or withdrawable truck reaches the test position and stops.
- Observe the position indicator on low voltage compartment
- Remove hand crank

Note:
The withdrawable part shall not be stopped at any intermediate position in the travel range between Service and Test or Disconnected position!

IMPORTANT NOTE



Insertion and withdrawable of circuit breaker (and other withdrawable parts) must be gentle and gradual; in order to avoid shock or overpressure which could deform the mechanical interlock

If operations are prevented, do not force the interlocks. Check whether the operating sequence is correct.

The force normally applicable to the insertion/ withdrawing lever is 260 N. In any case, the maximum applicable force shall never exceed 400N. Please also refer the installation and operations manual of circuit breaker.

CAUTION



The insertion and withdrawal must always be carried out with the circuit breaker in open condition!

Withdrawal from the Test/Disconnected position to outside the switchgear:

- Open the door of the circuit breaker compartment
- Release secondary wiring plug (Fig.79) and hold it in the storage position on withdrawable part.
- In case of floor rolling circuit breaker, open both ramps and keep them in open position, so that the breaker can come out through the ramp to the floor. For cassette type switchgear, kindly use CB trolley.
- Move sliding handles inwards against springs to release withdrawable part. Draw the withdrawable part out of the switchgear onto the floor.
- Secure the position of shutters with padlock

8.3.2 VD4 type circuit breaker

Charging the stored energy spring system:

- On the circuit breaker with charging motors, charging is carried out automatically. If the charging motor fails; the charging procedure can be carried out or completed manually in test position
- The circuit breakers supplied with spring charging motor for automatic charging have provision for manual charging
- In circuit breakers with only manual charging systems or in the event of failure of spring charging motor, open the door with circuit breaker in Disconnected position. Pull the integrated charging handle and stroke it for approximately 11 times until the charged condition is indicated. (Refer Fig. 76).
- When the charged condition is reached, the charging mechanism is automatically disengaged any further strokes of the lever have no effect. See the Fig. 76. Pumping is effective if the lever is stroked till the angle of 90°

Opening and closing the circuit breaker:

- Opening and closing operations with the withdrawable part in the Service position should be performed only with the door closed
- Operate the local or remote electrical control
- Observe the circuit breaker indication for ON/OFF

An additional mechanical switching device for manual operation of the circuit breaker in the Service position is also installed (see Fig. 26, 27). If the withdrawable part is in the Service position, operation is carried out using the knob which swings a push rod extension out. (see Fig. 26, 27).

8.3.3 Earthing switch - type EK6

The earthing switch EK6 has a snap closing mechanism which is independent of the rotation of the drive shaft. An earthing switch allocated to a circuit breaker is enabled for switching only when withdrawable part is in the Test/ Disconnected position or removed from the switchgear. Turn earthing switches ON only when the doors are closed.

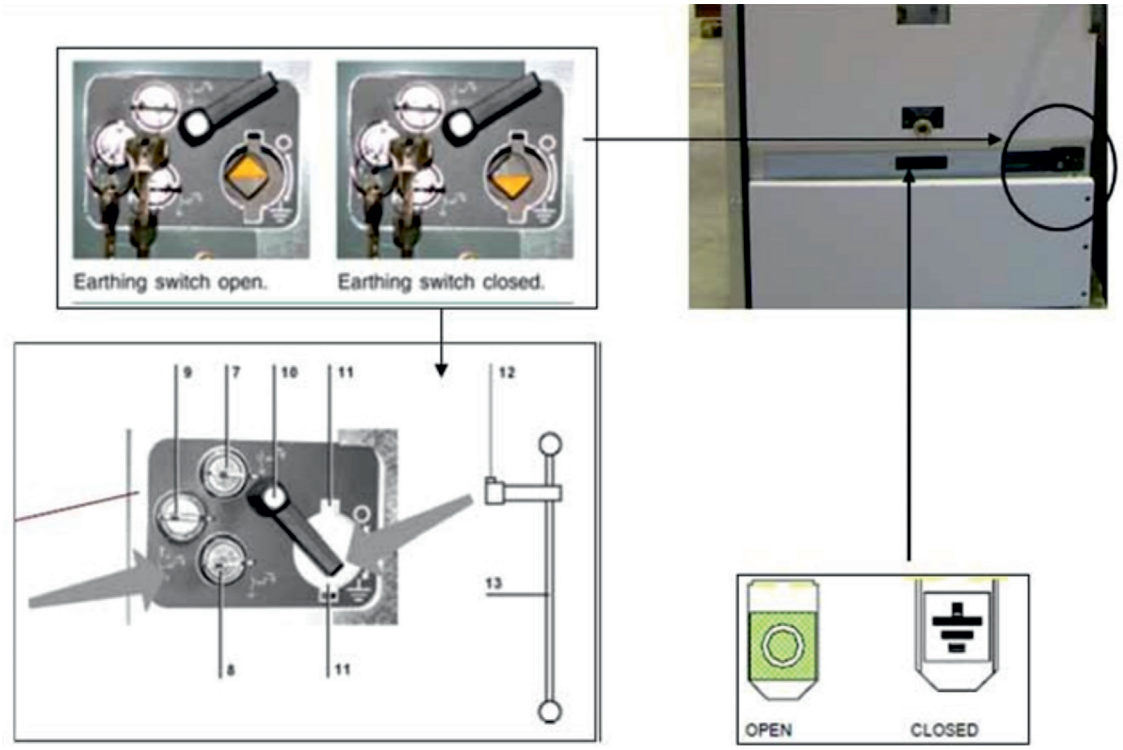


Figure 59 - Earth switch with key-lock arrangement

Left-top: Earth switch Maneuver position indicator as should be seen on front
Right - bottom: Earth switch position indicator as should be seen from lower window
7 Key lock*for Earth switch at open position
8 Key lock* for Earth switch at closed (earthed) position
9 Key lock* to prevent CB racking-in
10+11 Handle-cover to open entrance for operating lever
12+13 Earth switch operating lever (Art.No: 143429-802)

*Key-locks are optional. Lock by rotating the key 180º clockwise.
It is possible to remove the key only at locked position.



Figure 60 - Earth switch in open position

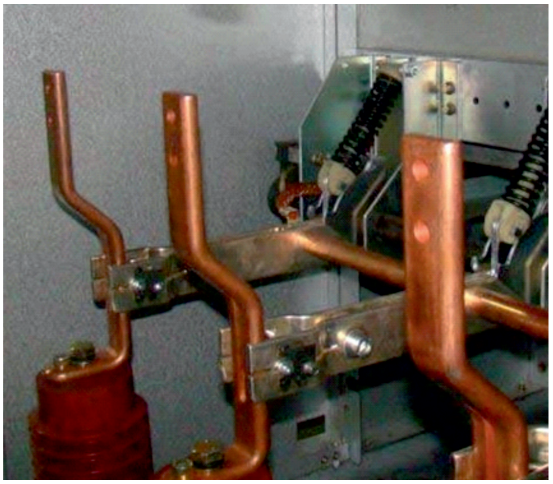


Figure 61 - Earth Switch in Closed position

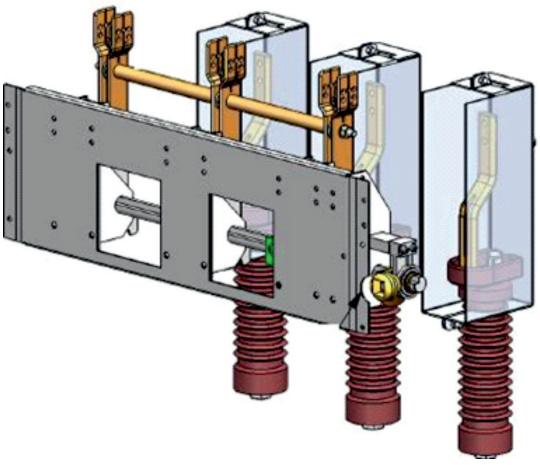


Figure 62 - Earth switch link mounted on insulator

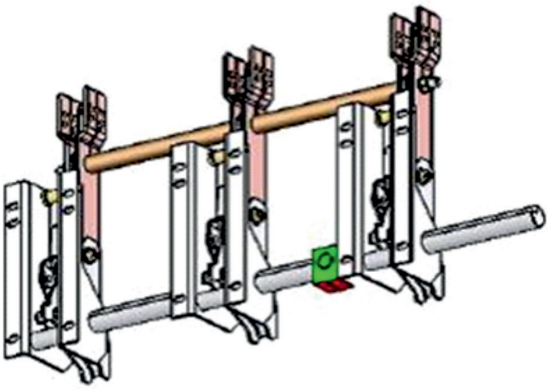


Figure 63 - Earth switch-EK6 type

Closing the earthing switch:
Ensure that the circuit breaker is in test or withdrawn position. Open the lever entrance by turning 90º the handle anti- clockwise. This will not be possible if:

- the CB is in service position
- key locked for Earth switch at open position. Do not force. Insert operating lever. Assure that the circuit to be earthed has no voltage. Turn the lever clockwise 180º to close the earthing switch.

This will not be possible if:

- electrical interlocking of ES position is on. Do not force. Remove the operating lever, the lever entrance is open. See the closed (Earthed) position of Earth switch on indicator from the lower inspection window. Key-lock if necessary the Earth switch in closed position.

CAUTION!

Earthing switch must not be attempted for operation when it is possible that personnel may be in the cubicle. If the operation is prevented, do not force the interlock and check that the operation sequence is correct.



Figure 64 - Front view with operating handle inserted

Opening the earthing switch
Ensure that the circuit breaker is in test or withdrawn position. The crank entrance is open.

Insert the operating lever. This is not possible if the Earth switch is key locked at closed position.

Turn the lever anti-clockwise 180º to open the earthing switch. This is not possible if electrical interlocking coil is on. Do not force.

Withdraw the operating lever.
Close the crank entrance by turning handle 90º clockwise.
(Note: The crank entrance must be closed before the circuit breaker can be racked into service position)

See the open (O) position indicator from the lower inspection window.

Key-lock if necessary the Earth switch in open position Key-lock if necessary the CB against racking into service position

8.3.4 Withdrawable measuring parts
Handling of the withdrawable measurement truck (without the switching operations and interlocking functions) in the metering switchgear is as described in section 3.2.3.2.

Withdrawable measurement trucks in incoming and outgoing feeder switchgears are put into the cable compartment using ramps. They would reach their service position immediately on putting the trucks into the switchgear.
The potential transformer is of shrouded type with HRC fuses.

Withdrawable measurement trucks in bus riser and metering switchgears are racked in /out behind closed door, similar to the circuit breaker being racked in/out in feeder and coupler switchgears.



Figure 65 - Position indicator and auxiliary contacts



Figure 66 - Electromagnetic interlock for earthing switch



Figure 67 - VT in SERVICE (connected) position



Figure 68 - VT in TEST (disconnected) position

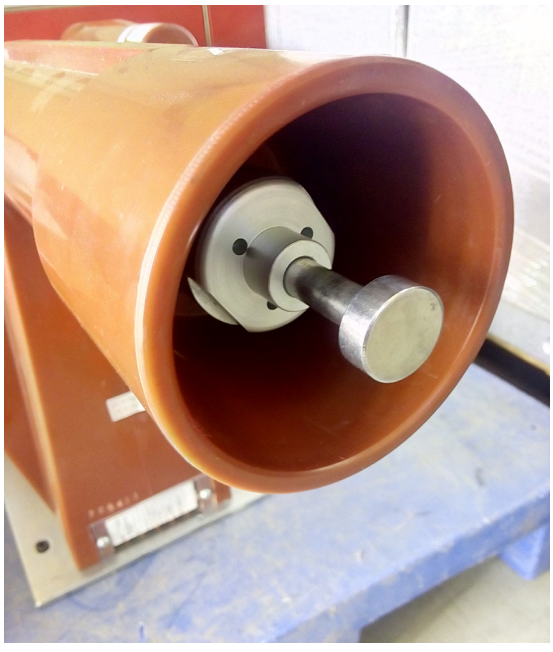


Figure 69 - VT withdrawn (removed) position view of Contact

Fixed voltage transformer in cable compartment

CAUTION!

Before accessing potential transformers in cable compartment the circuit shall be earthed.

The cables compartment with bolted cover shall be opened only by authorized maintenance personnel. For replacement of primary fuses, please refer the electrical data and article number



Figure 70 - VT in Cable



Figure 71 - VT connection (disconnected) position

8.4 Service trucks

It is possible to use service trucks for earthing the cable and busbar side circuits.



Figure 72 - Earthing Truck without making capacity



Figure 73 - Earthing truck with making capacity

8.4.1 Earthing truck without making capacity

These trucks carry out the same function as the earthing switches without 'making capacity'. Therefore they do not have the capacity to earth the live circuits. They are used to ensure fixed additional earthing, as required by the plant service and maintenance procedures, as at further guarantee for personnel. The use of these trucks foresees removal of the circuit breaker from the switchgear, and its replacement with the truck. The earthing trucks are fitted with an interlock which, when activated, prevents their rack-in during the presence of live voltage on the busbar or cable section

These trucks are available as two versions:

- Main busbar system earthing
- Power cable earthing

During the rack-in process, the main busbar earthing truck operates only the top shutter and earths the busbar contacts with switchgear earthing. Whereas, the power cable earthing truck, during the rack-in process operates only the bottom shutter and earths the power cable contacts with switchgear earthing. These trucks can also be used in the bus tie units. Wherein, both sides of the busbar system can be earthed by using both the types of trucks one after another.

CAUTION!

Do not put this earthing truck to a live circuit. Always ensure the circuit is in OFF condition before putting earthing truck. Ensure auxiliary supply is ON before putting earthing truck in to test condition. Ensure that the VDI/PT shall be in good condition before inserting the earthing truck into switchgear.

1. The earthing truck with pre-sensing contacts is inserted into the switchgear till it reaches its test position.
2. For ensuring safety, the door is closed before racking earthing truck into service position.
3. The truck is then racked-in from test to service position.
4. If the pre-sensing contact which is connected to PT or VDI senses a voltage at cable/bus side when it get engaged with switchgear contact pin, it will give an audible alarm as an indication that the primary side is live. Under such circumstances one should withdraw the truck back to test position and investigate the reason for the system being alive.
5. If no audible alarm is given by earthing truck, continue the movement of the truck till it fully reaches service position. Then rack-out the earthing truck to test position. As safety is now ensured, open the door, and rack-in the earthing truck again to its service condition. Now use the same racking handle rack-in the secondary contacts to their service position to ensure complete earthing.

8.4.1.1 Testing the off-circuit condition

In switchgears which are not equipped with capacitive voltage indication checking the off-circuit condition is carried out with a HV tester on the contact pin, the corresponding upper shutter or lower shutter opened, if the switchgears are equipped with capacitive voltage indication. Checking the off-circuit condition can be carried out by means of this device. In this case, proceed according to the manufacturer's instructions for the indicators. In case of any doubt about correct operation of capacitive voltage indication, the off-circuit condition must be checked using a HV tester.

CAUTION!



Checking the off-circuit condition must always be carried out in compliance with the relevant safety regulations and local operating conditions

8.4.2 Earthing truck with making capacity

Earthing trucks with making capacity carry out the same functions as the earthing switches with 'making capacity', and have the capacity to earth live circuits.

These trucks consist of circuit breakers fitted either with top terminals (for main busbar earthing) or with bottom terminals (for power cable earthing)

The set of contacts without terminals are short-circuited by means of a copper bar and connected to earth through the apparatus truck.

Earthing trucks with making capacity, in general, retain the important characteristics of circuit breakers such as full making capacity, and breaking the live circuits under fault conditions - ensuring extremely effective earthing even on circuits stressed under fault.

They have spring actuator, which enables us to carry out opening and closing operations, rapidly, also through remote electric control means.
The use of these trucks foresees removal of the circuit breaker from the switchgear, and its replacement with the truck.

These trucks are available in two versions:

- Main busbar earthing
- Power cable earthing

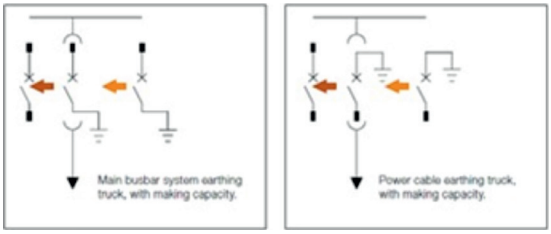
During the rack-in process, the main busbar earthing truck operates only the top shutter and earths the busbar contacts with switchgear earthing.

Whereas, the power cable earthing truck, during the rack- in process operates only the bottom shutter and earths the power cable contacts with switchgear earthing. These trucks can also be used in the bus tie units. Wherein, both sides of the busbar system can be earthed by using both the types of trucks one after another.

8.4.2.1 Operation of Earthing Trucks with making capacity

1. Ensure that the incoming supply of the busbars is turned OFF; by racking-out the incoming feeder's circuit breaker and outgoing feeder's circuit breaker, which are feeding the busbars and /or cables identified for earthing, as appropriate.
2. Remove circuit breaker from the switchgear identified for busbar and/or cable earthing, and replace the circuit breaker with earthing truck and move it till Test position.
3. Lock the front door of the circuit breaker compartment.

4. Rack-in the earthing truck from Test to Service position. Note: The earthing truck can be moved from the test to service position in switchgear only when the above said conditions (1) & (3) are satisfied, due to safety interlocks.
5. Once the earthing truck is in Service position, CLOSE the switching device of the earthing truck to earth the busbar side or cable side, as appropriate.



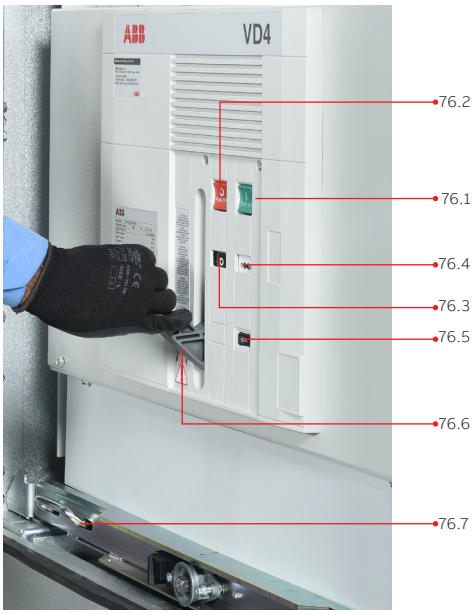
Note: Electrical schemes will have all kinds of necessary interlocks, hence please refer the order related documents too.



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Figure 74 - Metering door knob



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Figure 75 - Handle for operating Earth switch



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Figure 76 - Manual operation of withdrawable Part (VD4 breaker)

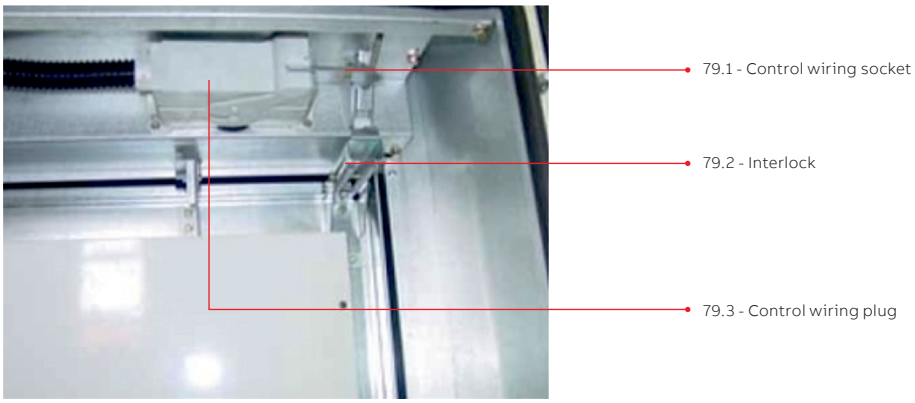
76.1 Mechanical ON Push button
76.2 Mechanical OFF Push Button
76.3 Mechanical Switch Position indicator
76.4 Charging condition indicator
76.5 Mechanical operating cycle counter
76.6 Charging lever
76.7 Sliding Handle, connected with the catch on the withdrawable assembly.



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Figure 77 - Racking operation

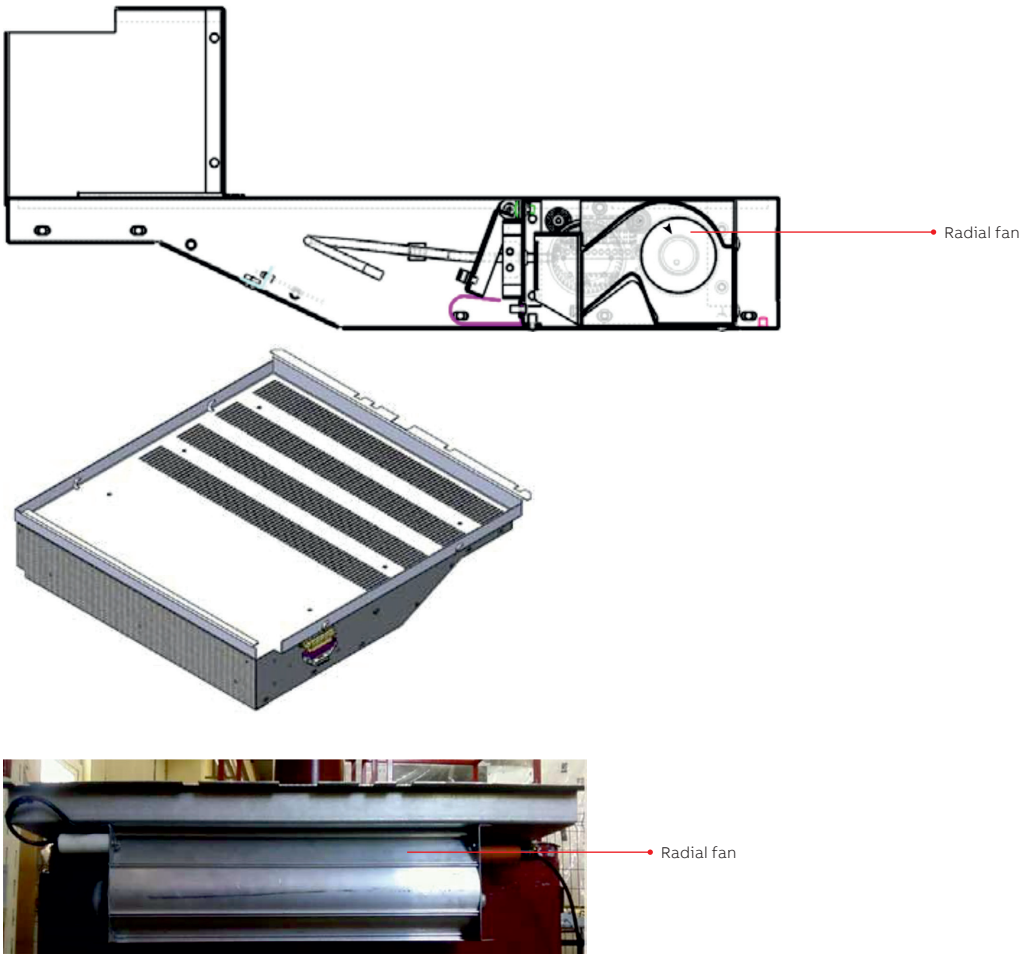


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Figure 78 - Operating handle
Handle (for moving the withdraw able part inside the switchgear)



—
Figure 79 - Control wiring socket

Fig number 80 below represents arrangement involved in Forced cooling fan placement in CB compartment.



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Figure 81 - Forced cooling arrangement

9. Maintenance

9.1 Maintenance strategies

Preventive maintenance is is maintenance carried out at predetermined intervals or according to prescribed criteria, aimed at reducing the failure risk or performance degradation of the equipment. This method is based on scheduled activities performed on the out-of-service equipment including: visual checks, apparatus cleaning, mechanical components lubrication, worn parts replacement and routine tests.

Risk-based maintenance is maintenance carried out by integrating analysis, measurement and periodic test activities with standard preventive maintenance. The gathered information is viewed in the context of the environmental, operation and process condition of the equipment in the system. The aim is to perform the asset condition and risk assessment and define the appropriate maintenance tasks. Please refer to next chapters for details of preventive and risk-based maintenance programs.

WARNING - Always follow 7 safety steps:



- Clearly identify the work location
- Disconnect and secure against reconnection
- Protect against any other live parts
- Take special precautions when close to bare conductors
- Check the installation is dead
- Carry out earthing and short circuiting
- Issue a permit to work

9.2 Preventive maintenance

Maintenance serves to preserve trouble-free operation and achieve the longest possible working life of the switchgear. It comprises of following closely related activities:

Inspection: Determination of the actual condition
Servicing: Measures to preserve the specified condition

Repair: Measures to restore the specified condition

Note:
When carrying out all maintenance work, the regulations in the country of installation must be strictly complied with. Maintenance work may be performed in a careful manner only by trained personnel familiar with the characteristics of the individual switchgear, in accordance with all relevant IEC safety regulations and those of other technical authorities, and with other overriding instructions. It is recommended that ABB service personnel be called in to perform the servicing and repair work detailed below. The inspection and servicing intervals for some of the equipment/components (e.g. parts subjects to wear) are determined by fixed criteria such as switching frequency, length of service and number of short- circuit operations. On the other hand, for other parts, the length of the intervals may depend, for example, on the different modes of operation in individual cases, the degree of loading, and also environmental influences (including pollution and aggressive air).

Operating instructions of circuit breaker must also be followed together with this installation, operation and maintenance manual.

If necessary, further details can be taken from the technical documentation for the switchgear Installation (including, for example, any special operating conditions agreed upon).

9.2.1 Intervals for inspection, servicing and repairs:

Time intervals for maintenance work to be carried out always depend on the operating conditions of switchgear and mainly on the mode of operation, the number of rated and short- circuit current switching operations, ambient temperature, pollution etc. We recommend carrying out the maintenance work at the following intervals

Activity performed	According to section	Time interval in years	According to number of switching operations
Inspection	9.3	1[1)]	As required[3)]
Servicing	9.4	2[2)]	As required[3)]
Repair	9.5	As required	As required

1) Under more demanding service conditions, we recommend shortening this interval as appropriate - also refer sect. 8.1 and 8.2
2) According to results of inspection.
3) Refer installation, operation and maintenance manual of circuit breaker

9.3 Inspection

- Wherever necessary, the working area must be isolated and secured against reconnection in accordance with the Safety Regulations specified by IEC and appropriate national standards before inspection.
- Correct condition of the switchgear should be monitored by regular inspections.
- Under normal operating conditions, inspection should be carried out every year by specially trained professional electricians / engineers.
- Under abnormal operating conditions (including adverse climatic conditions) and/or special environmental stresses (heavy pollution and aggressive atmosphere among others), inspection may be necessary at shorter intervals.
- Inspection is primarily to carry out a visual check for grime, corrosion and moisture for:
  - Effects of high temperature on main circuits
  - Traces of partial discharge on insulating material parts
  - Traces of leakage current on the insulating material parts
  - Effects on surfaces of the contact systems

However, inspection must also include verifying the correct mechanical and electrical operation of parts like switching devices, actuating, interlocking, protection and signaling devices.

- For switching devices, their separate installation, operation and maintenance manual should be referred.
- Check all switchgear accessories and auxiliary devices (e.g. storage batteries).
- No discharge must occur on the surfaces of equipment at operating voltage. This can, for example, be detected by characteristic noises, a clearly perceptible smell of ozone, or visible glowing in the dark

It is recommended to check whether isolating contacts fixed are fully intact and do not show any sign if damage. The contact points should be cleaned if signs of overheating (discolored surface) are visible. If any irrelevant repair measures should be taken.

9.4 Servicing

The need for cleaning measures during the course of an inspection in accordance with section 8.3, has been established as follows:

- Wherever necessary, the working area must be switched off and secured against reconnection in accordance with the Safety Regulations specified by IEC and appropriate national standards before cleaning
- Clean the surfaces in general. For weakly adhering dry dust deposits, use a softy dry cloth. For more strongly adherent grime, use a mild alkaline household cleanser or with ETHANOL F 25M
- Clean insulating surfaces and conductive components with ETHANOL F 25 M
- Wipe after cleaning using clean water and dry properly
- Should partial discharges occur as a result of condensation, application of a thin silicone film on the surface concerned is often effective as a temporary remedy. It is advisable to ask our after-sales service department for advice regarding permanent solutions to this type of unusual problem.

9.4.1 Maintenance of Busbar compartment

Checking of the tightening main busbars By gaining access

- From the top of the panel, dismount the roof plate
- From the rear side of panel: Remove the rear cover and rear wall of busbar compartment
- When the main busbars are visible, use a dynamometric spanner, check tightness of all the screws. Refer to the (Section 6) for the tightening values

9.4.2 Maintenance in cable compartment

Checking tightening of the cable busbar connections

- Open the cable compartment rear cover; the cable busbar connections are visible.
- Using a dynamometric spanner, check tightness of all the screws. Refer to the (Section 6) for the tightening values.
- Lower bar joints conductivity test

WARNING



The cable compartment door cannot be opened if the earthing switch is open

Earthing switches – type EK6; ST-E

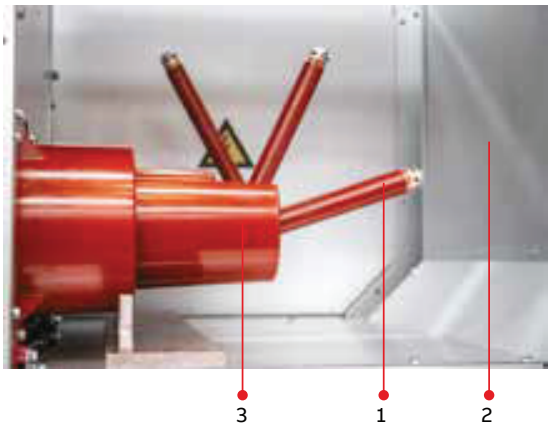
Cleaning the kinematics to prevent faults on the signalling contacts

- Carry out a visual inspection of the kinematics and check for any presence of dirt, humidity and signs of corrosion on the moving parts.
- Remove any deposits of dust using a dry cloth that does not leave any deposits on the treated surface (do not use woolen cloths).
- If necessary, grease the mechanical moving parts by applying a thin layer of mechanical grease for moving parts.

Instrument transformers

Cleaning and checking of the current transformers.

- Open the cable compartment rear cover; Instrument transformers are visible.



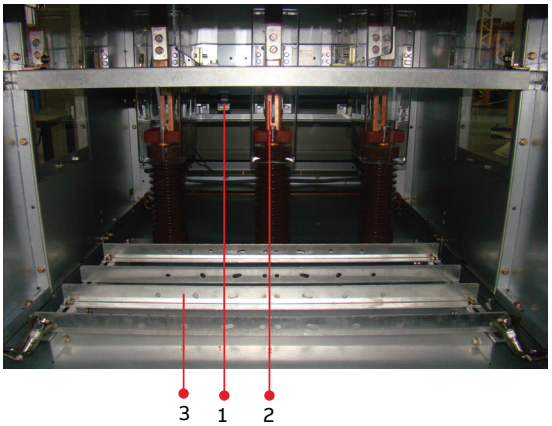
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Figure 82- View of the busbar compartment, shown without insulating covers.
1. Dropper
2. Rear cover of busbar compartment, removable
3. Bushings

- Visually check the connections of the current transformers.
- Using a dynamometric spanner, check the tightness of all the screws. Refer to the section 6 for the tightening values.

Cleaning and checking of the voltage transformers

Fixed version voltage transformers:

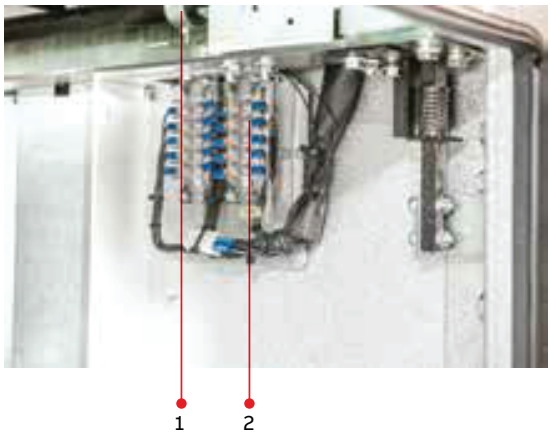
- Open the cable compartment rear cover
- Visually check the voltage transformer connections.
- Using a dynamometric spanner, check the tightness of all the screws. Refer to the section 6 for the tightening values.
- Carry out a visual inspection of the transformers and check for any presence of dirt.
- Remove any deposits of dust using a dry cloth that does not leave any deposits on the treated surfaces (do not use woolen cloths).



—
Figure 83-: Internal view of the cable connection compartment
1. Earthing switch position indicator
2. Cable connection bar
3. Cable clamp

Bus side Voltage transformer in removable version:

- Open the Circuit Breaker compartment lower rear cover.
- Manually withdraw the VT truck by using VT extraction truck
- Carry out a visual inspection of the transformers and check for any presence of dirt.
- Remove any deposits of dust using a dry cloth that does not leave any deposits on the treated surfaces (do not use woolen cloths).



—
Figure 84- Manual earthing switch operating mechanism.
1. Drive shaft
2. Auxiliary contact

9.4.3 Maintenance of Circuit-Breaker compartment

Lubrication of the isolating contacts:

- Remove any deposits of dust using a dry cloth that does not leave any deposits on the treated surfaces (do not use woolen cloths).



—
Figure 85 -Bus Side Voltage Transformer in Circuit Breaker compartment

- If necessary, grease the mechanical moving parts by applying a thin layer of mechanical grease for moving parts.

Bus side Voltage transformer in withdrawable version:
- Open the Circuit Breaker compartment door.
- Manually withdraw the VT truck.
- Carry out a visual inspection of the transformers and check for any presence of dirt. Remove any deposits of dust using a dry cloth that does not leave any deposits on the treated surfaces (do not use woollen cloths).

Cleaning and checking of the fuses.
- With the VT truck withdrawn, manually hook up the fuses contained in the resin tube of the voltage transformers.
- Carry out a visual inspection on the fuses and check for any presence of dirt.
- Remove any deposits of dust using a dry cloth that does not leave any deposits on the treated surfaces (do not use woollen cloths).

9.5 Repair

9.5.1 Switchgear in General
- **Repair of surface damage:**
- Carry out repair work immediately after a defect has been discovered.
- Completely remove all rust from damaged areas by mechanical means like wire brush.
- Lightly grind the surrounding paint coat and carefully degrease entire area. Immediately apply an anti-rust primer and, after appropriate hardening time, apply the top coat. Only use suitable and compatible paint products.
- Apply the top coat in standard RAL 7035 colour, or the relevant special colour.
- Carefully remove any white rust on aluminum/ zinc surfaces with a wire brush or cleaning pad like Scotch-Brite, and clean loosely adhering particles with a dry, non-fraying cloth. Treat the cleaned parts with zinc spray or zinc powder paint and, finally treat with aluminum spray for color matching.
- Carefully remove any white rust from passivated operating parts and any rust formed on phosphatized parts with a wire brush or metal-free cleaning pad like Scotch-Brite, and clean with a dry cloth. Then grease evenly (with Isoflex Topas NB 52/ EK339).
- Follow maintenance instructions in the manuals for individual equipment components
- Check that bolted connections in the busbar system and the earth connections are tight, and check the tightness using a torque wrench as per recommended torque values.
- Wherever necessary, grease the sliding parts and bearings in the switchgear.
- Top up grease on contact areas in the contact system when corroded or otherwise as necessary
- When lubrication is inadequate or missing, thoroughly clean the areas effected and grease them again with Isoflex Topas NB 52 / EK339.

9.6 Testing with withdrawable

When functional tests are carried out on the withdrawable parts compliance to conditions listed below shall be checked.

9.6.1 Withdrawable parts

Ensure the smooth operation of spindle nut in circuit breaker compartment by rotating the hand crank in both directions to verify its operation and lubricate the spindle nut appropriately.

9.6.2 Checking with auxiliary switch settings on withdrawable parts

The interlock condition in the test/disconnected and service positions are signaled by limit switches located on the withdrawable assembly and are configured at ABB. These electrical indications are mounted on low voltage compartment door.

1) Settings in test / disconnected position:
- With the CB Door closed, rack-in the withdrawable part from test/disconnected position towards the service position with a few turns of the crank, and slowly rack it out to the test condition. Auxiliary switch in test condition must switch over just before the test position is reached.
- Then slowly rack-in the withdrawable part from the test/ disconnected position towards the service position until auxiliary switch for service changes its state.

2) Settings in service position:
- With the CB door closed, rack-out the withdrawable part from service position towards the test/disconnected position with a few turns of the crank and then slowly rack-in the withdrawable part again to service position. The auxiliary switch at service position must then switch over just before reaching the service position.

9.6.3 Testing Interlock conditions

1) Disconnection or connection of the secondary plug and socket must be possible when withdrawable part (like vacuum circuit breakers, earthing truck, etc.) is in test/ disconnected condition i.e., unless the secondary plug and socket are connected the withdrawable part cannot be racked in.

2) The withdrawable part must be movable from the test/ disconnected position into the service position only when the circuit breaker is in open condition and with door closed. i.e., with the circuit breaker closed, its rack-in towards the service position must be prevented after half a turn of the crank in clockwise direction.

   Use no force! Also see the note in chapter 6.2.1!

3) withdrawable part must be movable from the service position into the test/disconnected position only when the circuit breaker is in open condition and door closed. If these conditions are not met, Its rack-out towards the test position must be prevented after half a turn of the crank in anti-clockwise direction.

   Use no force! Also see the note in chapter 6.2.1!

4) Closing of the circuit breaker must be possible only when the withdrawable part is in the defined test/disconnected position or service position. i.e., circuit breaker cannot be closed when the withdrawable part is in any other position.

5) When the withdrawable part is in the service position and the control voltage has failed, it is possible to open the circuit breaker (manually).

6) Accessing the earthing switch operating lever or operation of the earthing switch is possible only when the withdrawable part is either in test/disconnected position or placed outside the switchgear.

7) The withdrawable part must be movable from the test/ disconnected position in the service position only when the earthing switch is in open condition and with door closed. i.e., the rack-in of withdrawable part towards the service position must be prevented after two turns of the crank in clockwise direction.

   Use no force! Also see the note in chapter 6.2.1!

9.7 Testing Interlock conditions

9.7.1 Auxiliary switch setting on the earthing switch

1. There must be run-on of 0.5mm in the fully operated position before the plunger reaches the stop (for safety reason).

2. Auxiliary limit switch for earthing switch ON must be operated immediately once the dead center position of the toggle spring mechanism reaches in the closing process and the automatic rapid closing process has started.

3. Auxiliary limit switch for earthing switch OFF must
   a) be operated on earthing switches with manual mechanisms during the opening before half of the square shaft has become visible or 1 mm before tab of the slide makes contact with the armature of the de-energized locking magnet.

   b) To be operated on the earthing switch with motor operators immediately after the toggle spring mechanism has passed the dead center position during rotation of OFF position.

Note:
Check the direction of rotation of motor after repair work. Do not allow the motor to run up against a lock if the direction of rotation is incorrect.

88 Spare parts, Auxiliary materials, Lubricants





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Figure 87 - Operating accessories

9.8.1 Spare parts:
The list of spare parts, including moving parts and parts subject to wear, in UniGear ZS2 switchgear and VD4 circuit breaker is available on request. When parts are required, the serial number of the relative device shall always be quoted.



9.8.2 Spare parts:
Time intervals for maintenance work to be carried out always depend on the operating conditions of switchgear and mainly on the mode of operation, the number of rated and short- circuit current switching operations, ambient temperature, pollution etc. We recommend carrying out the maintenance work at the following intervals:

Lubricant	Isoflex Topas NB 52 / EK339
Halogen-free cleansers	ETHANOL F 25M (for general cleaning)
Touch-up paint	Standard colour RAL 7035

10. Product quality and environmental protection





UniGear ZS2 switchgears are produced in compliance with the requirements of international standards for quality management system and environmental management system. The level of excellence achieved in these fields is documented by quality certificates according to ISO 9001 and by the EMS according to ISO 14001.

End of life of product.

- The ABB company is committed to comply with the relevant legal and other requirements for environment protection according to the ISO 140001 standard.
- The duty of the company is to facilitate subsequent recycling or disposal at the end of product life

During disposal of product, it is always necessary to act in according with local legal requirements in force. The following methods of disposal are possible:

- Disposal can either be carried out thermally in an incineration plant or by storing on a waste site.

Raw material	Recommended method of disposal
Metal material (Fe, Cu, Al, Ag, Zn, W, others)	Separation and recycling
Thermoplasts	Recycling or disposal
Epoxy resin	Separation of metal material and the disposal of rest
Rubber	Disposal
SF6 gas	Discharging from equipment or further recycling or disposal.
Packing material - wood	Recycling or disposal
Packing material - foil	Recycling or disposal





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ABB India Limited
Medium Voltage Products
Plot No. 79, Street No. 17
MIDC Estate, Satpur, Nashik - 422 007
Maharashtra, India

Customer support Contact: **1-800-420-0707**
Customer support: **ppmvsupport@in.abb.com**

ABB Limited operates a process of continuous product development. We therefore reserve the right to change designs, dimensions and data without prior notice.

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