MEDIUM VOLTAGE PRODUCTS

LeanGear ZS9

Installation, operation and maintenance instruction manual

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01. Your safety first – at all times!

That is why our instruction 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.
- 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.

⚠ **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 relating to safety at work and correct handling of the switchgear.

⚠ **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.

⚠ **WARNING**

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.

If you have any further questions about this instruction manual, ABB's field service team will be pleased to provide the required information. Or contact us directly using the contact information on the last page.

02. Summary

Fig. 1: Curve for the determination of altitude factor k in relation to altitude H.

2.1 Introduction

The instructions in this publication refer to LeanGear ZS9 medium voltage switchgear with withdrawable apparatus. For correct use of the apparatus, please read the manual carefully.

Thanks to the advanced design of ABB switchgear, LeanGear ZS9 is suitable not only for many different applications, but also allows for further technical and construction modifications to suit installation requirements in consultation with ABB. Consequently, this manual may not include some specific instructions concerning special apparatus configurations. In these cases, it is therefore strongly recommended to consult both this manual and the latest technical documentation (circuit and wiring diagrams, foundation plans and any protection selectivity studies).

2.2 General

LeanGear ZS9 is a three-phase, metal enclosed, air-insulated, LSC-2B switchgear and all the units are factory-assembled, type-tested and suitable for indoor applications up to 12 kV. The units are designed as withdrawable modules and are fitted with a single busbar system.

Details of the technical design and configuration of individual switchgear, such as the technical data, detailed equipment lists for the individual panels and comprehensive circuit documentation etc., can be found in the relevant order documents.

2.3 Standards and specifications

LeanGear ZS9 switchgear panels comply with standards and specifications prescribed on IEC publications 62271-200 (2011) and 62271-1 (2007); for factory-assembled, metal enclosed and type tested high voltage switchgears.

Additionally, the switchgear panels offer IP 4X* (External) and IP4X (Internal) degrees of protection as prescribed by the IEC publication 60529.

During erection, commissioning and operation of the equipment/system, all the other work related activities like work regulation and safety regulation must be followed as per applicable IEC, national standards & local regulations.

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

* For higher IP, please consult ABB.

2.4 Operating conditions

2.4.1 Normal operating conditions

The 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 24h average	+35°C
Minimum (according to “minus 5 door class”)	-5°C
Ambient humidity:	
Maximum 24h average of relative humidity	95%RH
Maximum 24h average of water vapour pressure	2.2kPa
Maximum monthly average of relative humidity	90%RH
Maximum monthly average of water vapour pressure	1.8kPa

The normal operational altitude is up to 1000m** above sea level. The indoor ambient conditions are free of significant pollution, such as dust, smoke, corrosive and/or flammable gases, vapours or salt, etc.

**For higher altitude/ambient temperature, please consult ABB.

2.4.2 Special operating conditions

LeanGear ZS9 is tested for Level-2 of IEC-62271-304. 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 manufacturer in advance. For example:

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

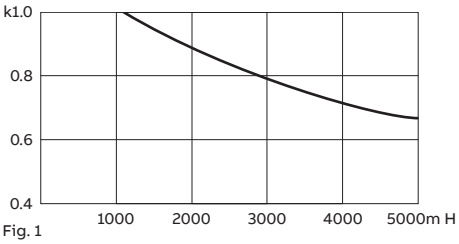

Fig. 1

Note on any special climatic operating condition:
When switchgear is operated in areas with high humidity and/or major rapid temperature fluctuations, there is a risk of dew deposits which must be excluded under 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 with ABB to avoid this condensation phenomenon and any resulting corrosion or other adverse effects.

03. Technical data

3.1 Electrical Data

Table 1: Main parameters for panel and circuit breaker.

	Unit	Rating
Rated voltage (U_r)	kV (r.m.s.)	12
Rated short-duration power-frequency withstand voltage (U_d)	kV (r.m.s.)	28
Rated lightning impulse withstand voltage (U_p)	kV (peak)	75
Rated frequency (f_r)	Hz	50
Rated normal current (I_r) of Busbars	A	800 / 1250
Rated normal current (I_r) of Circuit breaker branches	A	630 / 1250
Rated peak withstand current (I_p)*	kA	63
Rated short-circuit breaking current of circuit breaker	kA	25
Rated short-time withstand current (I_k)*	kA	25
Rated duration of short-circuit (t_k)*	s	3
Earthing Switch rated short-circuit peak withstand current (E1-class)	kA	63
Earthing Switch rated short-circuit breaking current	kA	25
Earthing Switch rated duration of short-circuit (t_k)	s	3
Rated single capacitor bank breaking current (C1)	A	400
Rated Cable Charging Current (C2)	A	25

* The short circuit withstand capacity of components must be taken into account separately. For individual circuit breaker data, see the Doc No : 1VYN403790-C “Installation, Operation and Maintenance Manual” for the relative circuit breaker.

⚠ **Note: For data on additional equipment e.g. circuit breakers, relays, etc. please check the manual for specific equipment.**

3.2 Resistance to internal arc faults

The internal arc fault withstand capacity is – AFLR 25kA, 1 s

3.3 Dimensions and weights

Table 2: Dimensions of 12 kV units. (Ref. Fig. 2)

Dimension	Notations	Metrics in mm
Height (#)	A	1755 / 2050
Width	B	600
Depth	C	1560 / 2070
Height of the basic part of Panel	D	1050
Height of LV Box	E	705 / 1000

Panel height shall vary based on LV Box height

Table 3: Weight ($) of 12 kV units; including withdrawable circuit breaker parts:

Rated Current in A	Approximate weight in kg
630 / 1250A	600

$ Panel weight shall vary based on equipments inside Panel

04. Panel design and equipment

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Fig. 2: Basic structure for LeanGear ZS9
—
Fig. 3(a): Cross section of feeder unit 12kV, 630A, 25kA
—
Fig. 3(b): Cross section of feeder unit 12kV, 1250A, 25kA

4.1 Basic structure and variants

The basic LeanGear ZS9 panel is an incoming/ outgoing feeder panel with vacuum circuit breaker. As shown in Fig. 2, it is divided into:

(1) Circuit Breaker compartment,
(2) Busbar compartment,
(3) Cable compartment,
(4) Low Voltage Compartment for secondary equipment,
(5) Integral Panel Gas Duct.

Apart from this, there are variants for various operating needs. Pictures in Fig. 3 to Fig. 8 show examples of possible configurations of a panel including electrical equipment.

For busbar sectionalizing, two panels are necessary – a coupling panel with withdrawable circuit breaker part and a bus riser panel (optional 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 accessories in the switchgear can be obtained from relevant order specific documents. Table 2 shows notations A, B, C, D, E mentioned in below Fig. 2

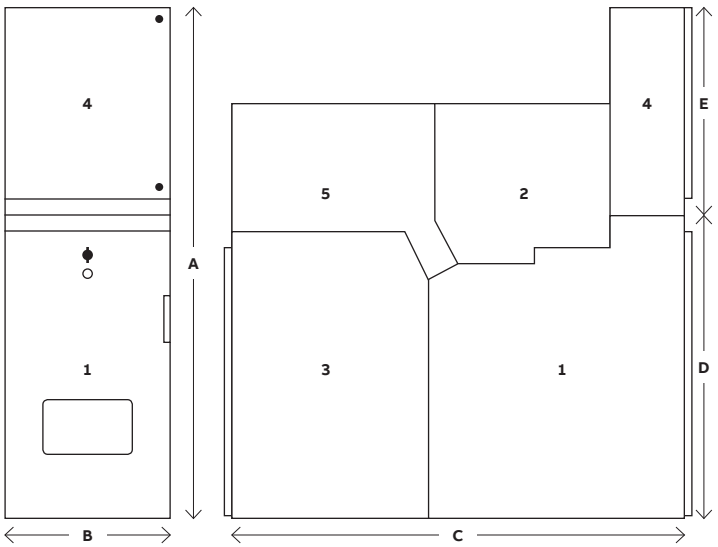

Fig. 2

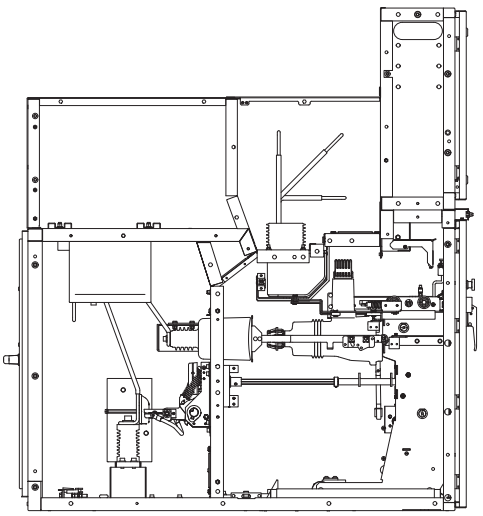

Fig. 3(a)

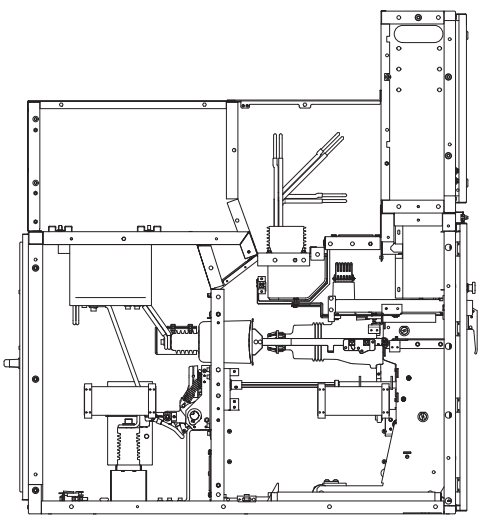

Fig. 3(b)

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Fig. 4(a): Cross section of Feeder with measurements unit 12KV, 630A, 25kA
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Fig. 4(b): Cross section of Feeder with measurements unit 12kV, 1250A, 25kA
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Fig. 5(a): Cross section of Bus Coupler unit 12kV, 630A, 25kA
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Fig. 5(b): Cross section of Bus Coupler unit 12kV, 1250A, 25kA

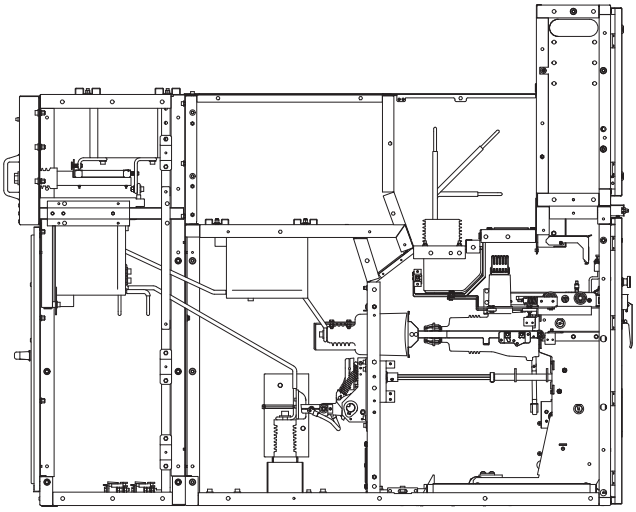

Fig. 4(a)

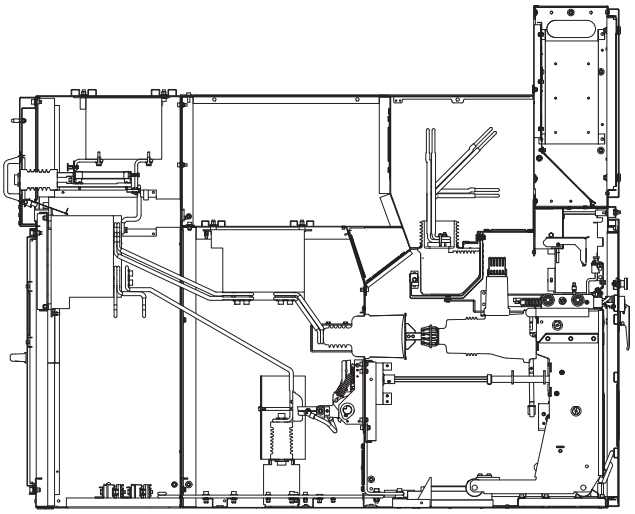

Fig. 4(b)

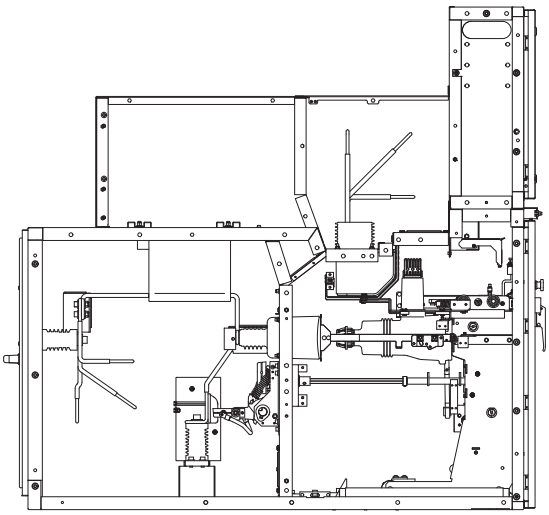

Fig. 5(a)

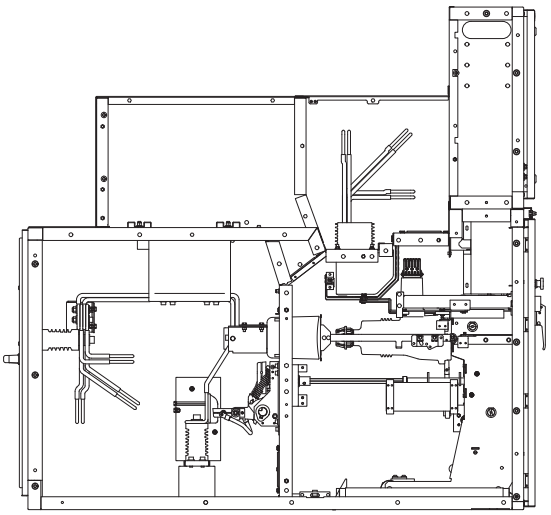

Fig. 5(b)

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Fig. 6(a): Cross section of Bus riser unit 12kV, 630A, 25kA
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Fig. 6(b): Cross section of Bus riser unit 12kV, 1250A, 25kA
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Fig. 7(a): Cross section of Bus Riser with measurements 12kV, 630A, 25kA
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Fig. 7(b): Cross section of Bus Riser with measurements 12kV, 1250A, 25kA
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Fig. 8: Cross section of Bus PT unit 12kV, Up to 1250A, 25kA

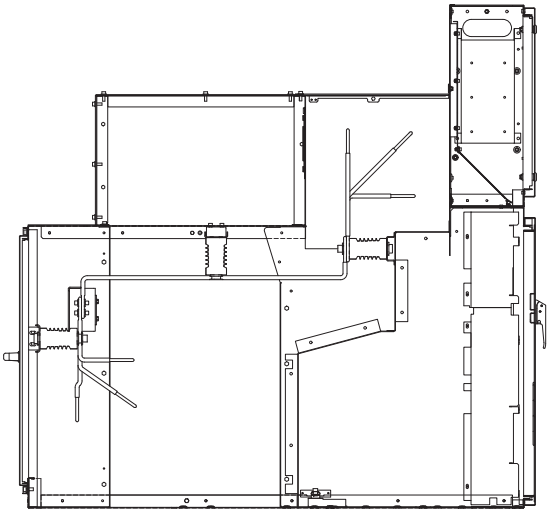

Fig. 6(a)

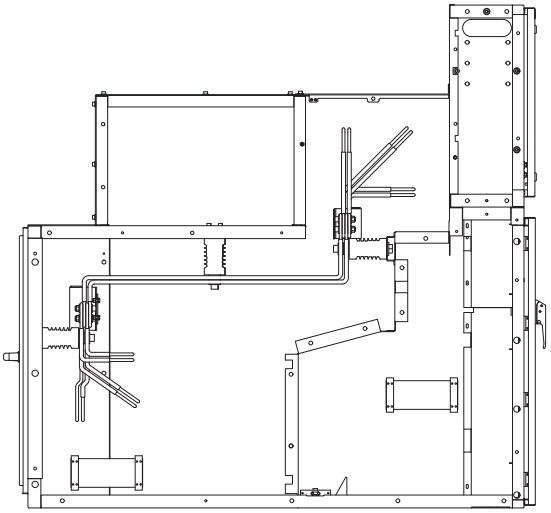

Fig. 6(b)

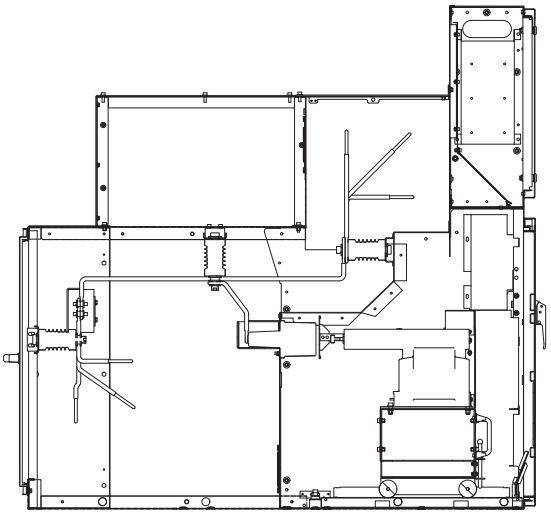

Fig. 7(a)

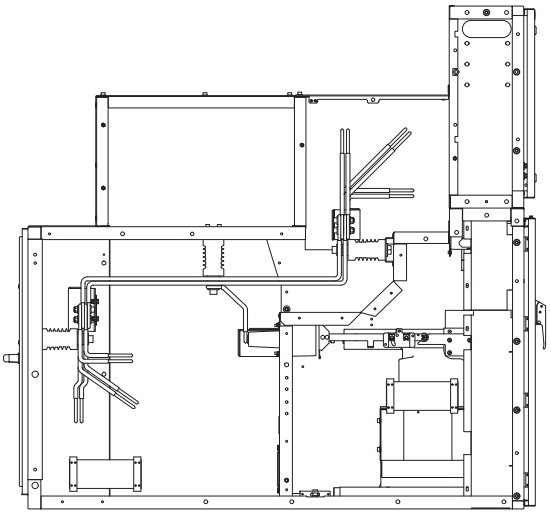

Fig. 7(b)

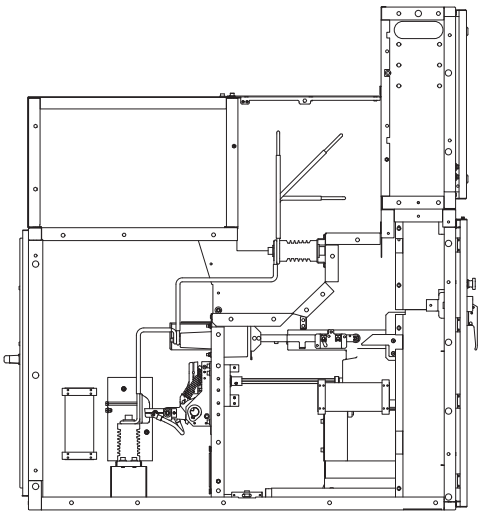

Fig. 8

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Fig. 9: Busbar Compartment
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Fig. 10: Inspection Window on CB Door
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Fig. 11: Mechanical Emergency Trip arrangement
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Fig. 12: Secondary plug and arrangement

4.1.1 Enclosure and partitioning
The enclosure and internal partitions of the panels are made of 2mm thick high quality AluZinc. Three high voltage compartments (viz: busbar compartment, circuit-breaker compartment and cable connection compartment) are equipped with pressure relief flaps fixed with steel screws on one longitudinal side and a breakable plastic rivet on the other side for busbar compartment and with self-supported arrangement for both circuit breaker and cable compartment. These pressure relief flaps open into the integral gas duct located just above the cable compartment; when over pressure happens in the event of an internal arc fault.

A pressure resistant door equipped with an inspection window, fitted with security glass, closes front side of the circuit breaker compartment. The sidewalls of each panel serve as partition between adjacent panels.

Cable and Busbar compartments have independent access covers, on rear and on top of the panel respectively. The low voltage compartment for secondary equipment is completely protected from the high voltage area.

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 panels.

Circuit breaker compartment door is pressure resistant design and can be padlocked also.

4.1.2 Ventilation of panels
Perforation on the pressure relief flaps are needed for the purpose of ventilation in those cases of certain rated currents in the busbars and branch bars.

4.2 Compartments in panel

4.2.1 Busbar compartment
The busbar compartment has three busbars of flat cross section - laid in sections from panel to panel. They are held in place by branch conductors. No special connection clamps are needed. Dimensions of busbars vary according to the current rating. Fig. 9 shows typical photo of busbar compartment.

Fig. 9

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 withdrawable part inside the panel. The tulip isolating contacts together with fixed isolating contacts are located on a mounting plate and fixed through spout bushing.

The shutters are opened by means of shutter operating brackets of the withdrawable circuit breaker part, using racking handle when moved to the service position. They close automatically when the breaker is racked-out. In the test/disconnected position of the breaker, separation of the main circuit is established by partitioning with movable metallic shutter. Connections of the control wiring, required for test purposes, need not be interrupted when the breaker is taken to test position.

ON/OFF indication & CHARGED/DISCHARGED condition of the closing spring of VCB can be observed through the inspection window when CB is in test or service position as shown in Fig. 10.

Fig. 10

Fig. 11

The switching operations are carried out with the door closed. Mechanical Emergency trip provision of the circuit breaker is possible when circuit breaker is in the service condition. Refer Fig. 11 for Mechanical Emergency Trip arrangement.

Mechanical emergency trip push button can be used to trip circuit breaker mechanically with front door closed when circuit breaker is in service position.

Socket for control wiring is firmly mounted inside the circuit breaker compartment and covered by a bracket as shown in Fig. 12. This bracket is for prohibiting insertion of CB from test to service position, if CB secondary plug is not inserted in socket on Panel.

Fig. 12

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Fig. 13: Racking mechanism
A: Emergency Trip Rod Assembly
B: Guide Wheels
C: Traverse Spindle Assembly
D: Pole Assembly
E: Limit Switches
F: Limit Switch for CB Test Position
G: Limit Switch for CB Service Position

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Fig. 14: Shutter operating lever
A: Right Top Shutter Operating Lever
B: Right Bottom Shutter Operating Lever

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Fig. 15: Earthing Trucks up to 1250A
A: Busbar side Earthing Truck
B: Cable side Earthing Truck

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Fig. 16: Inter-panel wiring provision through sides of LV Box

4.2.3 Withdrawable parts

4.2.3.1 Withdrawable circuit breaker parts

Withdrawable circuit breaker forms a complete module consisting of circuit breaker. The withdrawable assembly and circuit breaker are coupled via a multi-pole control wiring plug connector.

Withdrawable assembly establishes the mechanical connections between the panel and circuit breaker. The moving part of the circuit breaker is moved manually by means of a spindle, between the service and test positions with the front door closed. Service and test positions are set precisely by means of lead screw arrangement, to ensure that the breaker reaches the final position. The test and service position indication can be checked by means of an auxiliary switch connected on the racking mechanism. Fig. 13 shows typical racking mechanism and Fig. 14 shows typical shutter operating lever.

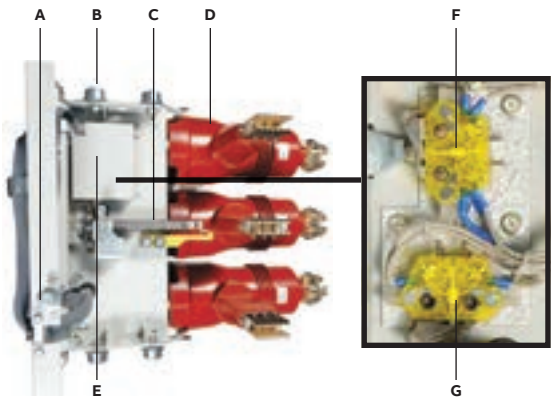

Fig. 13

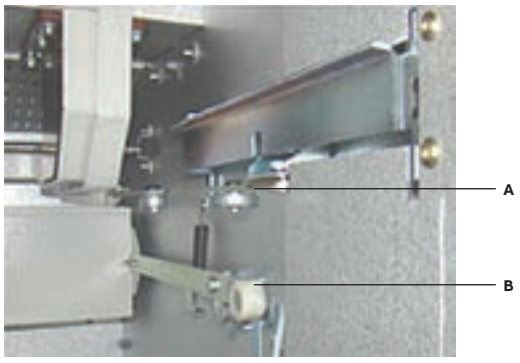

Fig. 14

The earthing connection between the withdrawable part and the panel is established by finger contact in circuit breaker frame and copper connection in panel, which remain connected from test position to the service position.

4.2.3.2 Other withdrawable parts

The withdrawable part can also be fitted with following trucks:

- Withdrawable fuses with fixed voltage transformers
- Earthing truck without making capacity (for main busbar system and power cables)

Fig. 15 shows typical view of Busbar side Earthing Truck and Cable side Earthing Truck.

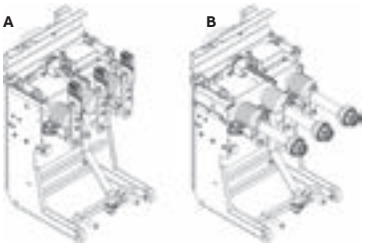

Fig. 15

4.2.5 Cable connection compartment

The cable compartment contains current transformers and only fixed type voltage transformers depending on the requirements of the customer.

The cable compartment is designed for installation of current transformers and other equipment like surge arrestors and voltage detecting insulators (VDI) etc.

4.2.5.1 Cable connections

The panel can accommodate multiple parallel single-core cable of maximum cross section of 630 sq.mm connected back to back as standard arrangement. Other options are available from relevant order specific documents.

4.2.6 Low voltage compartment

The low voltage compartment is an independent sheet metal box mounted on the panel for housing control and protection equipment. It is suitable for both conventional as well as microprocessor control technology. Typical standard height of the low voltage compartment is 705 mm. LV Box with max. height of 1000 mm is also available on request.

If secondary devices are not intended for door installation, they are mounted inside the low voltage compartment. Provisions are made for the inter-panel wiring through the sides of low voltage compartment as shown in Fig. 16.

Fig. 16

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Fig. 17(a): Circuit Breaker Compartment door enabling device on Circuit Breaker side
1: Spring loaded pin head
2: Square spigot
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Fig. 17(b): Circuit Breaker Compartment door enabling device on Panel side
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Fig. 18: Circuit Breaker door interlocking assembly
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Fig. 19: Circuit Breaker Compartment door interlocking plunger

4.3 Interlocks/protection against incorrect operation

4.3.1 Panel internal interlocking

There are a series of interlocks provided, as described below, to prevent hazardous situations, erroneous operation and to protect both personnel and equipment:

- The circuit breaker can be moved into test or service position only when the circuit breaker is in open condition. In the intermediate position, the circuit breaker is mechanically and electrically interlocked against ON–OFF operation.
- Racking of the withdrawable part from test to service position is possible only when its control wiring plug is connected to socket on Panel side.
- Disconnection of control wiring plug of withdrawable part from Panel side socket is not possible when withdrawable part is in service position.
- Earthing switch (optional) can be made ON (closed condition) only when CB is in test position.
- CB can be inserted from Test to Service position only when Earthing Switch is OFF (open condition).
- Details of other possible interlocks can be obtained from relevant customer specific order related documents.

4.3.2 Interlocks between panels

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

4.3.3 Door interlocking

The panels can be equipped with the following interlocks:

- The circuit breaker cannot be racked-in if circuit breaker compartment door is open (Fig. 17 (a) & (b)).

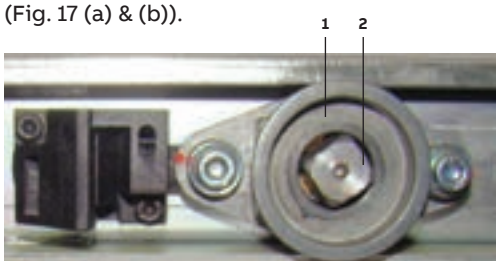

Fig. 17(a)


Fig. 17(b)

- The circuit breaker compartment door cannot be opened if the circuit breaker is in service or in any intermediate position (Fig. 18 & Fig. 19).


Fig. 18


Fig. 19

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Fig. 20(a): Locking Devices on CB Door
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Fig. 20(b): Locking Devices for Top & Bottom Shutter
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Fig. 20(c): Locking Devices for Top Shutter
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Fig. 20(d): Locking Devices for Bottom Shutter
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Fig. 20(e): Locking Devices for emergency mechanical trip

4.3.4 Locking devices

- The shutter can be secured independently of each other with padlocks when the circuit breaker is removed.
- Access to the circuit breaker racking slot can be restricted with a padlock (Hole Ø 8.2 mm). Refer Fig. 20 (a).
- Access to the circuit breaker compartment can be restricted with a padlock (Hole Ø 8 mm) on its door handle. Refer Fig. 20 (a).
- Hole Diameter size for Padlocking arrangements for other applications as below:
  (a) Top shutter – 8mm. Refer Fig. 20 (c).
  (b) Bottom shutter – 7mm. Refer Fig. 20 (d).
  (c) Emergency mechanical trip (Optional) – 8mm. Refer Fig. 20 (e).
  (d) Earthing Switch hole bracket – 8mm
  (e) PT shutter – 8mm
- Only padlocking facility is provided and Locks for the same are not part of supply from Switchgear manufacturer.

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
4	A	Apparatus compartment door opening	Truck in test position
	B	Apparatus racking-in	Apparatus compartment door closed

Note: Apparatus are circuit-breakers

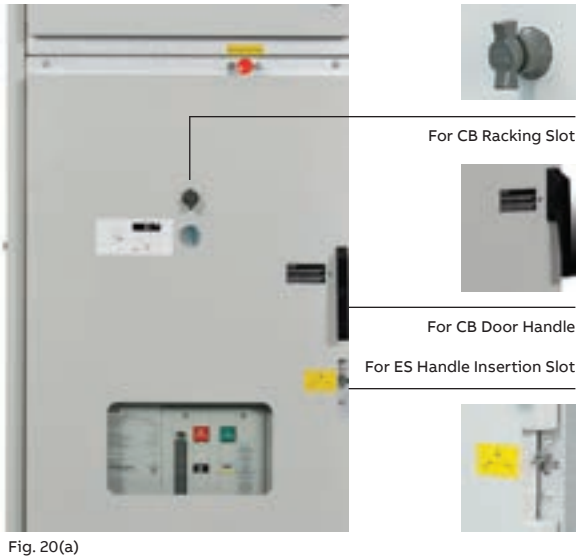

Fig. 20(a)

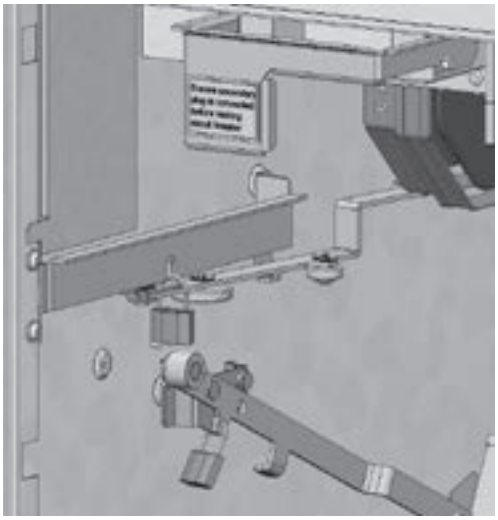
Fig. 20(b)

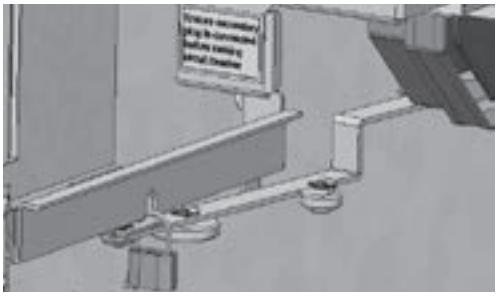
Fig. 20(c)

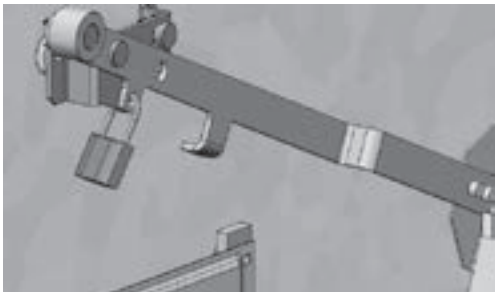
Fig. 20(d)

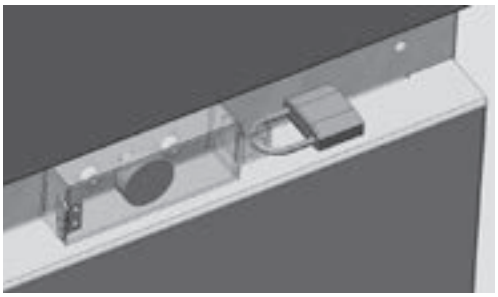
Fig. 20(e)

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Fig. 21(a): 32-Pin Control-wiring plug connector
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Fig. 21(b): 32-Pin Control-wiring socket
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Fig. 21(c): 32-Pin Control-wiring plug connector cover
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Fig. 22(a): Arrangement for allowing insertion of correct rating of circuit breaker in its respective rated Panel
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Fig. 22(b): Arrangement for preventing inter-changeability and insertion of different rating of circuit breaker in Panel
1: Stud on Panel side to obstruct insertion of wrong rating CB
2: CB Completion frame with cut-out at approriate location in its respective rated Panel

4.4. Plug connector coding

The low voltage compartment connections and the circuit breaker are coupled via a multi-pin control wiring plug connector (Fig. 21 (a)) of circuit breaker over socket (Fig. 21 (b)) on Panel side. Ensure to connect the secondary plug and socket before racking the circuit breaker to service position. The interlock view for control wiring plug and socket for insertion of withdrawable parts from test to service position is shown in Fig. 21 (c).

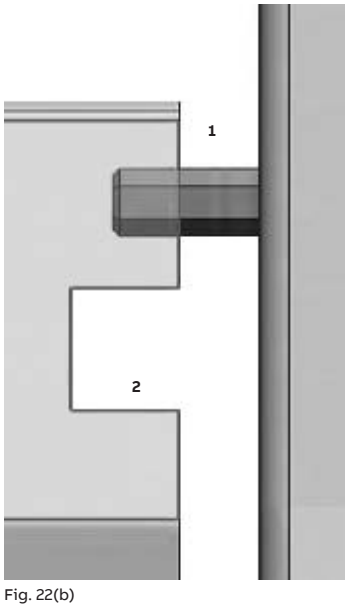
In order to avoid, racking of wrong rating of circuit breaker of same dimension of attributed rating of circuit breaker in Panel, a specific arrangement is provided for Panel and circuit breaker. For it, a stud is provided on Panel-side and respective cut-out is provided on circuit breaker completion frame to enable insertion of correct rating of circuit breaker (of say 630A) in its respective rated Panel (of 630A) as shown in Fig. 22 (a). Insertion of circuit breaker of different rating (of say 1250A) with same dimension as of 630A rated circuit breaker will be prevented in this case, as the cut-out on 1250A circuit breaker completion frame is at different location as shown in Fig. 22 (b). In this Fig. 22 (b), only the area highlighted in 22 (a) is shown, with completion frame of different rating (1250A) and Panel side stud location for 630A.

Fig. 21(a)

Fig. 21(b)

Fig. 21(c)

Fig. 22(a)



1. Stud on Panel side to obstruct insertion of wrong rating of CB

2. CB Completion frame with cut-out at appropriate location to allow insertion in its respective rated Panel

Fig. 22(b)

4.5. Device photos

—
Fig. 23: Feeder unit
—
Fig. 24: External view of low voltage compartment
—
Fig. 25: Circuit breaker compartment, open withdrawable part in service position
—
Fig. 26: Circuit breaker compartment, open withdrawable part in test position

Fig. 23

Fig. 24

Fig. 25

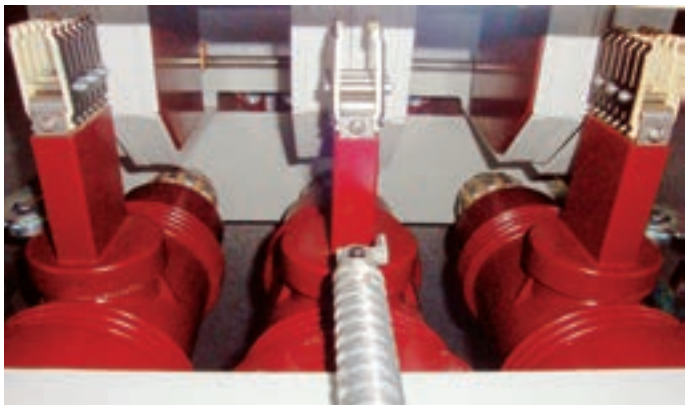


Fig. 26

—
Fig. 27: VInd circuit breaker operating element
A: Lever for manually charging the closing springs
B: Signalling device for circuit breaker open/closed
C: Rating plate
D: Opening push button
E: Closing push button
F: Signalling device for closing springs Charged/Discharged
G: Operation counter
H: Isolating contacts
I: Slide for operating the bottom switchgear shutter
J: Truck
K: Locks for hooking into the fixed part
L: Interlock bracket for Earthing Switch operation
M: Cabling connection
N: Connector (plug)
O: Circuit Breaker Earthing Contact
P: Handles for activating the locks (Sr. No. 11)
Q: Slide for operating the top switchgear shutter
R: Roller for Intermediate position operation interlock
S: Operating lever of circuit breaker racking-in/out

Fig. 27

Fig. 28

—
Fig. 28: VInd type circuit breaker pole side, pole top cover & actuating elements

—
Fig. 29: VInd Circuit breaker operating mechanism with sliding handles & coupling lever
A: Sliding handles for activating the locks
B: Coupling lever for racking in/out operation

Fig. 28

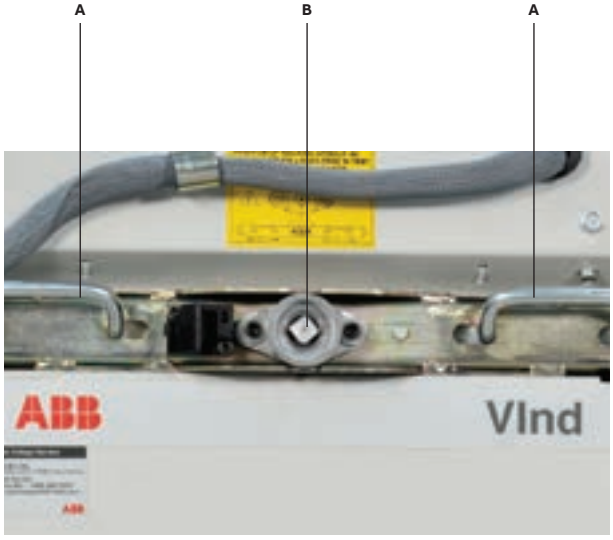


Fig. 29

05. Dispatch and storage

Fig. 30: Lifting arrangement

5.1 Condition on delivery

At the time of dispatch, the LeanGear ZS9 panels are factory-assembled, the withdrawable parts are placed in the test position and doors are closed.

The factory-assembled panels are checked at ABB works for completeness in reference to the terms of customer order and simultaneously subjected to routine testing (normally without AC voltage testing of the busbars) to IEC publication 62271-200, and are therefore tested for correct structure and function.

Busbars are generally not assembled. The busbar material, fasteners and accessories are packed separately; unless mentioned otherwise.

5.2 Packing

LeanGear ZS9 panels are packed for transportation to the destination in following types:

- Panels with basic packing
  - Pallet with plastic wrapping
- Panels with seaworthy packing:
  - Sealed in polyethylene sheeting
  - Vacuum Packing
  - Transport drying agent bags included

Observe the directions for use of the drying agent bags. The following applies:

- Coloured Silica Gel indicator blue: contents dry.
- Coloured Silica Gel indicator pink: contents moist (relative humidity above 40%).

5.3 Transport

The transport units are normally comprised of individual panels and in exceptional cases, small groups of panels. The following precautions must be taken during storage, transport and erection at the site.

- Transport panels upright and lifting should be done as per sign shown on packing case.
- 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 the following:
  - Crane.
  - Fork-lift truck and/or manual trolley jack.

5.3.1 Loading by crane:

- Fit lifting ropes of appropriate load capacity with spring catches (eyebolt Ø: 30mm).
- Keep an angle of at least 60° from the horizontal for the ropes leading to the crane hook.
- Hang the unit using ALL four lifting hooks!
- The lifting arrangement shown in Fig. 30 is not included in the delivery. Consider a minimum 1.5ton lifting capacity for each cubicle.

Fig. 30

5.4 Delivery

When the switchgear arrives at the site, please ensure following:

- Checking the consignment for completeness and for identifying any damages, including checking for moisture and its detrimental effects. In case of doubt, the packing must be opened and then properly resealed after replacing the 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 at various stages of consignment from its arrival to identify damages, if any.

—
Fig. 30: Typical Transport advices

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 panels and assembly materials.

5.5.1 Panels with basic packing

- A fully closed and dry well-ventilated storeroom with a climate in accordance with IEC 62271-1 to avoid any exposure to dust and water ingress. Ensure presence of normal, non-corrosive and uncontaminated atmosphere.
- The room temperature must not fall below -5°C and beyond +40°C.
- There must not be any other negative environmental influences.
- Store the panels upright.
- Do not stack panels.

5.5.2 Panels with seaworthy packing with internal protective sheeting

- Store the transport units protected from the weather, in a dry place, safe from any damage. A fully closed and dry well-ventilated storeroom with a climate in accordance with IEC 62271-1 to avoid any exposure to dust and water ingress. Ensure presence of normal, non-corrosive and uncontaminated atmosphere.
- Check the packing for 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 3 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 Handling

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

⚠ Warning!
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 should be connected and switched-on.

The cubicles, which are without vacuum packing, are normally fixed to the pallet. The pallet is suitable for lifting by fork-lift from all four sides provided that the width and length of transport pallet is fitting. Typical transport devices are shown in fig. 31. If the packing includes vacuum bags they might be used for storage indoors or under shelter for a period of time (of 3 months) 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 panels. Assure that the panel is not damaged, tilted or dropped.

For each switchgear transport unit, instructive labels or sketch is fixed on packing.

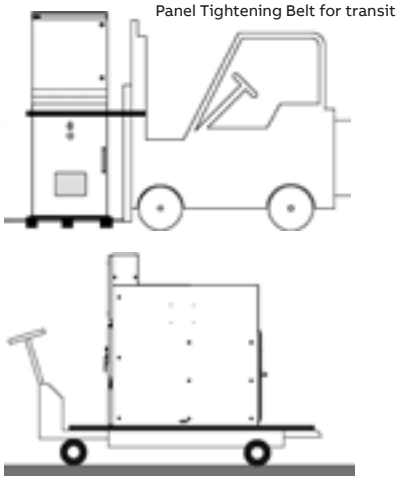


Fig. 31

If a crane is not available, the panel can be shifted up to the foundation channel by using suitable pallet truck under the pallet. At the place of installation, it is necessary to remove the wooden transport pallet under the panel and adjust the placement with respect to foundation channel. Lift the panel using suitable jacking tools to place on to 7/8 rollers for gently sliding on to the foundation frame.

Circuit breakers are delivered by placing inside panels. Please refer to Installation, Operation and Maintenance Manual for VInd-12kV circuit breakers. Doc: 1VYN403790-C.

06. Assembly of the switchgear at site

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Fig. 32: Fixing to the floor – Method A – Installation on C profile for concrete floor.
—
Fig. 33(a): Fixing to the floor – Method B – Installation on anchoring bolts.

In order to obtain an optimum installation sequence and 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 ABB authorized and responsible persons.

In case higher IP is needed please follow the instructions described in manual 1VYN404790-112 and 1VYN404790-113 available on request.

6.1 General

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 IEC 62271-1 including the conditions for the “minus 5 indoor” temperature class must be ensured.

Minimum front clearance: 1300mm (considering withdrawal of CB Truck)
Minimum rear clearance: 900mm
Minimum lateral clearance: 600mm
Minimum Ceiling Height from floor: 3000/3500mm#
Minimum Ceiling Height from chimney top: 765/1265mm#

(#: For minimum 3000mm ceiling height, IAC Rating is 20kA for 1sec. For minimum 3500mm ceiling height, IAC Rating is 25kA for 1sec.)

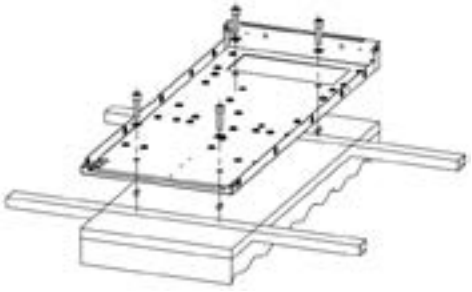

Fig. 32

6.2 Foundation

The following two basic methods of installing switchgear in the switchroom are identified:

Method A – installation on C profile for concrete floor

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

Method B – installation on anchoring bolts

Installation directly on the levelled concrete floor makes much higher demands on the floor levelling, which must, in this case, fulfil the same tolerances as the base irons during method “A” installation. Fastening is carried out by anchoring bolts in the concrete floor.

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.

Fig. 32 shows Method A for fixing to the floor with Installation on C profile for concrete floor.

Fig. 33(a) shows Method B for fixing to the floor with Installation on anchoring bolts. Fig. 33(b) shows detailed dimension for it. Fig. 33(c) shows typical Floor View and Switchgear Side view with recommended clearances.

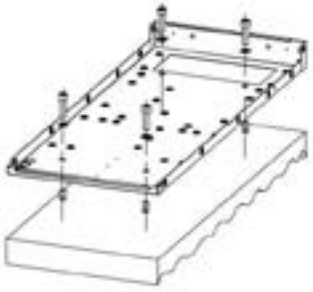

Fig. 33(a)

The general foundation drawing is given in following 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 ±1mm over a measuring length of 1m
- 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 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. To make the holes, use a drill with a suitable bit for the type of fixing to be made (through or threaded hole)

6.2.1 Checking of foundation

Check the foundation with respect to the foundation drawing supplied. The foundation frame on which cubicles are to be installed must be properly levelled. Level is to be checked using an appropriate water level based indicator. Use proper size of channels only with good cutting and fabrication quality if pre-foundation is done in MS Channel or Angles. 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.

6.2.2 Mounting of first cubicle on foundation frame

Start installation of the cubicle from any one side. It is advisable to start from the center when assembling switchgears with more than ten panels. The cubicle from factory is pallet mounted. It should be unloaded from the pallet as close as possible to the foundation frame location so that less movement is required after the cubicle is on the ground. Once the cubicle with pallet is on the ground, the same is to be pushed manually on to the foundation frame.
If the use of crowbar is unavoidable, the crowbar is to be inserted either at sides or at rear of the cubicle. Do not insert the crowbar in the front side of the cubicle. Please ensure that the cubicle, when mounted on the frame is vertical. If necessary, use shim to make the cubicle vertical. All cubicles to be pushed on the base frame as per general arrangement drawing and scheme supplied.

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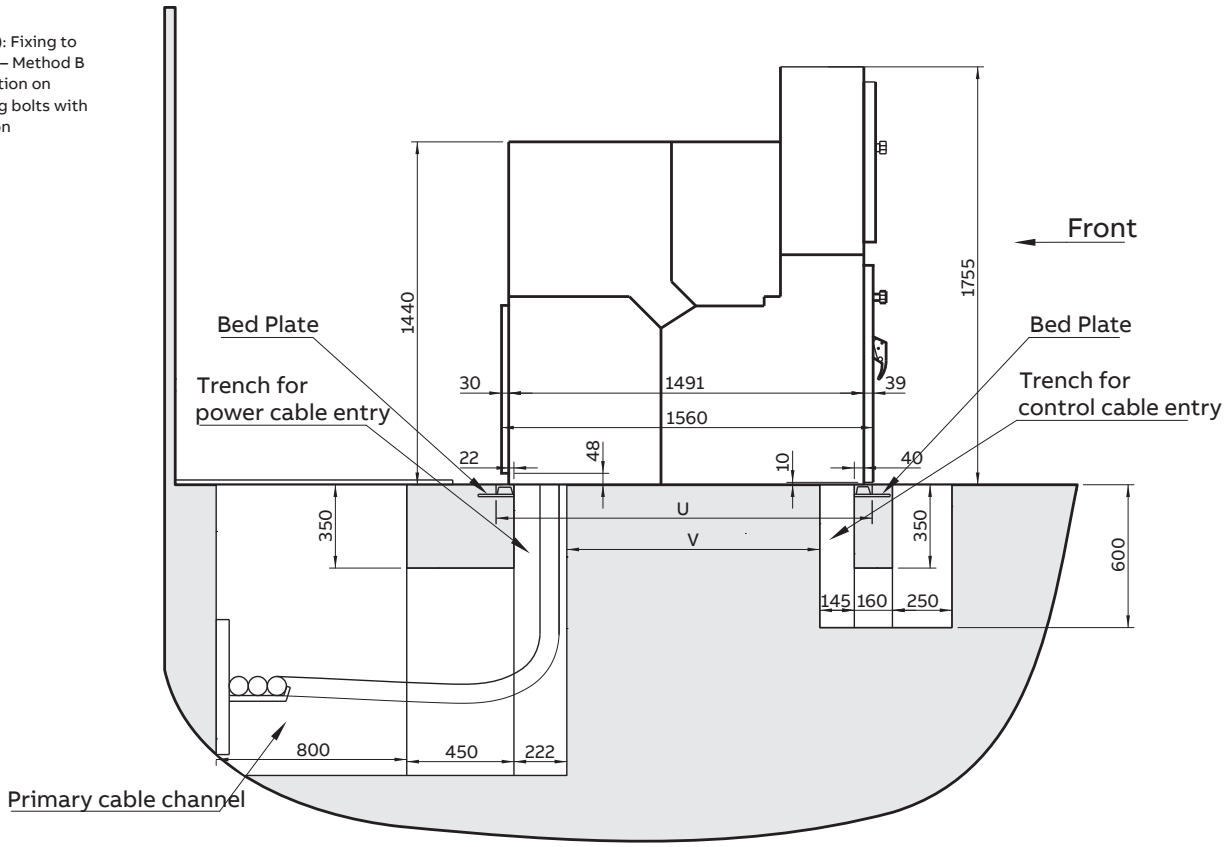
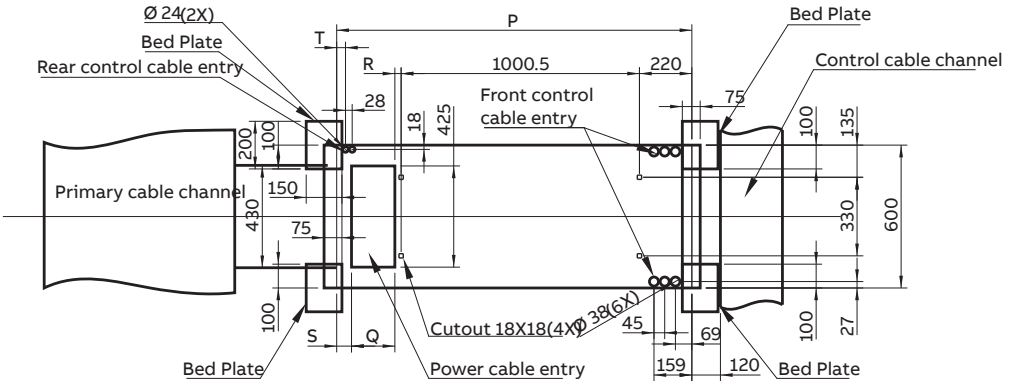
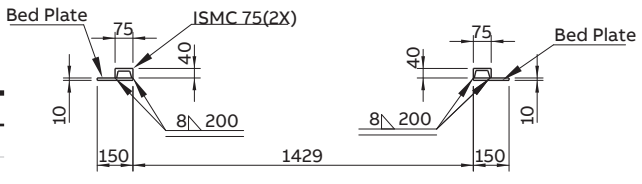
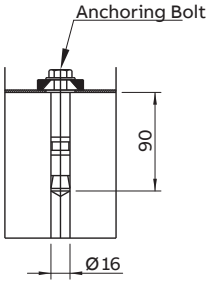
Fig. 33(b): Fixing to the floor – Method B – Installation on anchoring bolts with dimension







ISMC & Bed plate in detail



Design Table

Nomenclature	For 1560 depth	For 2070 depth
P	1491 mm	2001 mm
Q	182 mm	282 mm
R	25.8 mm	385.8 mm
S	62.2 mm	112.2 mm
T	37 mm	20 mm
U	1579 mm	2089 mm
V	1062 mm	1572 mm

Bed plate specications

Thickness 10 mm
Width 150 mm
Length 200 mm

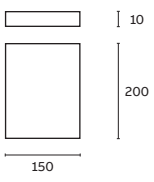


Fig. 33(b)

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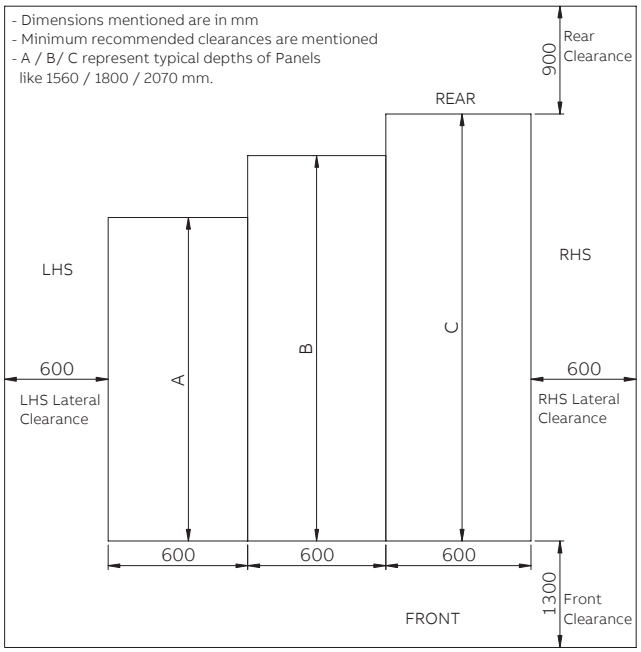
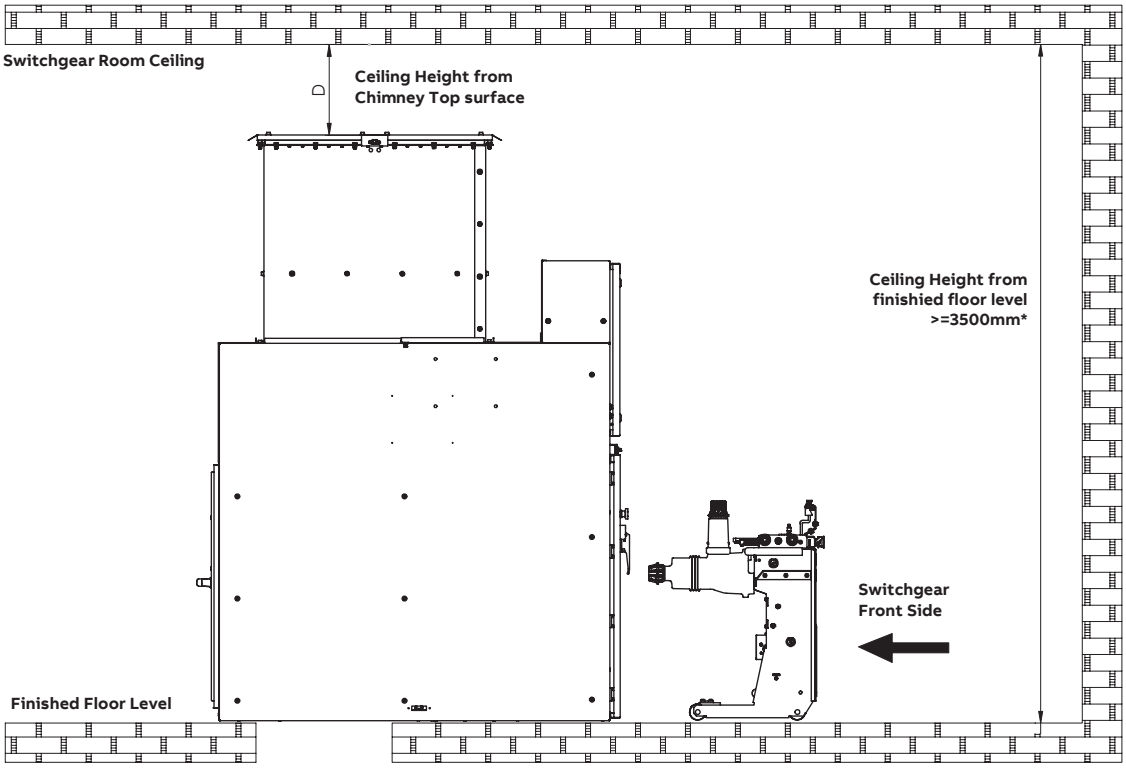
Fig. 33(c): Typical Floor View and Switchgear Sideview with recommended clearances

Typical Floor Layout with recommended minimum clearances



Typical Switchgear Side View with recommended clearances from ceiling



*-Contact ABB in case of lower ceiling Height

Note: Dimension'D' is for minimum ceiling height from Chimney Top Surface
For 20kA / 1sec IAC rating, recommended dimension 'D' is 765mm &
For 25kA / 1sec IAC rating, recommended dimension 'D' is 1265mm

Fig. 33(c)

—
Fig.34: Coupling Arrangement

Before erection the highest point of the floor is identified. The erection begins with the left hand side cubicle, which is placed in level with the highest point.

Next cubicle can then be installed, aligned and adjusted to the first one. Tighten the cubicles with bolts in the fitting holes close to the front and rear sides. The fixing is made by M10X30 bolts. The nuts and bolts for coupling of busbar and bolts for coupling of Panels at site shall be sent loose. Remaining cubicles should be erected in the same way. Fig. 34 shows the coupling holes highlighted by circles at front and rear side of Panel.

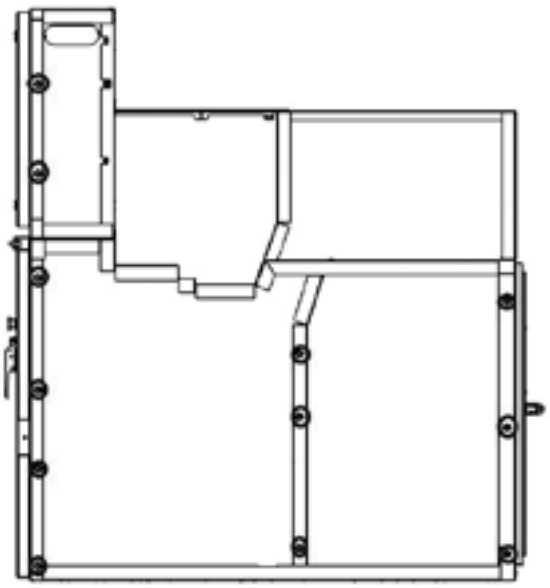


Fig. 34

6.2.3 Mounting of second, third and further cubicles on the frame

Follow the procedure described in 6.2.2. When the second cubicle is placed on the foundation, it must be pushed as close as possible to the first cubicle so that two cubicles touch each other from top to bottom.

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

6.3 Assembly of switchgear panels

Use screws of tensile class 8.8. Tightening torques for the busbar screw connections with disc washer are as follows:

Table 4

Tightening torques for copper bars or combined busbar connections		
Thread(2)	**Max. recommended tightening torque Nm(1)**	
	Without (η=0.14)	Oil or grease (η=0.10)
M5(3)	2.5	—
M6(3)	10	8
M8	25	20
M10	50	40
M12	85	69
M16	200	170
Tightening torques for copper bar connections combined with epoxy insulators		
Thread(2)	**Max. recommended tightening torque Nm(1)**	
	Without (η=0.14)	Oil or grease (η=0.10)
M8	15	12
M10	32	26
M12	45	36
M16	110	90
M20	220	180
Tightening torques for copper contact pins inside epoxy spout		
Thread(2)	**Max. recommended tightening torque Nm(1)**	
	Without (η=0.14)	Oil or grease (η=0.10)
M10	46	37
M20	250	200

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.
(3) Applicable only for fixing of subsidiary covers or terminal connections.

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.

It is recommended that the threads and head contact surfaces of bolts should be lightly oiled or greased to achieve the precise tightening torque (column Oil or grease in table).

The preparation work for installation is as follows:

- Remove withdrawable parts (Circuit Breaker/ Withdrawable PT/Earthing Truck) from the switchgear panels and store them with suitable protection.
- Dismantle lifting eyebolts.
- Transport the switchgear panels to the prepared installation point following the sequence shown on the switchgear plan.
- Release and remove floor cover.
- If any top-mounted enclosures or instrument transformers are removed for transport, bolt these in place in the specified position.
- Align the switchgear panel on the floor frame for correct positioning and vertical alignment (deviation of the panel edges from the vertical with respect to base must not exceed 2mm especially at the front) and bolt panels together only after proper alignment with the adjacent panel. It is advisable to start from the center when assembling switchgears with more than ten panels.
- When the switchgear has been properly assembled, fix the panels to the concrete floor using plugs, or weld or adequately bolt them to the foundation frame.

—
Fig. 35: Access for main busbar installation
A: Top cover for Busbar access and assembly
—
Fig. 36(a): Up to 800A Busbar assembly
—
Fig. 36(b): 1250A Busbar assembly

6.4 Installation of the busbars

⚠ Caution!
The encapsulating sheet steel of cubicles may have sharp edges inside and on the roof.

Access possibilities for the main busbars installation are shown in Fig. 35. They are:

- Side access while installing the adjacent cubicle.
- Removable roof plate to access busbars from top.

It is advisable that the busbar erection is to be done in parallel with the cubicle erection when access to the main busbar compartment is available from sides. The insulated main busbars and Busbar junction shrouds are delivered loose items. (Main busbar & droppers sleeving and shrouds are optional). Fastening parts are delivered ready-fixed on the dropper busbars.

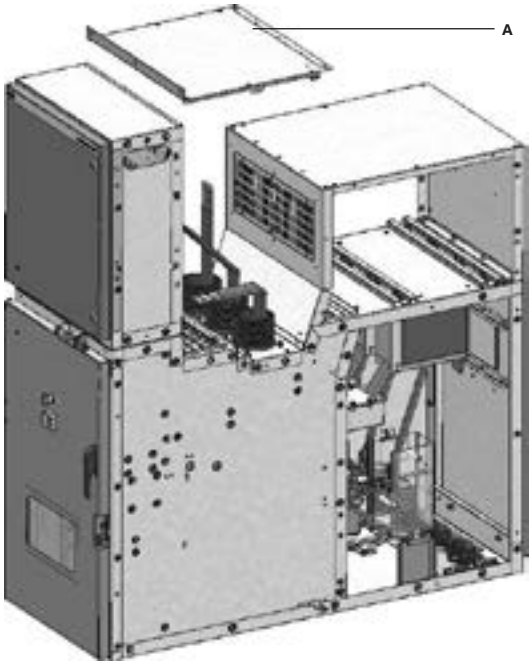


Fig. 35

Fig. 36 (a) and (b) shows snap of typical busbar assembly with flat busbar and jumper. Fig. 36 (c) to (d) shows typical busbar and jumper assemblies in bus-coupler and riser panels. Typically M12 x 45 & M12 x 55 bolts are used for busbar – Jumper assembly for 800A & 1250A busbar rating respectively.

If insulated busbars are provided, care must be taken to protect the insulation against damage during storage and handling. Damaged insulation must be renewed. It is recommended to store loose busbars and links in clean and dry enclosed area to avoid possible damages. Busbar assembly work requires cleanness as the dielectric strength will be decreased by foreign objects like metal dust, loose threads and oil patches.

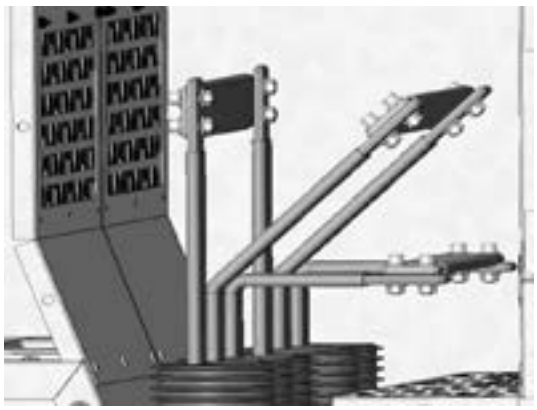


Fig. 36(a)

Make sure the contact surfaces of busbars and connector parts are clean. Use only the strong type of conical spring-washers (ABB standard 9ADA334, DIN6796) for all bolted conductor connections. This will help maintaining required pressure for the lifetime of the switchgear and eliminates the risk of problems due to overheating. Apply Isoflex Topas NB 52 lubricant on busbar joints before mounting the busbars. Torquemeter should be used during erection, tightening torques are as tabulated (refer Table 4).

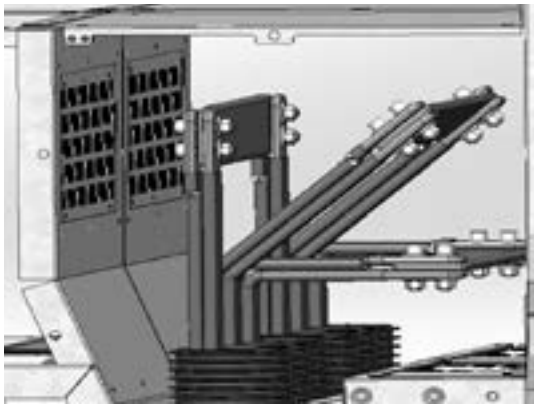


Fig. 36(b)

—
Fig. 36(c): Bus-coupler & Bus-riser Busbar assembly for up to 800A
—
Fig. 36(d): Bus-coupler & Bus-riser Busbar assembly for 1250A
—
Fig. 37(a): Typical shroud for busbar dropper connection
—
Fig. 37(b): Up to 800A Jumper-Busbar Assembly
—
Fig. 37(c): 1250A Jumper-Busbar Assembly
—
Fig. 37(d): Carrier for end-cap in Busbar-joint assembly for up to 800A
—
Fig. 37 (e): Carrier for end-cap in Busbar-joint assembly for 1250A

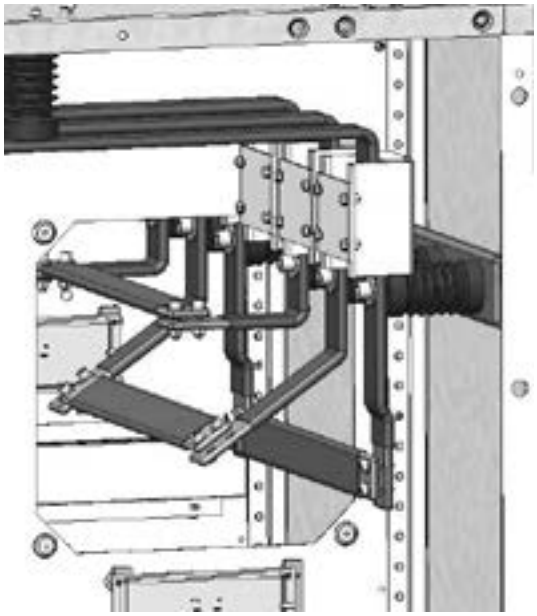


Fig. 36(c)

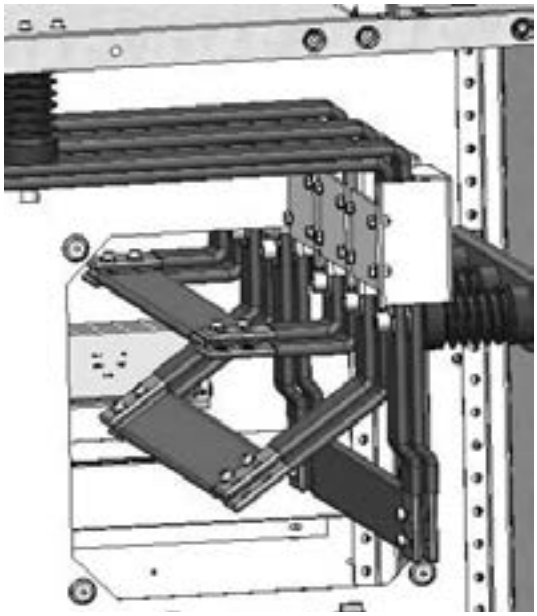


Fig. 36(d)

Busbar Shrouds

The busbar shrouds are provided for all main busbar dropper connections. Check for correct type for shroud end cap and support and place them on the main busbar before fixing the main busbar onto the dropper. Typical view of shroud and its assembly for various busbar-dropper connections are shown in Fig. 37 (a) to (e).

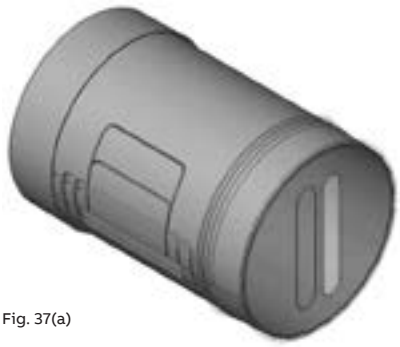


Fig. 37(a)

Based on number of busbar and jumper links, the busbar shroud and end cap is used.

Note:

The connection of the busbars is carried with “stabilized connections” which means that quality of the busbar joint does not change over a period of operating time and therefore it is not necessary to inspect tightness of busbar connections regularly; but this is on the condition that correct assembly is carried out as described in the preceding paragraphs especially paying attention to the following:

- The connections are either brushed with a wire brush, preserving the grease film, or cleaned with a metal-free non-woven cleaning cloth and evenly greased with a thin coat of Isoflex Topas NB 52 or equivalent.
- Prescribed torque is applied during tightening of the joint using a calibrated torque wrench.

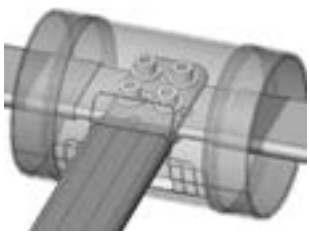


Fig. 37(b)

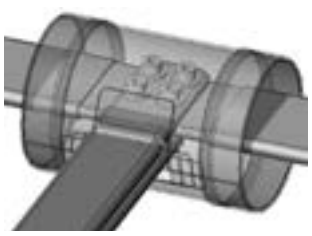


Fig. 37(c)

Fig. 37(d)

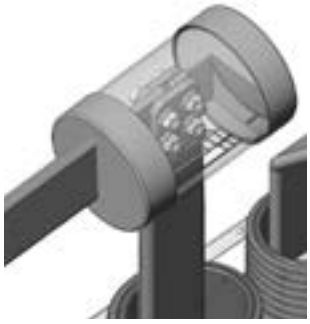


Fig. 37(e)

—
Fig. 38: View of Panel with Gasduct Exhaust
—
Fig. 39(a): Use of Steel and Nylon Screws & Washers in Gasduct exhaust assembly for Panel on Extreme Left side or middle of Switchboard
—
Fig. 39(b): Use of Steel and Nylon Screws & Washers in Gasduct exhaust assembly for Panel on Extreme Right side of Switchboard
—
Fig. 39(c): Opening direction of Pressure release flap in chimney / Gasduct exhaust assembly for Panel on Extreme Left side or middle of Switchboard
—
Fig. 39(d): Opening direction of Pressure release flap of chimney / Gasduct exhaust assembly for Panel on Extreme Right side of Switchboard
—
Fig. 39(e): Gasduct and Gasduct Exhaust assembly View

6.5 Gasduct Exhaust:

LeanGear family switchgear is designed with integral gas duct. Vertical gasduct exhaust is required for releasing the hot gases if generated during internal arc fault. The integral gas duct compartment of all Panels in Switchboard are connected to each other and finally to vertical gasduct exhaust typically mounted on Panel at extreme ends. Typically for Switchboard of 10 Panels, gasduct exhaust is recommended for mounting on extreme Panels. For the gasduct exhaust mounted on Panel on extreme left side or middle of Switchboard, arrangement shown in Fig. 39 (a) & (c) are applicable. For the gasduct exhaust mounted on Panel on extreme right side of Switchboard, arrangement shown in Fig. 39 (b) & (d) are applicable.

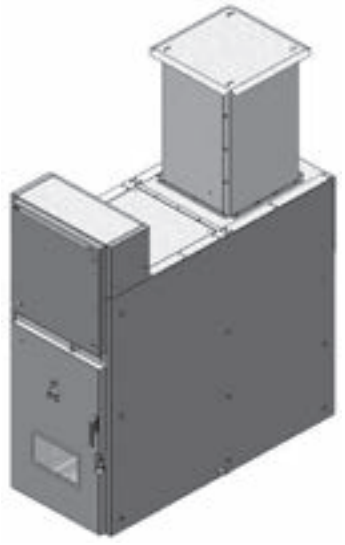


Fig. 38

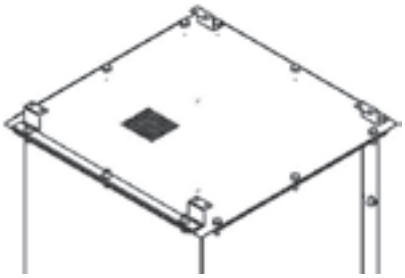


Fig. 39(a)

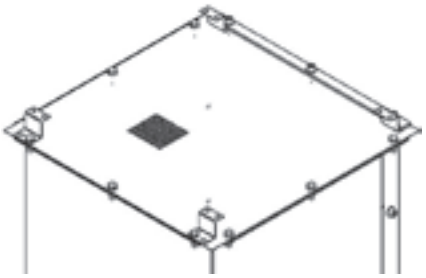


Fig. 39(b)

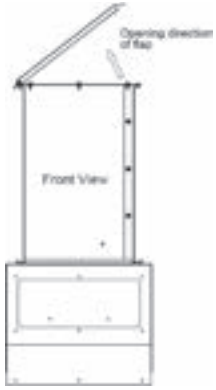


Fig. 39(c)

Fig. 39(d)

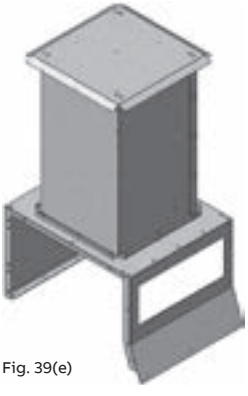
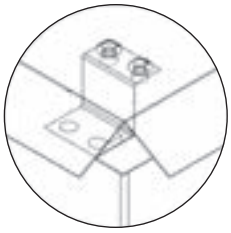
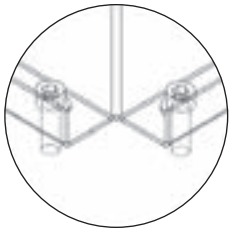


Fig. 39(e)



View: C



View: D

—
Fig.40(a): Power Cable connection

—
Fig.40(b): Power cable gland plate and cable clamping arrangement
1: Gland plate
2: Channel for Cable Clamping
Please ensure to close any opening left after connection of power cables.

6.6 Cable connection

6.6.1 Power cables

The standard method for the entry of power cables in the switchgear is shown in Fig.40 (a). The cables are conveyed from below through floor covering, which is divided at the cable entry point. The cables go through gland plate, which can be adapted to the required cable diameter. Cables are fastened in the panel by means of clamps mounted on cable strips, which are part of the panel floor covering. The clamps make it possible to fasten cables. Fig.40. (b) shows typical Cable Clamp and Reducer ring views.

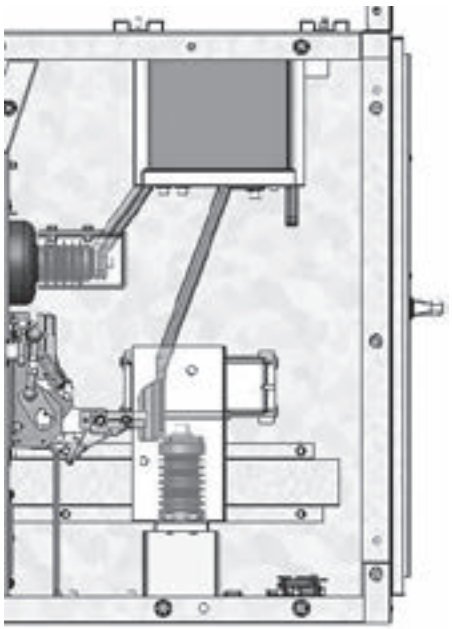


Fig.40(a)

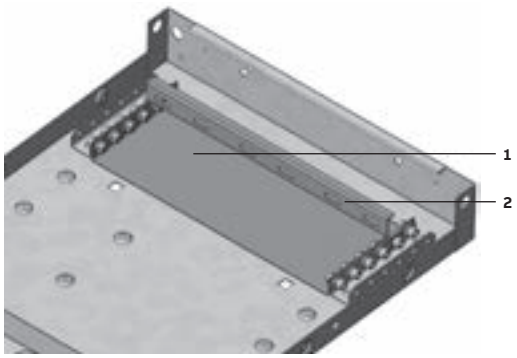


Fig.40(b)

The cable termination bars have different versions; these are mainly based on number of parallel cables, CT rated current and short circuit rated current.

The hole size for connection of power cables shall be as per respective project related documents. In all cases, the earthing of cable screens is carried out on the stripholding cable clamps. The cable strip is at earth potential.

Note:
The cable glands or clamps or grommets or reducer rings are not in scope of ABB.

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 completed
- Individual parts of the floor covering must be mounted
- Cable gland must be moved down so that nuts in the rings fit into the corresponding recesses in the 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

⚠ Caution!
The cables must be earthed before the accessing the cable compartment.

—
Fig. 41: Low Voltage compartment
—
Fig. 42(a): End Cover assembly
1: Panel with End Cover assembled
2: Exploded view of End Cover assembly
—
Fig. 42(b): Use of coupling strips for coupling of adjacent panels and coupling of extreme panel with end cover assembly from top and rear side
1: Panel Coupling Strip
2: Extreme Panel and End Cover Coupling Strip
—
Fig. 42(c): Panel side view end cover assembled

6.6.2 Control cables

The control cables entry is from front bottom side through circuit breaker compartment.
The control cables are terminated in the low voltage compartment. When they enter from the basement they can run inside the front part of the panels. The control cables will run through the bottom of the circuit breaker compartment to the LV Box of intended cubicle. Earthing connections are to be made to the copper bar located inside the low voltage compartment. Fig.41 shows typical view for components mounting and wiring inside Low Voltage Compartment.

Fig. 41

6.7 End covers

Towards the end of installation, assemble the end covers at the extreme right and left panels of the switchboard.

Refer Fig.42(a) shows exploded view of endcover assembly. Fig.42(b) shows use of coupling strips for coupling of adjacent panels and coupling of extreme panel with end cover assembly from top and rear side. Fig.42(c) shows snap of LeanGear ZS9 Panel with end cover assembled.

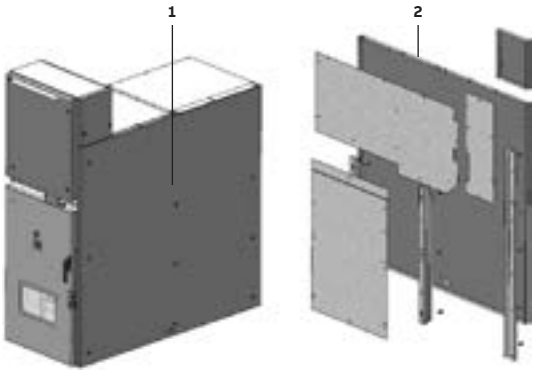


Fig. 42(a)

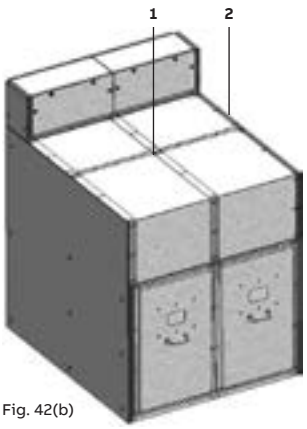


Fig. 42(b)

Fig. 42(c)

6.8 Assembly photos

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Fig. 43: shows completely assembled LeanGear ZS9 Panel

—
Fig. 44: shows cross-section view of Panel with wound type CT arrangement

Fig. 43

Fig. 44

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Fig. 45 (a) and Fig. 45 (b) shows view of LeanGear ZS9 with VInd circuit breaker.
—
Fig. 46: Rear side view of LeanGear ZS9 Panel

Fig. 45 (a)

Fig. 45 (b)

Fig. 46

Fig. 47: Main earth bar assembly

6.9 Earthing the Switchgear:
All cubicles have a copper bar for the earth system. The main earth bar is of standard length and is located at bottom of the cubicle. While joining the panels during erection, the earth bar is also to be connected with the earth bus of the adjoining panel using the copper link provided at the same location. Conical washers to ABB standard 9ADA334 must also be used throughout the earth bar connections. The earth bar, now connected and running through all the panels must be connected to the station earth system. Copper bars used for earth connection to the Aluzinc plate must be greased “type E” to avoid galvanic corrosion. Fig. 47 shows main earth busbar assembly views.

1 – Main Earth bar
2 – Scrapping Earth bar
3 – Main Earth bar Connecting Link
4 – Earthing Link for Earthing Switch

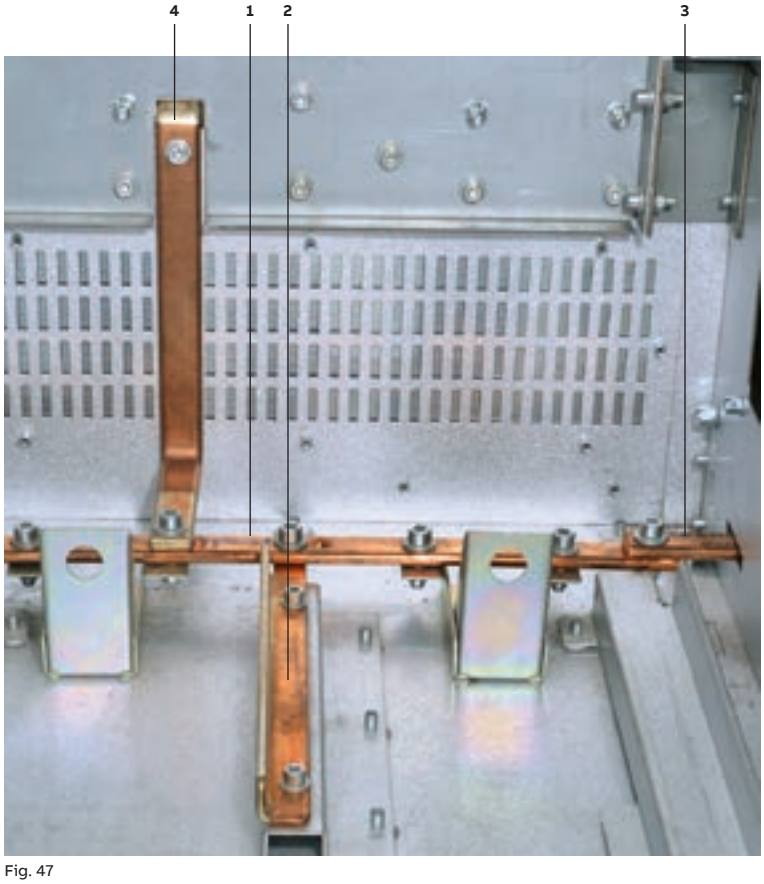

Fig. 47

6.10 Installation of interconnecting bundles:
The interconnecting bundles are supplied rolled up in the low voltage compartment or in the accessories. They are marked and fitted with ferrules or connectors at both ends. Openings are provided in the side walls of the low voltage compartment for these lines to be looped through from panel to panel as shown in Fig. 16

6.11 Final errection work:
In 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 the switching devices, withdrawable parts, isolating contacts, insulating parts, etc.
- Check connection of the main earthing bar to the installation earthing conductor (following the appropriate safety regulations).
- Check the painted surface for any damage if so, do necessary touch up as described in section 9.5.
- Remove all residues of materials, foreign bodies and tools from the switchgear.
- Clean the switchgear, rubbing down insulating parts with a soft, dry, clean, non-fraying cloth. Remove any greasy or sticky dirt.
- Correctly remount all covers removed during assembly and testing procedures.
- Ensure all the shorting wires/links used while testing are removed.
- Perform AC voltage testing of the main circuits according to IEC 62271-1. Pay special attention to voltage transformers and cables, etc. during this procedure. Switch the auxiliary and control voltage ON.
- Ensure PT’s are isolated and CT secondary is shorted while taking high voltage test.
- Carry out testing operations on switching devices manually or by electrical control, and simultaneously observe the relative position indicators.
- Check mechanical and electrical interlocks for effectiveness, without using force.
- Set the protective devices in the switchgear to the required values and check their function with test equipment.

07. Operation of the switchgear

Fig. 48: Manual charging

Note on safety at work
The relative work and operating procedures must be carried out carefully by trained specialists familiar with the installation, taking into account all the relative safety regulations according to the IEC and other relevant professional bodies, as well as local work regulations and instructions.

⚠ **Warning:**
Do not walk on the top surfaces of the switchgear.

7.1 Switching operation

⚠ **Carry out switching operations with the front doors closed.**

7.1.1 Withdrawable apparatus

Manual insertion from the test/disconnected position to the service position:

- Connect control wiring plug (Fig. 21 (a) and (b)).
- Close the VCB Compartment front door.
- Ensure that the apparatus is in OFF condition (in case of VCB).
- Fit hand crank on square spigot of the spindle mechanism, after opening the hole by turning slide (Fig. 49).
- Turn the crank clockwise (20 turns) until the stop is reached and the breaker or withdrawable part truck is in the service position.
- Observe the position indicator on low voltage compartment.
- Remove hand crank.

It must be noted that the spring loaded pin head (Item: 1 in Figure 17 (a)) will lie completely on the rear side of the panel door when the hand crank is moved from square spigot of spindle mechanism. This ensures that the rear part of the pin head has been shifted onto the hexagonal cap of the spindle and prevents unintentional wrenching of the spindle during panel service. Wrenching may lead to the circuit breaker blocking.

Note: The withdrawable part must not be stopped in any intermediate position in the travel range between the service and test/disconnected position!

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

- Ensure that the apparatus is in the OFF position.
- Reverse the procedure described above for insertion into the service position.

⚠ **Important note:**
Insertion and withdrawal of circuit breakers (and other withdrawable parts) must be gradual; in order to avoid shock or overpressure which could deform the mechanical interlock. If the operations are prevented, do not force the interlocks and check that the operating sequence is correct.

The maximum forces which can normally be applied to the charging spring lever is < 200 N for the EL operating mechanism. The torque normally required to carry out racking-in and racking-out is < 25 Nm. This value must not be exceeded. If operations are prevented or difficult, do not force them and check that the operating sequence is correct.Please also refer to the technical documentation of the circuit breakers for installation and operations manual.

⚠ **Caution:**
The insertion and withdrawal must always be carried out with the apparatus 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. 28) and hold it in the storage position on the withdrawable part.
- Open both the ramps and keep it in open position, so that the breaker can come out through the ramp to the floor.
- Move sliding handles (Fig. 49) inwards against the springs to release circuit breaker/earthing truck, and draw it out of the cubicle to the floor.
- Secure the position of the shutters with padlock.

—
Fig. 48: Charging the stored energy spring system
1. Opening push button
2. Closing push button
3. Signalling device for circuit breaker open/ closed
4. Signalling device for closing spring charged/discharged
5. Lever for the manual charging the closing spring
6. Mechanical operating cycle counter

—
Fig. 49: Using CB Racking Handle/Hand Crank for racking in/out of circuit breaker
1: CB Racking Handle / Hand Crank
2: Sliding Handle

7.1.2 Circuit breaker – type VInd

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 breakers supplied with spring charging motor for automatic charging have provision for manual charging also.
- On breakers with only manual charging systems or in the event of spring charging motor, open the door with the breaker in the disconnected position, pump the integrated charging handle approx. 10 times until the charged condition is indicated. See fig. 48.
- When the charged condition is reached, the charging mechanism is automatically disengaged, and any further strokes of the lever have no effect. See the fig.48. Pumping is effective if the lever is moved in the angle of 90 degrees.

Opening and closing the circuit breaker:

- Opening and closing operations of circuit breaker in service position should only be performed with the door closed.
- Operate the local or remote electrical control.
- Observe the switch position indicator.

Fig. 49

The switching operation counter for the circuit breaker automatically increases by one unit with each operating cycle.

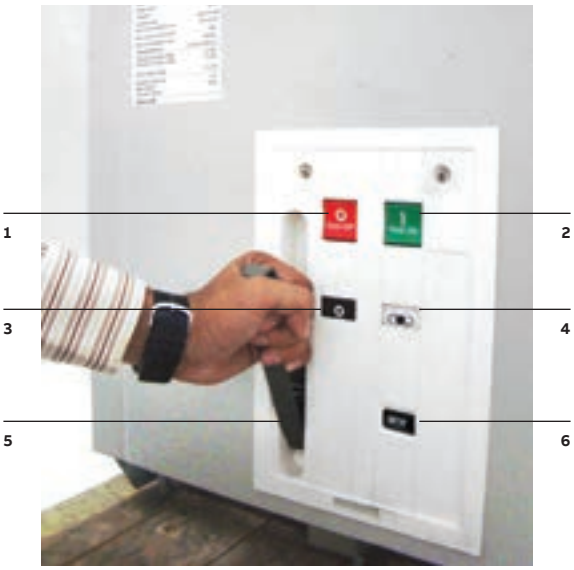

Fig. 48

For further details regarding operations and maintenance of VInd circuit breakers, see the instruction manual 1VYN403790-C.

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Fig. 50(a): Earth Switch assembly in Cable Comp. Compartment
—
Fig. 50(b): Location of ES handle insertion on Panel Front RHS
—
Fig. 50(c): ES handle insertion slot. Covered by flap with padlocking facility
—
Fig. 51(a): ES Handle with ES in open position
—
Fig. 51(b): ES Handle with ES in closed position

7.1.3 Earthing switch – type EK6

The earthing switch – has a snap closing mechanism which is independent of the rotation of the drive shaft.

An earthing switch allocated to a circuit-breaker is only enabled for switching when respective circuit breaker is in the test/disconnected position or removed from the switchgear panel. Only turn earthing switches on when the doors are closed. Refer Fig. 50 (a), (b) & (c).

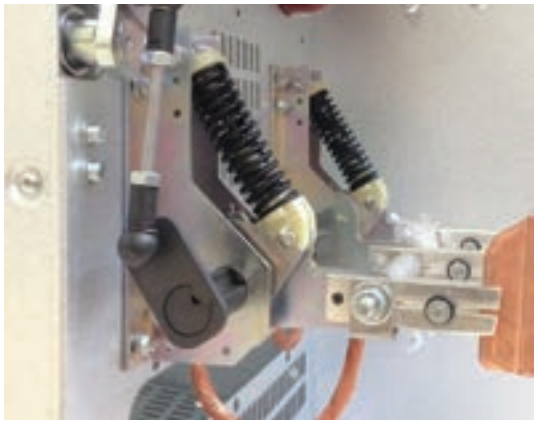

Fig. 50(a)

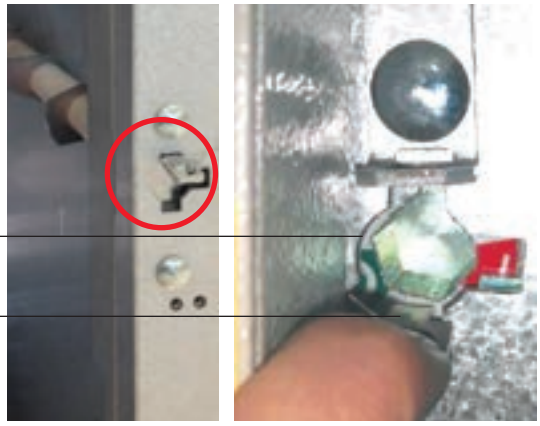

Fig. 50(b)

Fig. 50(c)

Manual opening and closing:
When the respective circuit breaker is in the test/ disconnected position, press the slide on ES handle insertion socket downwards and insert ES operating handle in socket.

⚠ Caution!
If the operation is prevented, do not force the interlock and check that the operation sequence is correct.

Turn the ES handle clockwise through approx. 150° until the stop is reached to close the earthing switch, or anticlockwise until the stop is reached to open the earthing switch. Make sure that the operating lever is turned right up to the stop in the opening process, to ensure that the earthing switch is in its defined limit position. Refer Fig. 51 (a) and (b).

Fig. 51(a)

Fig. 51(b)

—
Fig. 52(a): Fixed voltage transformer with fuse assembly in withdrawn position
—
Fig. 52(b): Fixed voltage transformer with fuse assembly in service position
—
Fig. 53(a): Bus-PT Trolley
—
Fig. 53(b): Bus-PT Trolley in Test position
—
Fig. 53(c): Bus-PT Trolley in Service position

7.1.4 Withdrawable metering parts

In incoming panels with metering requirement, fixed voltage transformer with withdrawable type fuse arrangement is provided in cable compartment. Typical snaps with HT Fuse assembly in connected and withdrawn position is shown in Fig. 52 (a) & (b). When HT Fuse assembly is in withdrawn condition, the associated openings on cable compartment get covered with shutter. This shutter is provided with padlocking facility to restrict access through these openings. The cable compartment have bolted cover which only authorized maintenance personnel should open. For possible replacement of fuses, please note the exact electrical data and article number of the primary fuses related to the order.

⚠ Caution!
Before access to VT's in cables compartment the circuit must be earthed.

In case of Bus-PT Panel, the Bus-PT trolley is withdrawable type as shown in Fig. 53(a). Fig. 53(b) shows view with Bus-PT trolley in test position and Fig. 53(c) shows view with Bus-PT trolley in service position.

Bus-PT trolley need to be inserted from test to service position with closed door.

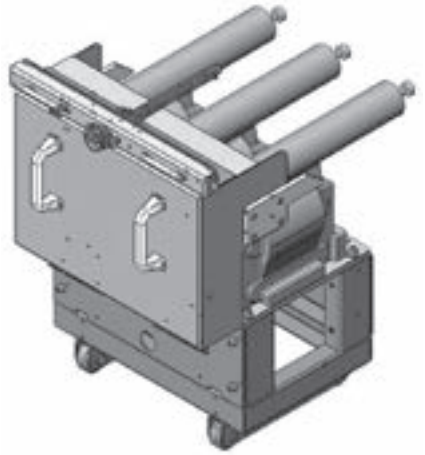

Fig. 53(a)

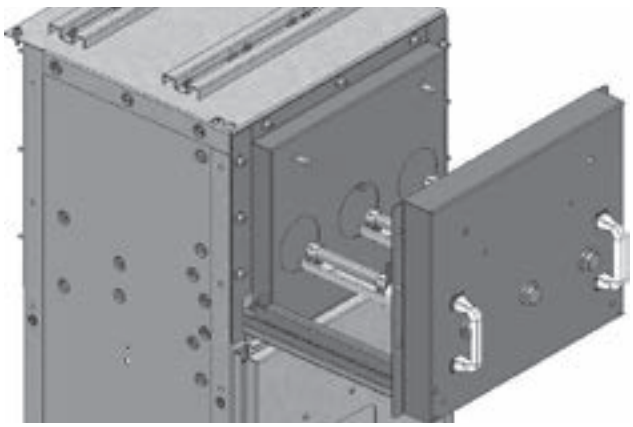

Fig. 52(a)

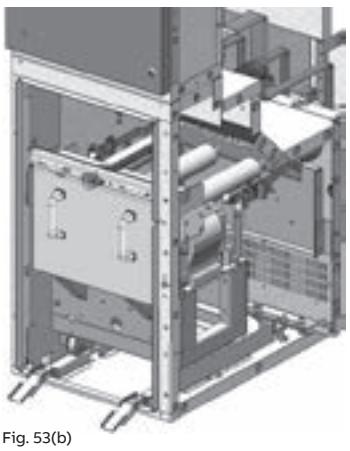

Fig. 53(b)

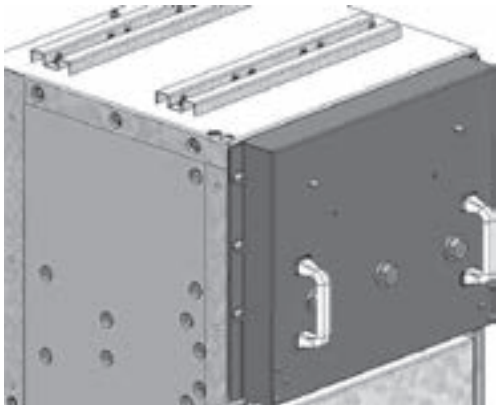

Fig. 52(b)

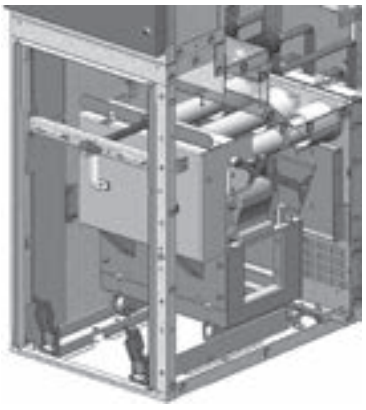

Fig. 53(c)

7.2 Test Procedure

7.2.1 Testing the off-circuit condition

Switchgear panels which are not equipped with capacitive voltage indication, checking the off-circuit condition is carried out with a HV tester on the contact pin, after the corresponding upper shutter or lower shutter has been opened.

If the panels 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 or the indicators. (Optionally, switchgear can be equipped with various types of indicators coming from various manufacturers).

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!

7.2.2 Testing with withdrawable parts

When functional tests are carried out on withdrawable parts, compliance with the conditions listed below should also be checked.

7.2.2.1 Withdrawable parts

Carry out testing for manually operated withdrawable parts:

- Turn hand crank in the required direction.
- Ensure that the spindle nut is correctly lubricated.

7.2.2.2 Checking auxiliary switch settings on withdrawable parts

Compliance with the interlock conditions in the test/disconnected and service position areas is ensured by position signalling switches located in the withdrawable assembly and are factory-set. During testing operations, the withdrawable part must be moved by hand with the racking handle fitted.

1. Settings in the area of the test/disconnected position:
   - Move the withdrawable part out of the test/ disconnected position towards the service position with a few turns of the racking handle.
   - Slowly move the withdrawable part back to the stop.
   - Auxiliary switch in test must then switch over just before the stop is reached.
   - Slowly insert the withdrawable part from the test/disconnected position towards the service position until auxiliary switch for service just operates.

2. Settings in the area of the service position:
   - Move the withdrawable part out of the limit position towards the test/ disconnected position with a few turns of the racking handle.
   - Slowly move the withdrawable part forward again to the stop. Auxiliary switch at service must then switch over just before the stop is reached.

7.2.2.3 Testing interlock conditions

1. The withdrawable part must only be movable from the test/disconnected position into the service position when the circuit breaker is open.

   Check the following conditions individually:
   - With the circuit breaker closed, insertion of the withdrawable part towards the service position must be locked after only half a turn of the crank in the clockwise direction.

   Use no force! Also see the note in chapter 8.3.1!

2. The withdrawable part must only be movable from the service position into the test/ disconnected position with the circuit breaker open.

   Check this condition as follows:
   - With the circuit breaker closed, withdrawal movement of the withdrawable part must be locked after only half a turn of the crank in anti-clockwise direction.

3. Closing of the circuit breaker must only be possible when the withdrawable part is in the defined test/disconnected position or service position.

   Check this condition as follows:
   - It must not be possible to close the circuit breaker with the withdrawable part in any position between the test/ disconnected position and the service position. Enabling of switching when the withdrawable part moves into the service position is carried out electrically by operation of service position auxiliary switch.
   - For movement into the test/disconnected position, the same enabling conditions mentioned above apply in the same way, in this case by means of test position auxiliary switch in the withdrawable assembly.

4. The control wiring plug must be inserted to socket to allow travel of circuit breaker from Test to service position.

   Check this condition as follows:
   - If control wiring plug is not inserted to socket, the flap on socket will restrict racking of circuit breaker from Test to Service position.

5. The earthing switch must be in open condition to restrict travel of circuit breaker from Test to service position.

   Check this condition as follows:
   - If earthing switch is in closed condition, the cam on earthing switch operating rod will restrict racking of circuit breaker from Test to Service position.

6. The circuit breaker must be in test/ disconnected position to allow closing of earthing switch.

   Check this condition as follows:
   - If the circuit breaker is in service position, the bracket on circuit breaker side sheet will restrict closing operation of earthing switch.

7. It must not be possible to open the control wiring plug, when the circuit breaker is in service position.

   Check this condition as follows:
   - If the circuit breaker is in service position, the CB compartment door cannot be opened due to closeddoor interlock. Hence until the circuit breaker is rackedout to Test position and CB compartment door is opened, the control wiring plug cannot be removed.

8. When earthing switch is closed, circuit breaker must be racked in to service position in respective panel.

   Check this condition as follows:
   - If earthing switch is closed, the cam on earthing switch operating rod will restrict the racking of circuit breaker from Test to Service position.

   Following is the brief list of minimum interlocks to be ensured:

   Withdrawable part in service-position
   - Circuit-breaker CLOSE
     - — Prevented to operate earthing switch
     - — Prevented to move withdrawable part to test position
     - — Prevented to remove (LV) control plug
     - — Prevented to open CB compartment door
   - Circuit-breaker OPEN
     - — Prevented to operate earthing switch
     - — Prevented to remove (LV) control plug
     - — Prevented to open CB compartment door

   Withdrawable part between service and test position
   - — Prevented to operate earthing switch
   - — Prevented to operate circuit-breaker
   - — Prevented to remove (LV) control plug
   - — Prevented to open CB compartment door

   Withdrawable part in test-position
   - Circuit-breaker CLOSE
     - — Prevented to move the withdrawable part in service-position
   - LV control plug disconnected
     - — Prevented to move the withdrawable part in service-position
   - Earthing switch CLOSE
     - — Prevented to move the withdrawable part in service-position

7.3 Service trucks

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

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, to enhance safety for personnel. The use of these trucks need removal of the switching device from the switchgear (circuit breaker) and its replacement with the truck. The units pre-set for use of earthing trucks are fitted with an interlock which, if activated, prevents their racking-in in the event of live voltage on the bus/cable section.

This truck is available in two versions:

- Main busbar system earthing.
- Power cable earthing.

During the racking-in phase, the power cable earthing truck only operates the bottom shutter and earths the contacts connected to the bottom branches (and therefore to the power cables) by means of the switchgear structure. These trucks can also be used in the bus-tie units. In this case, they earth the two sides of the main busbar system by using both type of trucks one after another.

⚠ Caution!

Do not insert 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 healthiness of Earthing Truck before inserting into Panel for Earthing. Ensure to connect the secondary plug and socket before racking the earthing truck to service position.

1. The truck is inserted in to the cubicle with pre-sensing contact in test position. Y-phase arm is normally connected with VDI.
2. Door is closed before racking earthing truck in to service condition.
3. The truck is then moved from test to service condition.
4. If the pre-sensing contact which is connected to VDI senses a voltage at cable/bus side when it get engaged with cubicle contact pin it will give an audible alarm as an indication that the primary side is live. If this happens one should stop racking-in and the truck should be moved back to test position and the reason for system being live to be investigated. After investigation and appropriate action for ensuring desired earthing of system, repeat step 3 & 4.
5. If no audible alarm is given by earthing truck, continue the movement of the truck till it is fully in service position. In this case VDI does not sense voltage on bus/cable side and the contactor do not operate thus energizing the solenoid. Rack-out the earthing truck to test condition and open the door, again rack-in the earthing truck to service condition. Now using the same handle rack-in the secondary contacts which is on the top of the earthing truck till it fully engages with the presensing contact arrangement.
6. Also in the above case, the contactor operates and cutoff the supply to solenoid, thus blocking the movement of earthing truck towards earthed position. This movement is also blocked in case of failure of auxiliary voltage supply. It is also mandatory to ensure that the VDI shall be in healthy condition before inserting the earthing truck in to switchgear.

08. Commissioning

8.1 Preparatory work
In preparation for commissioning, the following work must be carried out:

- Check the general condition of the switchgear for any damage or defects.
- Visually inspect the switching devices, withdrawable parts, isolating contacts, insulating parts, etc.
- Check connection of the main earthing bar to the installation earthing conductor (following the appropriate safety regulations).
- Check the paintwork for damage and, where necessary, touch up as described in (chapter 9.5).
- Remove all residues of materials, foreign bodies and tools from the switchgear.
- Clean the switchgear, rubbing down insulating parts with a soft, dry, clean, non-fraying cloth. Remove any greasy or sticky dirt as described in (chapter 9.4).
- Correctly remount all covers etc. removed during assembly and testing procedures.
- Instruct local operators regarding the basic details of regular handling of the switchgear.
- Check readiness for operation and switching status of electrical systems both upstream and downstream of the switchgear.

Depending on allocation of responsibilities, it may also be necessary to check the following equipment in areas adjacent to the switchgear:

- Power cables.
- Auxiliary cables.
- Auxiliary power source.
- Remote control system.
- Complete earthing system.
- Switchgear room equipment.
- Switchgear room conditions.

8.2 Measurements and tests
Tests at site are mandatory prior to energization of the switchgear.

The main purpose of site tests in general is to make sure the switchgear is ready for energization, not to repeat the factory testing and confirm the factory results. For manufacturer's recommendation of test scope and method please contact ABB's Service Department. After performing the tests, make sure that all normal service conditions are restored.

⚠ **WARNING**

- **The check is only successful if all the above tests have been passed successfully.**
- **If the inspection gives negative results, do not put the apparatus into service but, if necessary, contact ABB's Customer Service Department.**
- **Only energise the switchgear with all the withdrawable parts in the test position and with the circuit-breaker open.**

8.3 Start-up

- Comply with all relevant safety regulations.
- Ensure that the circuit breakers in the system are in the OFF position.
- Remove any existing earthing and short circuiting connections in the critical switching area.
- Energize the feeder cables.
- Connect the switchgear step by step, observing the signals 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 high voltage power supply being connected.
- Watch the irregularities of any kind.

09. Maintenance

9.1 Maintenance strategies

Preventive maintenance 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 the 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 only be performed in a careful manner 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 over-riding 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 shortcircuit breaking 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).

The following operating instructions must also be followed, together with this instruction manual in the individual cases concerned:

Installation, Operation and Maintenance Manual for VInd-12kV circuit breakers. Doc No.: 1VYN403790-C.

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

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 the 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:

Table 5:

Activity performed	According to section	Time interval in years	According to number of switching operations
Inspection	9.2	4[1]	As required[3]
Servicing	9.3	4[2]	As required[3]
Repair	9.4	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) See the Installation, Operation and Maintenance Manual of the circuit breakers.

Fig. 54: View of the busbar compartment
1 – Busbar
2 – Jumper
3 – Shroud
4 – Top Bushing

9.3 Inspection

- Where 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 once every four years by ABB authorised 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:
  - Effects of high temperature on the main circuits.
  - Traces of partial discharge on the insulating material parts.
  - Traces of leakage current on the insulating material parts.
  - Surfaces of the contact systems.

However, inspection must also to include correct mechanical/electrical operation of parts like switching devices, actuating, interlocking, protection and signalling devices.

- With regard to the switching devices, their separate Installation, Operation and Maintenance Manual should be followed.
- Check all switchgear accessories and auxiliary devices (e.g. storage batteries).
- No discharge should 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.
- Visually checking the contact system. We recommend to check isolating contact, are fully intact and do not show any sign of damage.
- The contact points should be cleaned if signs of overheating (discoloured surface) are visible. If any irregular conditions are detected, then relevant repair measures must be taken.

9.4 Servicing

If, during the course of an inspection in accordance with section 9.2, the need for cleaning measures has been established, proceed as follows:

- Where 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:
  Remove any dry dust deposits which are not strongly adherent using a soft dry cloth. Remove any more adhering dirt with ETHANOL F 25 M.
- Clean insulating surfaces and conductive components with ETHANOL F 25 M.
- Wipe down after cleaning, using clean water, and dry properly.
- Should any partial discharges occur as a consequence of the condensation phenomenon, a temporary remedy which is often effective is application of a thin layer of silicone over the surface involved. For a permanent remedy to this type of unusual problem, contact the ABB service department.

9.4.1 Maintenance in busbar compartment

Checking of the tightening main busbars:
Fig. 54 shows typical components inside busbar compartment.

- Unscrewing the screws on Top cover as shown in figure 35 to get access to Busbar compartment and assemblies.
- After the removal of the bulkhead from the circuit-breaker compartment, the main busbars are visible.
- Using a dynamometric spanner, check tightness of all the screws. Refer to the (chapter 6.3) for the tightening values.

Fig. 54

Fig. 55: Internal view of the cable Connection compartment
1 – Wound Type Current Transformer
2 – Cable Termination Point
3 – Earthing Switch moving contact
4 – Earthing Switch fixed contact
5 – Earthing Switch Universal mechanism
6 – Power cable gland plate

9.4.2 Maintenance in cable compartment

Fig. 55 shows typical components inside cable compartment.

Checking tightening of the cable busbar connections

- Open the cable compartment door; the cable busbar connections are visible.
- Using a dynamometric spanner, check tightness of all the screws. Refer to the table on (chapter 6.3) for the tightening values.

Note

The cable compartment door must be opened only after ensuring that the supply is dead and respective feeder's earthing switch is closed.

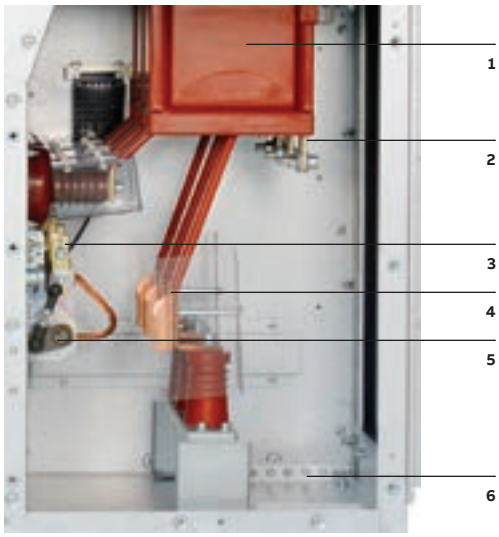

Fig. 55

Earthing switches – type EK6

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.
- Manually check correct changeover of the earthing switch signalling 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).
- If necessary, grease the mechanical moving parts by applying a thin layer of mechanical grease for moving parts.
- Carry out a visual inspection of Universal mechanism in Earthing Switch assembly and check any presence of dirt, humidity and signs of corrosion on the moving parts.

Instrument transformers

Cleaning and checking of the current transformers.

- Open the cable compartment door.
- Visually check the connections of the current transformers.
- Using a dynamometric spanner, check the tightness of all the screws. Refer to the table in (chapter 6.3) for the tightening values.

Cleaning and checking of the voltage transformers and antiferroresonance circuit.
Fixed version voltage transformers:

- Open the cable compartment door.
- Visually check the voltage transformer connections.
- Using a dynamometric spanner check tightness of all the screws. Refer to the table in (chapter 6.3) 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).
- In case of Isolatable type HT Fuse with fixed VT arrangement, also carry out a visual inspection of the Fuse assembly and remove any deposits of dust using a dry cloth that does not leave any deposits on the treated surfaces.

Voltage transformers in withdrawable version in cable compartment:

- Open the cable 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 woolen cloths).

Voltage transformers in withdrawable version used in Bus-PT Panel:

- Open the Bus-PT Panel door, which houses Bus-PT.
- 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 woolen cloths).

Cleaning and checking the anti-ferroresonance circuit:

- Open the miniature circuit-breakers positioned inside the low voltage compartment to remove the auxiliary power supply to the panel.
- Carry out a visual inspection on the anti-ferroresonance resistors and check for any presence of dirt.
- Manually check correct insertion of the cabling. Cleaning and checking of the HT 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 woolen cloths.

9.5 Repairs

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 paintwork areas on steel sheet and other steel parts by mechanical means, e.g. with a wire brush.
- Lightly grind the surrounding paint coat and carefully degrease the entire area. Then immediately apply an antirust primer and, after an 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 aluminium/zinc surfaces with a wire brush or cleaning pad, e.g. Scotch-Brite, and clean loosely adhering particles with a dry, non-fraying cloth. Next treat the cleaned parts with zinc spray or zinc powder paint and, finally, treat with aluminium spray for colour matching.
- Carefully remove any white rust from passivated operating parts and rust formation on phosphatized parts with a wire brush or metal-free cleaning pad, e.g. Scotch-Brite, and clean with a dry cloth. Then grease evenly (with Isoflex Topas NB 52).
- Follow the maintenance instructions in the manuals for individual equipment components.
- Check that the bolt connections at the contact points in the busbar system and the earth connections are tight, and that the contact system functions correctly.
- Where necessary, grease slide plates and bearings in the panel again or thoroughly clean them.
- Then grease them again with Isoflex NB 52 lubricant.
- 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 lubricant.

9.6 Risk-Based maintenance

ABB supports LeanGear users with optimized and cost effective strategies to ensure that the correct actions are implemented at the right time. Asset managers are fully supported in moving from conventional approaches (‘Corrective maintenance’ and ‘Preventive maintenance’) to advanced strategies (‘Risk-based maintenance’ and ‘Condition-based maintenance’). In this way, the service activity is no longer driven by predefined timeframes, observations and past experiences, but takes into account the actual condition of the equipment, the required reliability level and the expectation for life time extension. This assessment is performed by trained technicians as part of riskbased maintenance programs or is carried out automatically by on-line monitoring systems for condition-based maintenance solutions. Please contact ABB for further details.

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Fig. 56: Double bit key (to use the central locking device and the screw type door lock)
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Fig. 57: Crank handle (to move the Withdrawable part inside the panel)
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Fig. 58: Earthing Switch operating handle

9.7 Spare parts, auxiliary materials and lubricants

A spare parts list is available on request for procurement of spare parts. It basically includes moving parts and parts subject to wear. All assembly operations of spare parts/accessories must be carried out following the instructions enclosed with the spare parts, by ABB personnel or by suitably qualified customer personnel with in-depth knowledge of apparatus & panel (IEC 62271-1) and all the Standards aimed at carrying out these interventions in safe conditions. Should the maintenance be carried out by the customer's personnel, responsibility for the interventions remains with the customer.

List of Recommended spare parts and accessories:

– Circuit breaker compartment door handle
– Circuit breaker compartment ramp
– Support insulator
– Space heater
– Shroud
– Shroud cap
– Project specific components like indication lamps, switches, etc. as applicable

To order switchgear spare parts/accessories, refer to the ordering sales codes indicated in the technical catalogue and always state the following:

- Type and Serial number of Switchgear Panel
- Rated voltage of Switchgear Panel
- Rated normal current & breaking capacity of circuit breaker
- Rating of required electrical spare parts.

For apparatus specific spares part requirement, please refer apparatus Doc No : 1VYN403790-C "Installation, Operation and Maintenance Manual" or contact our service office.

Auxiliary materials and lubricants:

- Lubricant – Isoflex Topas NB 52
- DOW CORNING Silastic 1080 RTV Silicone Sealant
- Halogen-free cleansers (optional) – ETHANOL F 25 M (for general cleaning)
- Touch-up paint (optional) – Standard colour RAL 7035

9.8 Operating accessories:

Fig. 56

Fig. 57

Fig. 58

10. Product quality and environmental protection

The LeanGear ZS9 panels are produced in compliance with the requirements of international standards for the quality management system and environmental management system. In these fields, the level of excellence achieved is documented by quality certificates according to ISO 9001 and by the EMS according to ISO 14 001.

End of life of product
ABB is committed to complying with the relevant legal and other requirements for environmental protection according to the ISO 14 001 standard.

The duty of company is to facilitate subsequent recycling or disposal at the end of product life. During disposal of the product, it is always necessary to act in accordance 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 and the disposal of rest
Rubber	Disposal
Packing material – wood	Recycling or disposal
Packing material – foil	Recycling or disposal

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1VYN404790-022 - Rev: 0, en - Installation, operation and maintenance instruction manual - 2018.01 (LeanGear ZS9)