

Medium Voltage Products

ZN1

Installation, Operation and Maintenance Manual



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Sl. No.	Title	Page No.
1	Summary	6
1.1	General	6
1.2	Standards and Specifications	6
1.3	Operating Conditions	6
1.3.1	Normal operating conditions	6
1.3.2	Special operating conditions	6
2	Technical Data	7
2.1	Electrical Data	7
2.2	Resistance To Internal Arc Faults	7
2.3	Dimensions and Weights	7
3	Panel Design and Equipment	8
3.1	Basic structure and variants	8
3.1.1	Enclosure and partitioning	9
3.1.1.1	Ventilation of Panels	10
3.2	Compartments in Panels	10
3.2.1	Busbar Compartment	10
3.2.2	Circuit-breaker Compartment	10
3.2.3	Withdrawable parts	10
3.2.3.1	Withdrawable circuit-breaker parts	10
3.2.3.2	Other withdrawable parts	11
3.2.4	Cable connection compartment	12
3.2.4.1	Cable connections	12
3.2.5	Low voltage compartment	12
3.3	Interlocks / protection against erroneous operation	12
3.3.1	Panel internal interlocking	12
3.3.2	Interlocking between panels	13
3.4.3	Door interlocking	13
3.3.3	Locking devices	14
4	Device photos	15
5	Apparatus plug coding	17
6	Dispatch and storage	18
6.1	Condition on delivery	18
6.2	Packing	18
6.3	Transport at site	18
6.3.1	Loading by crane	18
6.4	Delivery	18
6.5	Intermediate storage	19
6.5.1	Panels with basic packing	19
6.5.2	Panels with seaworthy or similar packing with internal protective sheeting	19
6.6	Unpacking	19
7	Assembly of the switchgear at site	20
7.1	General site requirements	20
7.2	Foundations	20
7.2.1	Checking of foundation	20
7.2.2	Mounting of first cubicle on foundation frame	20
7.2.3	Mounting of second, third and further cubicles on the frame	22
7.3	Assembly of switchgear panels	22
7.4	Installation of the busbars	23
7.5	Cable connection	25
7.5.1	Power cables	25

7.5.2	Control cables	26
7.6	End covers	26
7.7	Laying the interpanel wires	27
7.8	Assembly photos	27
8	Operation of the switchgear	29
8.1	Commissioning	29
8.2	Preparatory work	29
8.2.1	Start-up	29
8.3	Switching operation	29
8.3.1	Withdrawable apparatus	30
8.3.2	Circuit-breaker - type VInd	31
8.3.3	Withdrawable metering parts	32
8.4	Test Procedure	32
8.4.1	Testing the off-circuit condition	32
8.5	Service trucks	33
9	Maintenance	34
9.1	General	34
9.1.1	Intervals for inspection, servicing and repairs	34
9.2	Inspection	35
9.3	Servicing	35
9.4	Repair	35
9.4.1	Switchgear in general	35
9.5	Testing with withdrawable parts	36
9.5.1	Withdrawable parts	36
9.5.2	Checking auxiliary switch settings on withdrawable parts	36
9.5.3	Testing interlock conditions	36
9.6	Spare parts, auxiliary materials, lubricants	37
9.6.1	Spare parts	37
9.6.2	Auxiliary materials, lubricants	37
10	Product quality and environmental protection	38

Safety first at all times!

To emphasize on safety, our instruction manual begins with the following recommendations:

Precaution

- Keep the Installation, Operation and Maintenance Manual accessible to all personnel involved in installation, operation and maintenance
- Ensure that the equipment is stored in a closed room free of dust and moisture till erection
- Ensure installation of switchgear and/or switchboard in closed rooms suitable for electrical equipment
- Ensure that installation, operation and maintenance are carried out by trained, qualified and authorized personnel only
- Fully comply with the legally recognized standards (IEC or local), regulations of the local electrical authority and stipulated safety requirements
- Ensure that activities related to switchgear are carried out as per relevant instructions / guidelines given in the manual and as well applicable local safety standards and work practices.
- Make sure that the specified limits are not exceeded under operating conditions of the equipment
- Pay special attention to the instructions marked with hazard symbol. 

Warning

- Always follow the Installation, Operation and Maintenance 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 to work on this equipment
- Do not override safety interlocks, either electrical or mechanical, during operation and/or maintenance

1 Summary

1.1 General

ZN1 is a three-phase, metal-clad, air-insulated 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 bus bar system.

The relevant customer specific documents explain details like technical data, equipment list for individual panels, schematic diagram and list of apparatus of individual switchgear.

1.2 Standards and Specifications

ZN1 switchgear panels comply with standards and specifications prescribed on IEC publications 62271-200 and 62271-1; for factory-assembled, metal-clad and type tested high voltage switchgears.

Additionally, the switchgear panels offer IP 4X and IP 2X degrees of protection for the enclosure and for partitions respectively, 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.

1.3 Operating Conditions

1.3.1 Normal operating conditions

The switchgear is suitable for normal operating conditions for indoor switchgears and switchboards in accordance with IEC 62271-1. The following limit values, among others, apply:

Ambient temperature:

Maximum + 40 °C

Maximum 24 h average + 35 °C

Minimum (according to "minus 5 indoor class") - 5 °C

The maximum site altitude is 1000 m above sea level.

Note: For higher ambient please consult ABB

1.3.2 Special operating conditions

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

For example:

- At altitudes above 1000 m, effects of the reduction in dielectric strength of air on the insulation level must be taken into account (please refer to graph in fig.1).
- Increased ambient temperatures must be compensated for; in the design of bus bars, branch conductors and withdrawable parts. Otherwise, the current carrying capacity will be limited.
- Heat dissipation in the switchgear panel can be improved through better air circulation by provision of fans for optimizing the current carrying capacity.

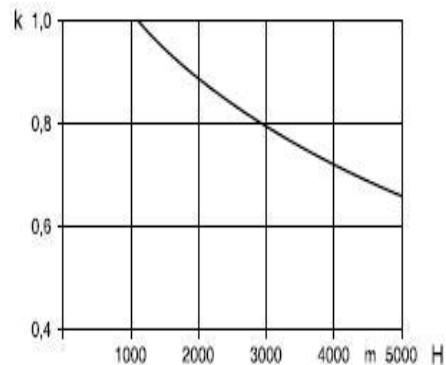


Figure 1:
Curve for the determination of altitude factor k in relation to altitude H

Note on any special climatic operating condition:

When switchgears are operated in areas with high humidity and/or with major rapid temperature fluctuations, there is a risk of dew deposits, which must remain an exception in normal operating conditions for indoor switchgear. Preventive action must be taken in consultation with the manufacturer to avoid this condensation phenomenon and any resulting corrosion or other adverse effects.

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

2 Technical Data

2.1 Electrical Data

Table 1: Main parameters for panels with circuit breaker

Rated voltage (U _n)	kV (r.m.s. value)	12
Rated short-duration power-frequency withstand voltage (U _{pr})	kV (r.m.s. value)	28
Rated lightning impulse withstand voltage (U _{pl})	kV (peak value)	75
Rated frequency (f)	Hz	50
Rated normal current (I _n) of Busbars	A	2000
Rated normal current (I _n) of Circuit-Breaker branches	A	1250
Rated peak withstand current (I _p)*	kA	66
Rated short-circuit breaking current of Circuit- Breaker	kA	26.3
Rated short-time withstand current (I _{st})*	kA	26.3
Rated duration of short-circuit (t _{sc})*	s	3

* The short-circuit withstand capacity of components must be taken in to account separately. For individual switching device data, see the Installation, Operation and Maintenance Manual for the relative switching device.



Note: For data on additional equipment e.g. relays and circuit-breakers, check the manual for specific equipment.

2.2 Resistance to Internal Arc Faults

The fault withstand capacity is 26.3 kA for 1 s - IAC AFLR 26.3kA, 1 s

2.3 Dimensions and Weights

Table 2: Dimensions of 12 kV units

Dimension	Notations	Metrics in mm
Height	A	1755
Width	B	600
Depth	C	1500 / 2050
Height of the basic part of Panel	D	1050
(Ref. Fig.2)	E	705 / 1100

Table 3: Weights of 12 kV units; including withdrawable circuit-breaker parts:

Rated Current in A	Mass in kg
1250	800

3 Panel Design and Equipment

3.1 Basic structure and variants

The basic ZN1 panel is an incoming/outgoing feeder panel with vacuum circuit-breaker using insertion technology. It is divided into circuit-breaker compartment (A), Busbar compartment (B), Cable compartment (C), Control cabinet (D) for the secondary equipment and integral gas duct (E). Apart from this, there are variants for various operating needs. Pictures in fig.3 to fig.6 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 bus bar metering and earthing). In equipment without busbar sectionalizing, a direct bar connection between the bus bars will be established. Further details about installation and equipping the switchgear can be obtained from relevant order specific documents.

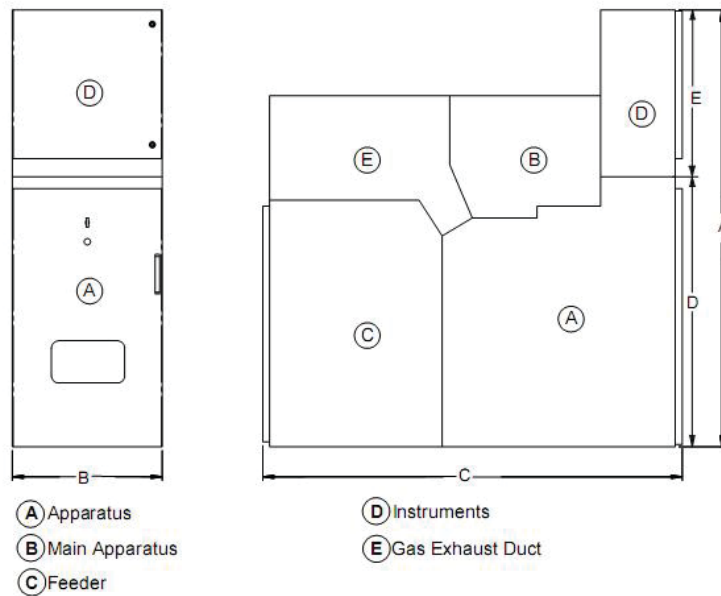


Fig.2: Basic structure for ZN1

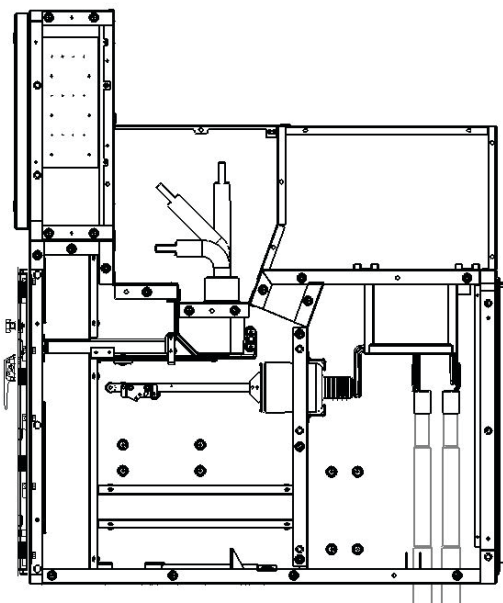


Fig. 3: Cross section of feeder unit 12kV, 1250A, 26.3kA.

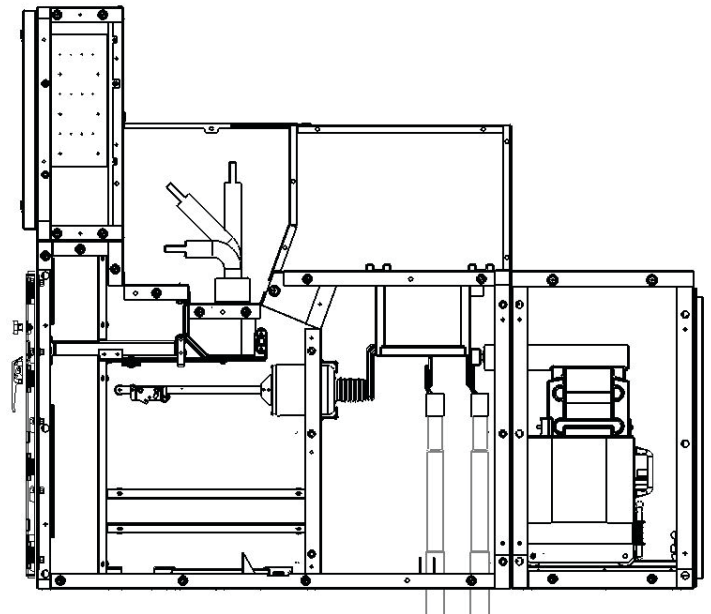


Fig.4: Cross section of Coupler unit 12KV, 1250A, 26.3kA

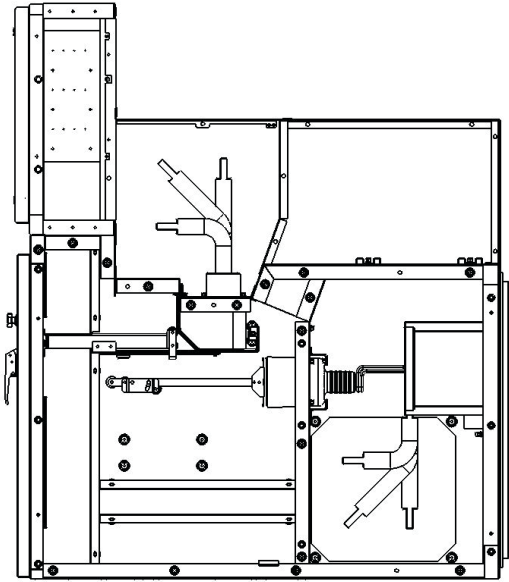


Fig. 5: Bus riser with withdrawable voltage transformer - 12kV, 1250A, 26.3kA

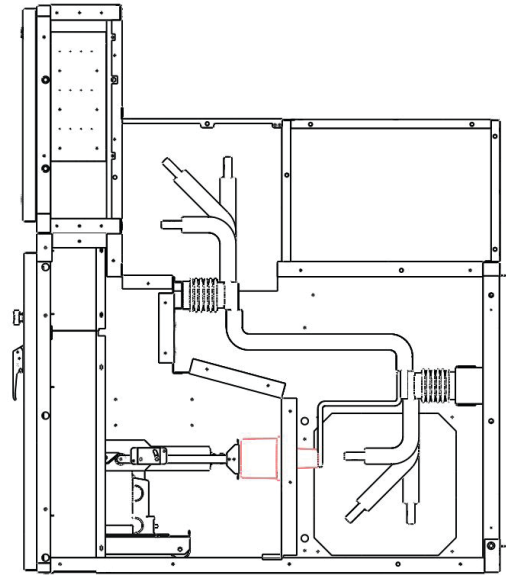


Fig 6: Bus riser with withdrawable voltage transformer - 12kV, 1250A, 26.3kA

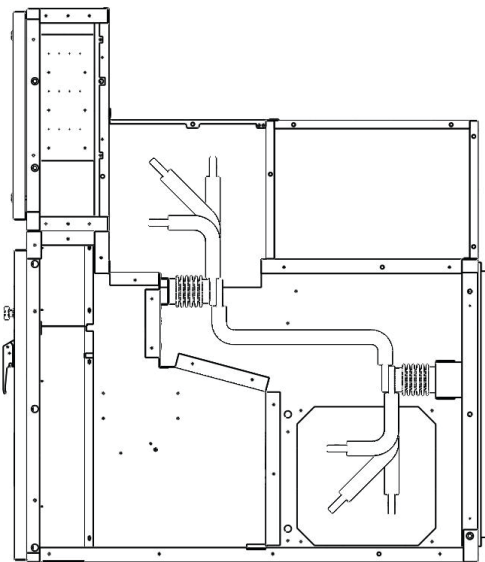


Fig. 7: Bus riser unit-12kV, 1250A, 26.3kA

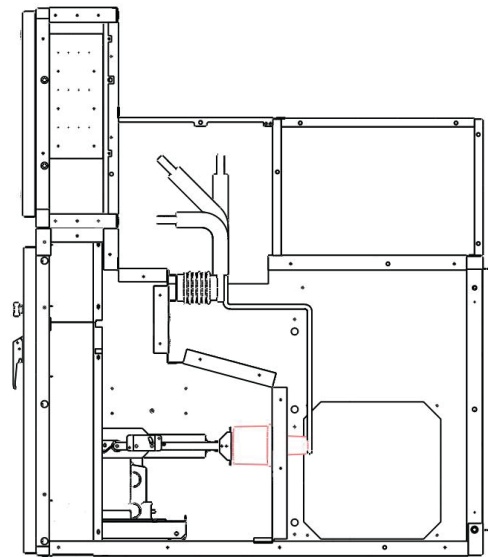


Fig. 8: Bus PT unit-12kV, 1250A, 26.3kA

3.1.1 Enclosure and partitioning

The enclosure and internal partitions of the panels are made of 2mm thick high quality coated steel sheets. 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. 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

Doors, end covers and shutters are made of high quality steel sheets, which undergo thorough cleaning through 7 tank process before powder painted. The finishing coat is of standard RAL 7035 color shade. (special color shades on request and by mutual agreement).

The circuit-breaker compartment door is pressure resistant design and can be padlocked also.

3.1.1.1 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.

This is also required in cases of higher ambient temperature (>40°C) and /or increased frequency (60 Hz).

It may also be necessary to provide additional cooling system in consideration of factors like current rating, frequency, ambient temperature and operating conditions.

3.2 Compartments in Panels

3.2.1 Busbar Compartment

The busbar compartment has three aluminum busbars of tubular cross section - laid in sections from panel to panel. They are held in place by tubular branch conductors. No special connection clamps are needed. Diameter and thickness of busbars vary according to the current rating. Sleeving of busbars and branch connections are optional.

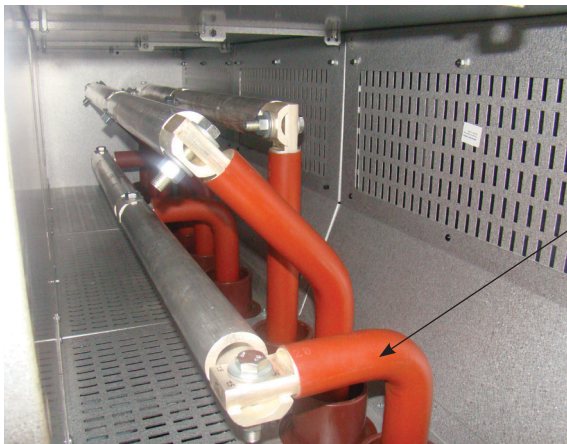


Fig.9: Busbar Compartment

3.2.2 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 mounting plate.

Metal shutters covering insertion openings, are also included. 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 Fig.8. 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.

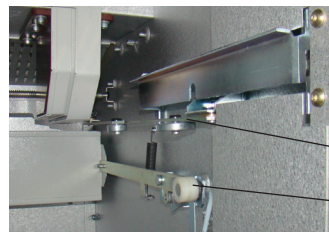


Fig.8: Shutter operating lever

In the test position, the breaker is still completely inside the panel with door closed. The ON / OFF push button and mechanical indicator located on the circuit-breaker, and CHARGED / DISCHARGED condition of the closing spring can be observed through the inspection window.

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

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

3.2.3 Withdrawable parts

3.2.3.1 Withdrawable circuit-breaker parts

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



Fig 11: Secondary plug and arrangement photo.

The withdrawable assembly establishes the mechanical connections between the panel and circuit breaker. The moving part with 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 auxiliary switch connected on the racking mechanism.

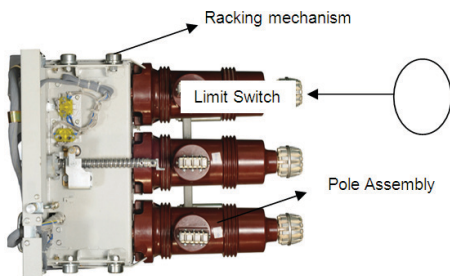


Fig 12: Racking mechanism.

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.

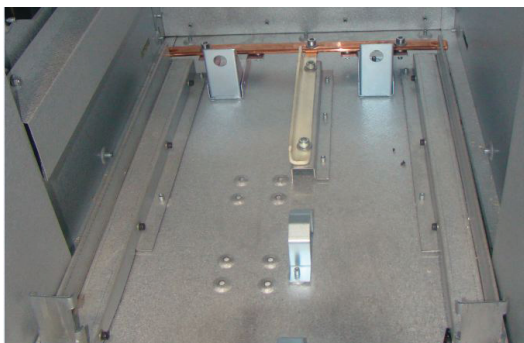


Fig 13: Earthing of circuit breaker inside the panel.

3.2.3.2 Other withdrawable parts

The withdrawable part can also be fitted with following trucks:

- Metering voltage transformers trucks with fuses. (Refer sec 8.3.3)
- Earthing truck without making capacity (for main busbar system and power cables)

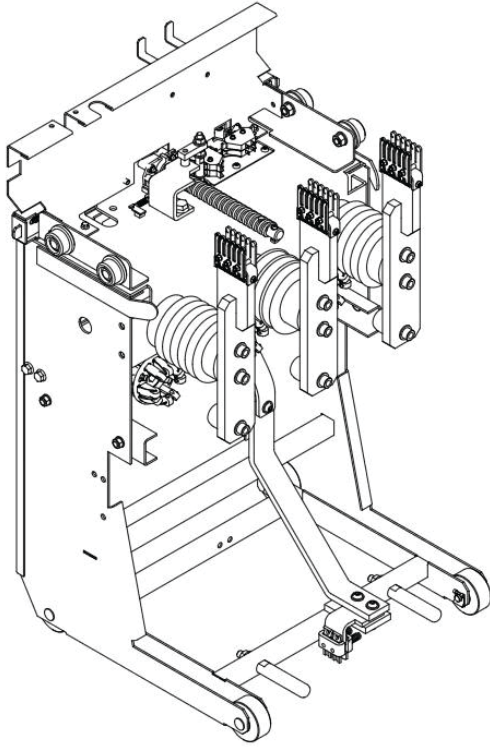
These earthing trucks are intended for fail-safe temporary earthing in cubicles for ZN1 type indoor switchgear. This earthing truck is suitable to earth a circuit which is under OFF condition. This earthing truck can sense the voltage even if we put in to a live circuit, which will prevent further racking-in by means of an interlock and thus ensure safety of the operators. Before using this earthing truck one has to ensure that the system which is intended to be earthed is in OFF condition.

These trucks are available in two versions:

- Earthing of the main busbar system.
- Earthing of the power cables.

It is imperative that the switchgear must guarantee maximum safety to the operator and highest plant reliability against accidental switching on the circuit during scheduled or unscheduled maintenance. This can be ensured by taking out the breaker from the panel and inserting the earthing truck to short the circuit with main earthing.

More details Ref. Section: 8.5



Busbar side
Fig 14: Earthing Truck

3.2.4 Cable connection compartment

The cable compartment contains current transformers and fixed or withdrawable voltage transformers depending on the requirements of the end customer.

The cable compartment is designed for installation of current transformers and other equipment like surge arrestors and voltage detecting insulators (VDI) etc. The firmly mounted voltage transformers are connected on the primary side with suitable connectors, while the removable / withdrawable type voltage transformers are fitted with HRC fuses.

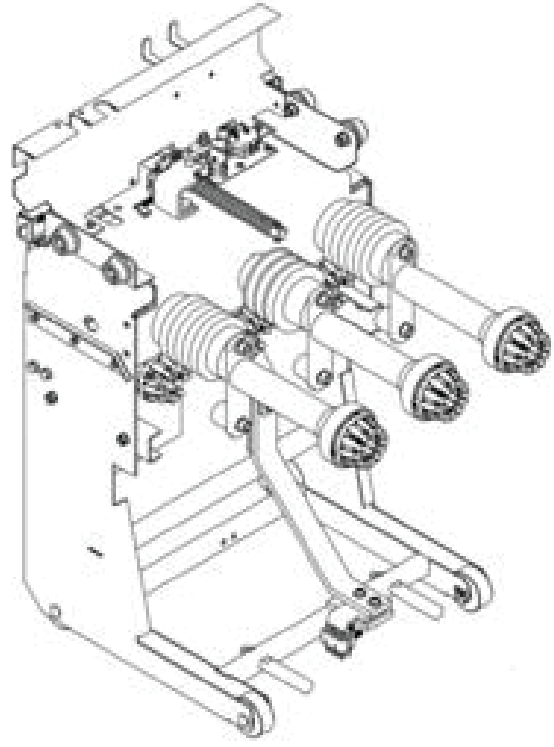
3.2.4.1 Cable connections

The panels can accommodate up to two numbers of parallel single-core cable of maximum cross section of 630 sq.mm can be connected back to back arrangement.

3.2.5 Low voltage compartment

The control cabinet 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. The height of the control cabinet is 705 mm. Higher height of 1000mm is available on request and mutual agreement.

If secondary devices are not intended for door installation,



Cable side

they are mounted inside the low voltage compartment. Provisions are made for the interpanel wiring through the low voltage compartment.

3.3 Interlocks / protection against erroneous operation

3.3.1 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 withdrawable part can be 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.
- The circuit breaker can be switched ON only when the withdrawable part is in the test or in service position. In the intermediate position, the switch is mechanically interlocked. When the circuit breakers have an electrical release, the interlock is also electrical.
- In panels with digital relay, prevention of malfunction of the switch can also be achieved by means of the relay software.
- Connecting and disconnecting the control wiring plug (Fig.9 or 27) is possible only in the test position of the

withdrawable part with door open condition.

- Details of other possible interlocks can be obtained from relevant customer specific order related documents.

3.3.2 Interlocks between panels

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

3.4.3 Door interlocking

The panels can be equipped with the following interlocks

- The circuit-breaker cannot be racked-in if the apparatus compartment door is open (Fig 14 & Fig 15)
- The apparatus compartment door cannot be opened if the circuit breaker is in service or in any undefined position (Fig 16 & Fig 17)



Fig.17 Apparatus door interlocking assembly

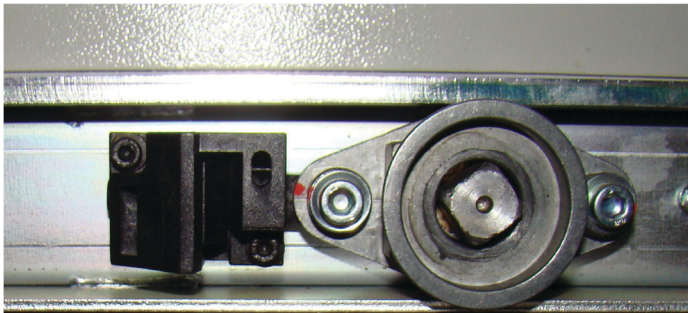


Fig.15 Circuit-breaker compartment door enabling device

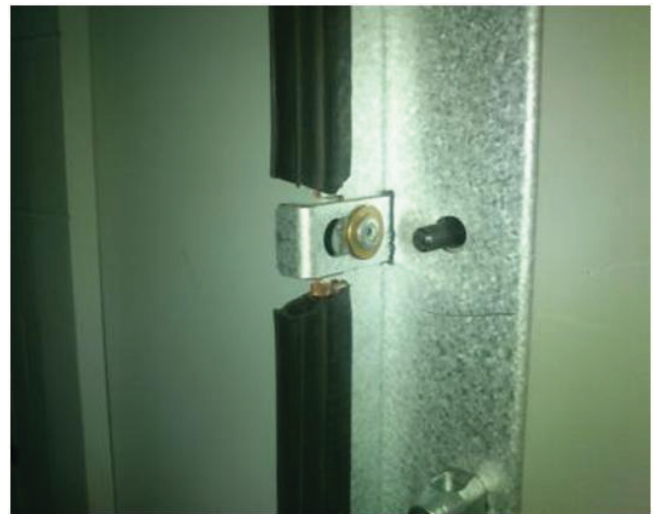


Fig. 18 Apparatus door interlocking plunger



Fig.16 Circuit-breaker compartment door enabling device

3.3.3 Locking devices

- The shutter can be secured independently of each other with padlocks when the withdrawable circuit-breaker part has been removed.

- Access to the circuit-breaker racking slot can be restricted with a pad lock.
- Access to the circuit breaker compartment can be restricted with a padlock.

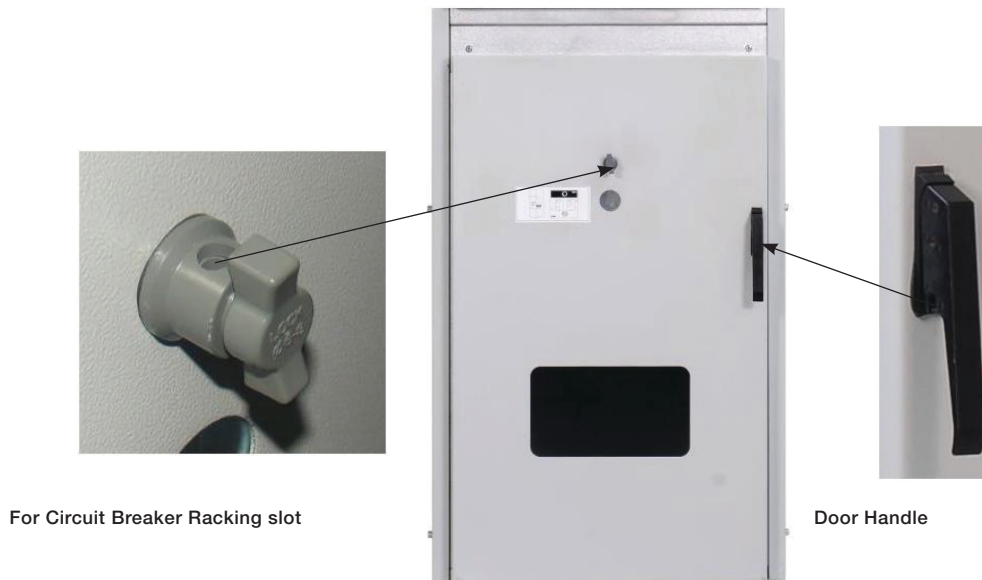


Fig 19: Locking Devices on C.B. Door

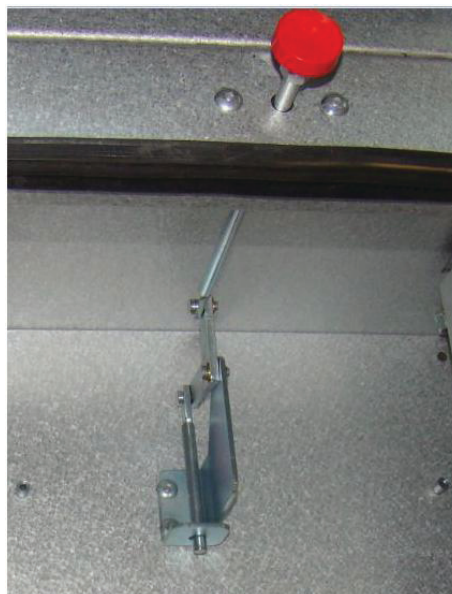


Fig.20: Push button (on request) for emergency mechanical OFF operation for breaker with front door closed when the withdrawable part is in service position.

4 Device photos



Fig.21: Feeder unit



Fig.22: External view of low voltage compartment



Fig.23: Circuit-breaker compartment, open withdrawable part in service position

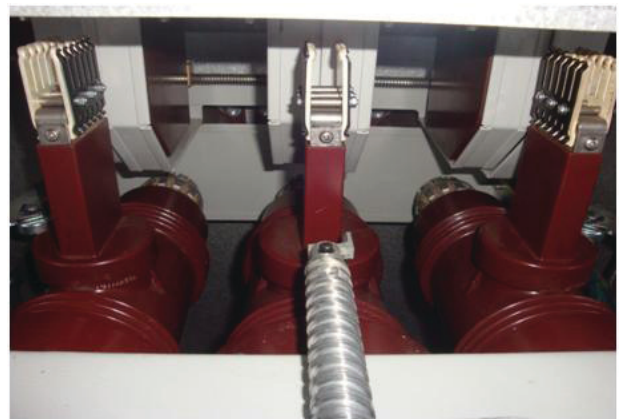


Fig.24: Circuit-breaker compartment, open withdrawable part in test position



1. Lever for the manually charging the closing spring.
2. Opening push button.
3. Closing push button.
4. Signaling device for circuit breaker open/closed.
5. Signaling spring for closing spring charged/discharged.
6. Handle for operating the truck locks.
7. Operating lever for circuit-breaker racking-in/out.

Fig 25: VInd circuit-breaker operating element



Fig 26: Circuit-breaker, type VInd, operating mechanism side, withdrawable assembly

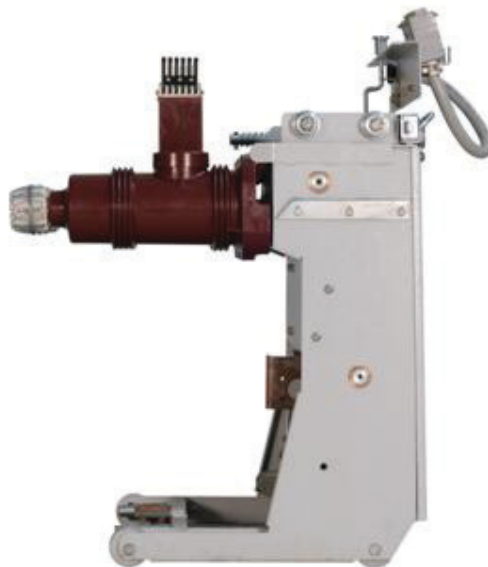


Fig.27: VInd type circuit-breaker pole side, pole top cover & actuating elements

5 Apparatus plug coding

The withdrawable assembly and the circuit breaker are coupled via a multi-pole control wiring plug connector. Ensure to connect the secondary plug and socket before racking the circuit breaker to service position.

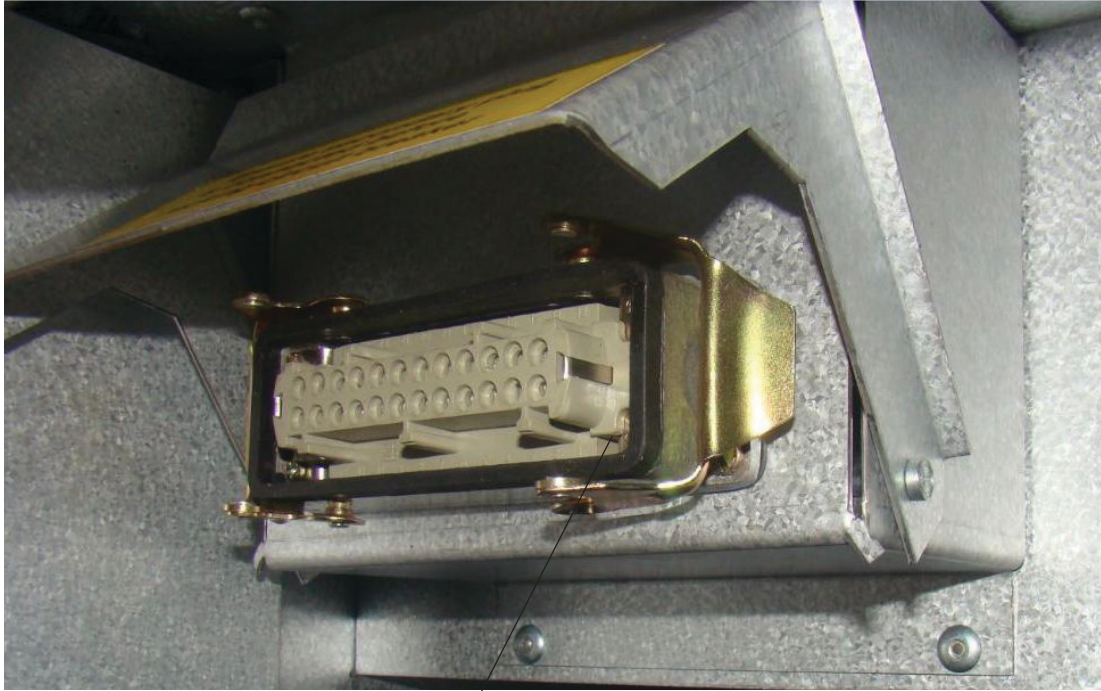


Fig.28: 24-pole connector

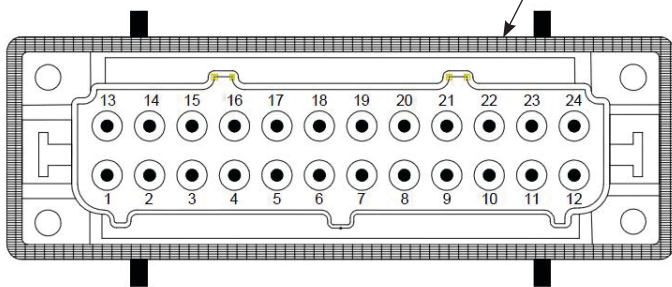


Fig.29: Control-wiring plug connector coding shown for a 24-pole connector

6 Dispatch and storage

6.1 Condition on delivery

At the time of dispatch, the ZN1 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.

6.2 Packing

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

- Panels with basic packing or without packing.
- Panels with seaworthy or similar packing (including packing for containerized shipments):
 - Sealed in polyethylene sheeting
 - Transport drying agent bags included
 - Moisture indicator included
- Observe the directions for use of the drying agent bags. The following applies:
 - Coloured indicator blue: contents dry
 - Coloured indicator pink: contents moist (relative humidity above 40%).

6.3 Transport at site

The transport units are normally comprised of individual panels and in exceptional cases, small groups of panels. Each panel is fitted with four lifting lugs. The following precautions must be taken during storage, transport and erection at the site.

- Transport panels upright.
- Take the high center-of-gravity into account.
- Carry out loading operations only after ensuring that all precautionary measures to protect personnel and materials are taken.
- Use the following:
 - Crane

- Fork-lift truck and/or
- Manual trolley jack.

6.3.1 Loading by crane:

- Fit lifting ropes of appropriate load capacity with spring catches (eyebolt diameter: 30 mm)
- Keep an angle of at least 60° from the horizontal for the ropes leading to the crane hook.
- Hang the unit using ALL four eyebolts!

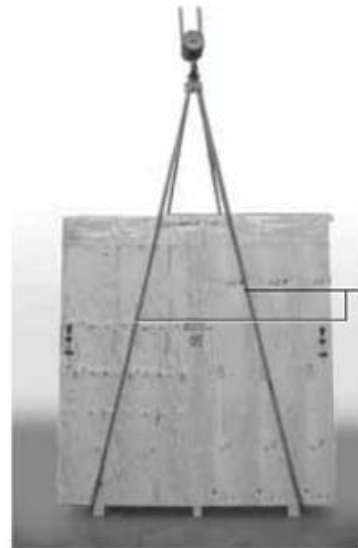


Fig 30. Lifting arrangement

6.4 Delivery

The responsibilities of the consignee when the switchgear arrives at the site include, but are not limited to, the following:

- Checking the consignment for completeness and for identifying any damages, including checking for moisture and its detrimental effects. In case of doubt, 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 to document any major damage.

6.5 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.

6.5.1 Panels with basic packing

- A dry well-ventilated storeroom with a climate in accordance with IEC 62271-1.
- The room temperature must not fall below $-5\text{ }^{\circ}\text{C}$.
- There must not be any other negative environmental influences.
- Store the panels upright.
- Do not stack panels.
- Open the packing, at least partially.

6.5.2 Panels with seaworthy or similar packing with internal protective sheeting

- Store the transport units protected from the weather, in a dry place, safe from any damage.
- 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, has been exceeded, the protective function of the packing can no longer be guaranteed. So, take suitable action for protecting the equipment if intermediate storage is to be extended further.

6.6 Unpacking

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 palette is suitable for lifting by fork-lift from all four sides provided that the width and length of transport palette is fitting.

If the packing includes vacuum bags they might be used for storage indoors or under shelter for a period of time adapted

to the ambient conditions. Packing for storage purpose can be supplied upon specific request.



CAUTION! The center of gravity may vary according to apparatus installed in panels. Assure that the panel is not damaged, tilted or dropped.

The lifting beam in fig: 30 is not included in the delivery. Consider a minimum 1.5 ton lifting capacity for each cubicle.

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

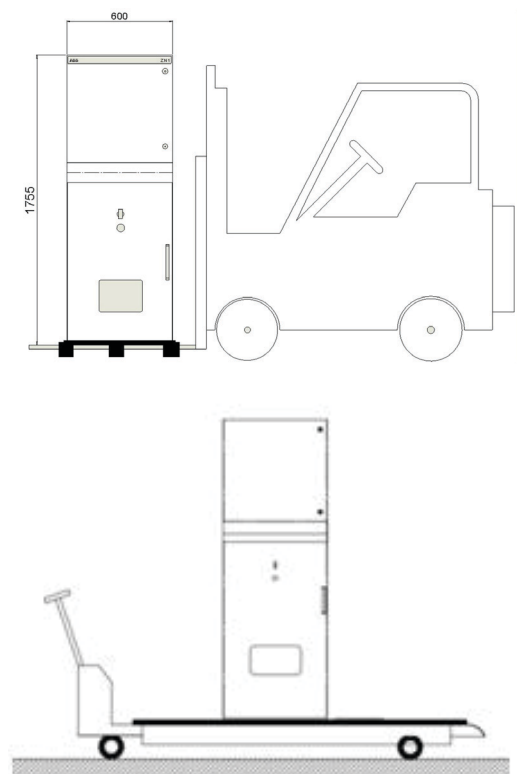


Fig.31 Transport advices

If a crane is not available, the panel can be shifted up to the foundation channel by using 2 pallet trolleys 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.

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

7 Assembly of the switchgear at site

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 authorized and responsible persons.

7.1 General site requirements

On commencement of installation on site:

- The switch-room must be completely finished
- Provided with lighting and electricity supply
- 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

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.

7.2 Foundations

7.2.1 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 leveled. The level difference more than the 2mm is not permitted. Level is to be checked using an appropriate water level based indicator. Use proper size

of ISMC 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. Ref Fig. 31

7.2.2 Mounting of first cubicle on foundation frame

Start installation of the cubicle from any one side. 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 GA and scheme supplied.

First cubicle on the frame is to be welded after the cubicle is properly mounted on the foundation frame.



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

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. The cubicles are provided with trestles, if necessary, in the front, at the back and in the middle along the switchgear. This is made by one or more layers of thin steel plates. If the cubicle is mounted against the wall make sure that the bolts for the rear cover are tightened before fixing the cubicle.

Next cubicle can then be installed and 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 M8X25 bolts. Remaining cubicles should be erected in the same way. Following are the coupling holes required to fix two panels. Refer Fig.32

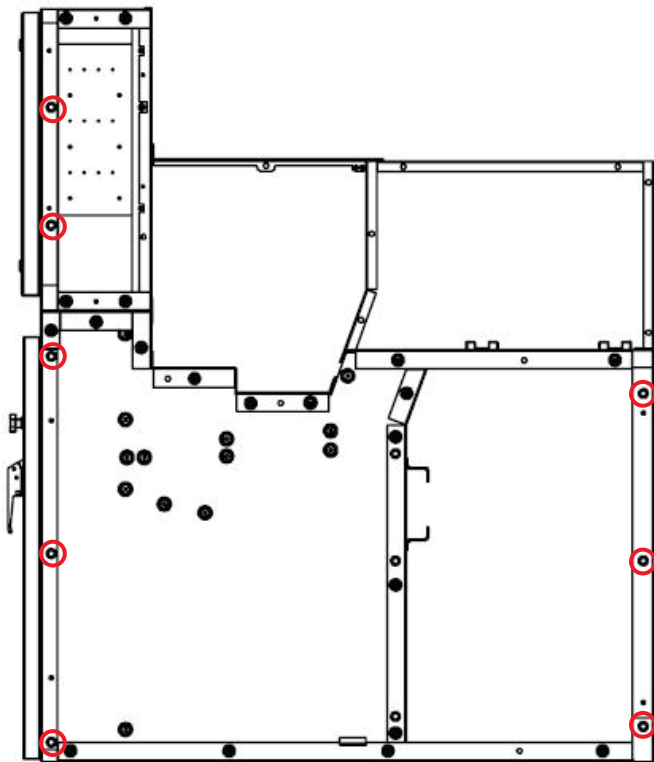


Fig.33 Coupling Arrangement

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

Follow the procedure described in 7.2.2. 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 weld other cubicles on frame till all cubicles are erected and busbars are coupled.

7.3 Assembly of switchgear panels

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

Thread	Recommended tightening torque Nm	
	Without Lubricant	Oil or Grease
M6	10.5	4.5
M8	26	10
M10	50	20
M12	86	40
M16	200	80

1. The rated tightening torques for fasteners without lubrication is based on a coefficient of friction for the thread 0.14. (the actual values are subject to an unavoidable range, in part not inconsiderable).
2. Rated tightening torques for fasteners with lubrication in accordance with DIN 43 673 standard.
3. Thread and head contact surface lubricated.

It is recommended that threads and the head contact surface of the bolt should be lightly oiled or greased, so as to achieve a precise rated tightening torque.

The individual installation stages are as follows:

- Remove withdrawable parts from switchgear panels and store them with suitable protection.
- Dismantle lifting eyebolts.
- Transport 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 2 mm. 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.

7.4 Installation of the busbars



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 the figure below. They are:

- side access while installing the adjacent cubicle
- removable roof plate

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. Busbar assembly work requires cleanness as the dielectric strength will be decreased by metal dust, etc.

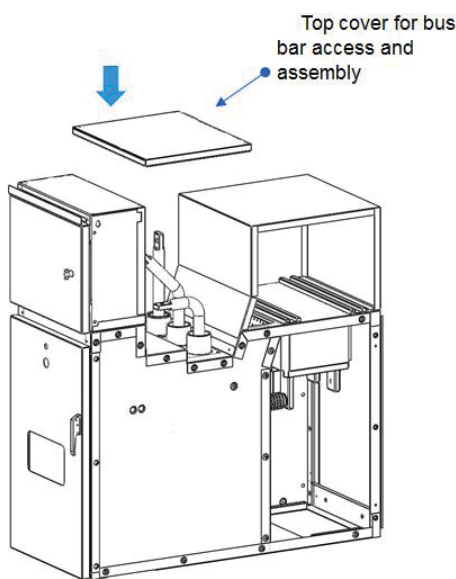


Fig. 34 Access for main busbar installation

If insulated bus bars are provided, care must be taken to protect the insulation against damage during storage and handling. Damaged insulation must be renewed. The air cushion type PVC protective covering will protect the insulated parts from damage during transport and during installation. Keep them covered on the busbars as long as possible until commissioning. Busbar assembly work requires cleanness as the dielectric strength will be decreased by foreign objects like metal dust, loose threads and oil patches.



Fig. 35: Busbar assembly.

Make sure the contact surfaces of busbars and connector parts are clean. Use only the strong type of conical spring-washers (ABB 9ADA334, DIN 6796) 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. Torque-meter should be used during erection, tightening torques are as tabulated (refer Table 4).

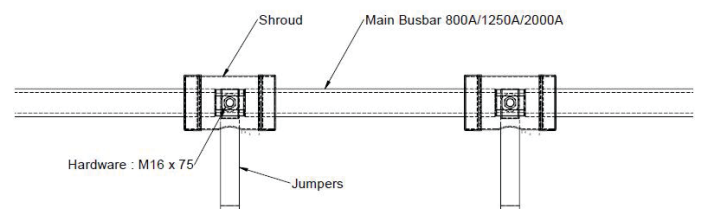


Fig.36: Shroud arrangement optional

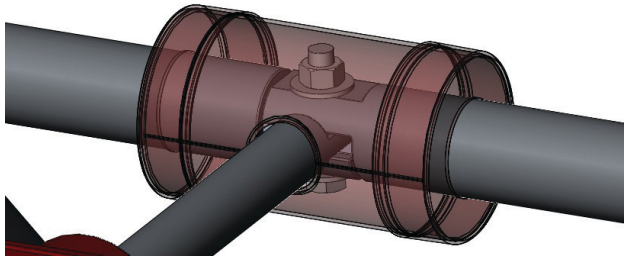


Fig. 37: Busbar Arrangement with shroud optional

Busbar Shrouds (Optional)

The busbar shrouds apply are provided for all main busbar-dropper connections (on special request). Check the correct size for tee boots and place them on the main busbar before fixing the main busbar onto the dropper. These shrouds are optional items and need to check with order related documents for availability.

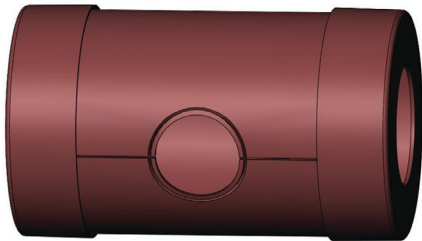


Fig.38:Busbar shroud optional

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 overlapping surfaces are cleaned thoroughly with a brass wire brush to remove oxidized surface (skin).
- Cleaned with metal free non-woven cloth.
- 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.



CAUTION!

The encapsulating sheet steel of cubicles may have sharp edges, please be careful !

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 bus 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.

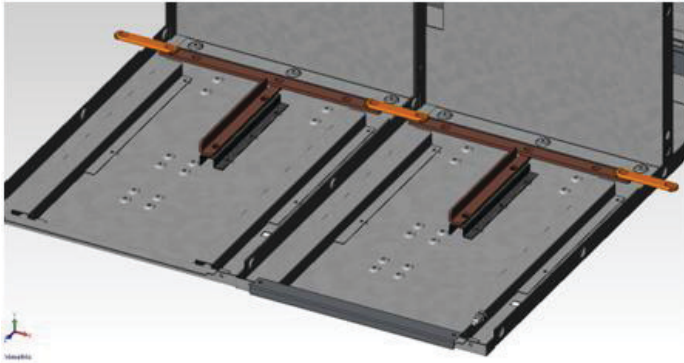


Fig.38: Main earth busbar assembly.

7.5 Cable connection

7.5.1 Power cables

The standard method for the entry of power cables in the switchgear is shown in Fig.39. 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.

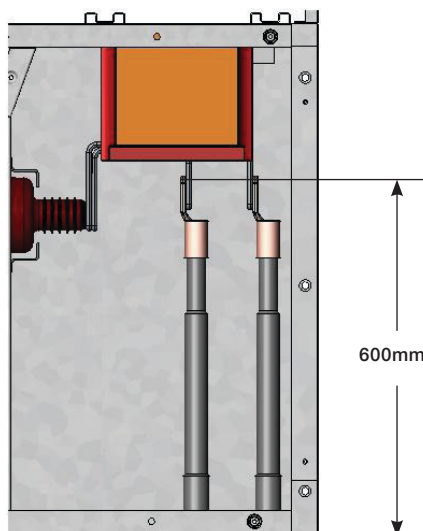


Fig.40: Cable connection.

Cable sealing ends are mounted on the cable cores according to the manufacturer's instructions. It is possible to use cable sealing ends of different manufactures (e.g. Raychem) but it is necessary to keep the length of the cable ends same, including cable sealing ends, which are given with respect to the distance of cable connecting bars from the panel floor covering. These bars have different versions; these are mainly based on number of parallel cables, CT rated current and short circuit rated current.

The bars are equipped with the holes for M16 screws. If M12 screws are used for cable connections, special washers with inner diameter suitable to M12 screws are supplied. In all cases, the earthing of cable screens is carried out on the strip-holding cable clamps. The cable strip is connected to the earth potential

It is also possible to place the removable arrangement of voltage transformer in the cable compartment. These can be fitted with HV fuses similar to those in the measuring panel. Three fixed mounted surge arresters can also be installed here. But in both these cases the number of parallel cables must be reduced.

Note: The cable glands or clamps and grommet 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 connected
- 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. The cables must be earthed before the accessing the cable compartment.

7.5.2 Control cables

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 low voltage compartment to the intended cubicle. Earthing connections are to be made to the copper bar located inside the low voltage compartment



Fig.41 Low Voltage compartment

7.6 End covers

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

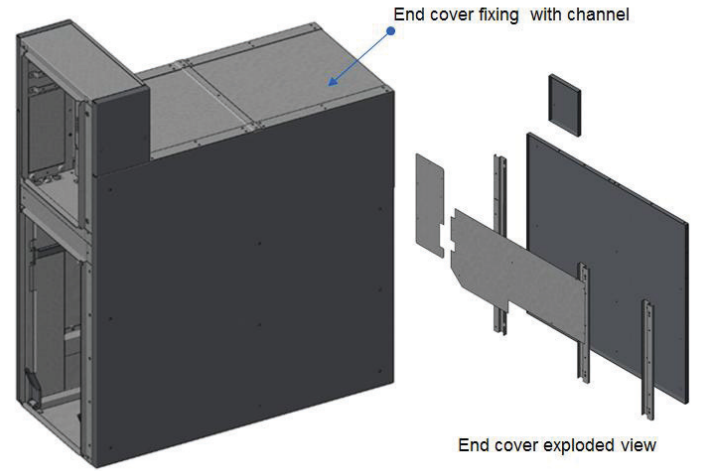


Fig. 42 End Cover assembly

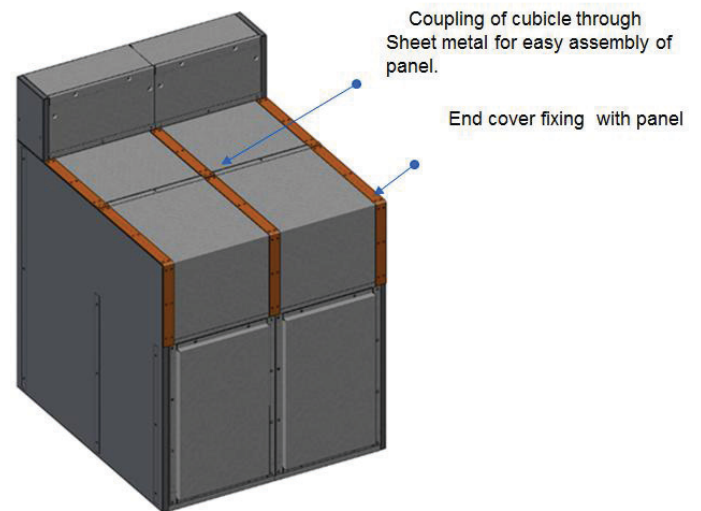


Fig. 43 End Cover final assembly



Fig. 44 Assembly photos

7.7 Laying the interpanel wires

The interpanel wires are supplied rolled up in a bundle, in the control cabinet. They are marked and fitted with ferrules at both ends. Openings are provided in the side wall of the control cabinet for these wires for looping from panel to panel.

7.8 Assembly photos



Figure 44: ZN1 cubicle with block type CT arrangement



Fig 46: Complete cubicle assembly



Fig 47: Cubicle rear covers assembly

8 Operation of the switchgear



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.

8.1 Commissioning

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.
- 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 section 6.4.
- 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.

8.2 Preparatory work

– 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
- switchroom equipment
- switchroom conditions

8.2.1 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

8.3 Switching operation



Carry out switching operations with the front doors closed.

8.3.1 Withdrawable apparatus

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

- Connect control wiring plug (Fig.27)
- Close the 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.47)
- 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 box
- Remove hand crank

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



Fig 48:Manual insertion





Important note:

Insertion and withdrawal of circuit-breakers (and other withdrawable parts) must be gradual; in order to avoid shock or over pressure 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 force normally applicable to the insertion/withdrawing lever is 260 N. In any case, the maximum applicable force must never exceed 400 N. Please also refer to the technical documentation of the circuit-breakers for installation operations.



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.27) 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.47) inwards against the springs to release withdrawable part, draw the withdrawable part out of the cubicle to the floor.
- Secure the position of the shutters with padlock (Fig. 18).

8.3.2 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
- 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/contactors in the disconnected position, pump the integrated charging handle approx. 10 times until the

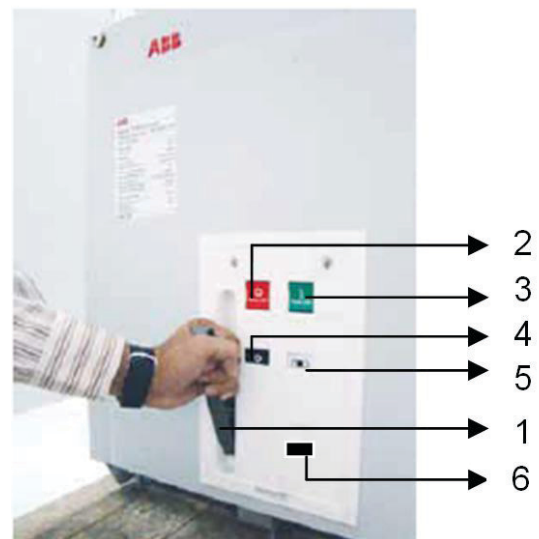
charged condition is indicated see fig. 48.

- 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°.

Opening and closing the circuit-breaker:

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

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



1. Lever for the manual charging the closing spring.
2. Opening push button.
3. Closing push button.
4. Signaling device for circuit breaker open/closed.
5. Signaling spring for closing spring charged/discharged
6. Mechanical operating cycle counter

Fig.49:Manual charging

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

8.3.3 Withdrawable metering parts

Handling of the withdrawable metering truck in the metering panel is as described in section 3.3.3.2, without the switching operations and interlocking functions.

Withdrawable metering trucks in incoming and outgoing feeder panels are put into the cable compartment using a ramp. They reach their service position immediately and engage in the panel earthing by means of the racking frame at the sides. The voltage transformers used correspond to the type used in the metering panel, and therefore HRC fuses can also be used along with the voltage transformers.



Fig 50: Withdrawable voltage transformer



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

The cables compartments have bolted cover which only authorized maintenance personnel can open. For possible replacement please note the exact electrical data and article number of the primary fuses related to the order.

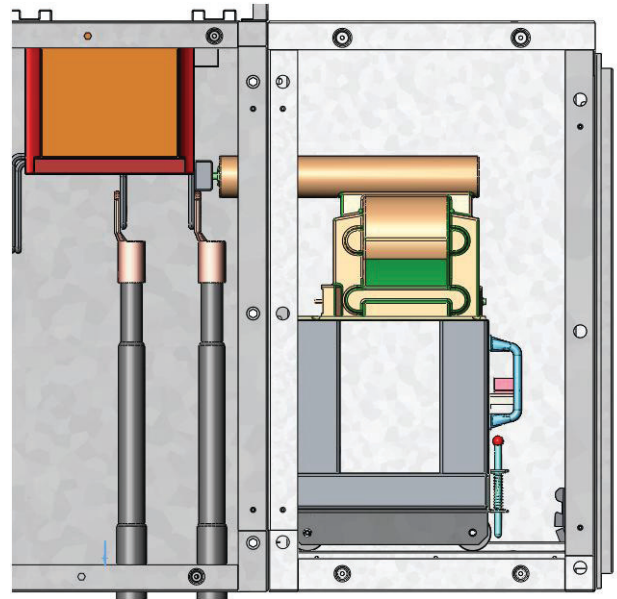


Fig51: VT in cable compartment.

8.4 Test Procedure

8.4.1 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!

8.5 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, as at further guarantee for personnel. The use of these trucks foresees removal of the switching device from the switchgear (circuit-breaker) and its replacement with the truck. The units preset 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 main busbar earthing truck only operates the top shutter and earths the contacts connected to the top branches (and therefore to the main busbar system) by means of the switchgear structure.

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.

Caution: Do not put this Earthing Truck to a live circuit. Always ensure the circuit is in OFF condition before putting Earthing Truck. Ensure auxiliary supply is on before putting earthing truck in to test condition.

The truck is inserted in to the cubicle with pre-sensing contacts in test position. The truck is then moved towards by means of racking handle from test to service condition. If the pre-sensing contact which is connected to VT or 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. One should stop racking-in if this happens. 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 the VT does not sense voltage on bus/cable side and the contactor do not operates thus energizing the solenoid. Now using the same handle rack-in the secondary contacts which is on the top of the earthing truck till it fully engages with pre-sensing contact arrangement.

If an audible alarm is given by earthing truck, when racking operation of truck has started, the truck has to be moved back to the test position and the reason for the system being live is to be investigated. Also in the above case, the contactor operates and cut-off 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. Its also mandatory to ensure that the VDI / VT shall be in good condition before inserting the earthing truck in to switchgear.

9 Maintenance

9.1 General

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 overriding instructions. It is recommended that ABB service personnel be called in to perform the servicing and repair work detailed below. The inspection and servicing intervals for some of the equipment/components (e.g. parts subject to wear) are determined by fixed criteria, such as switching frequency, length of service and number of short-circuit 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).

Operating instructions must also be followed, together with this Installation, Operation and Maintenance Manual of the apparatus.

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

9.1.1 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	8.2	4 ¹⁾	
Servicing	8.3	4 ²⁾	10000 ³⁾
Repair	8.4	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.

9.2 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 specially trained professional electricians / engineers
- Under abnormal operating conditions (including adverse climatic conditions) and/or special environmental stresses (heavy pollution and aggressive atmosphere (among others), inspection may be necessary at shorter intervals
- Inspection is primarily to carry out a visual check for grime, corrosion and moisture:
 - 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 include correct mechanical/electrical operation of parts like switching devices, actuating, interlocking, protection and signaling 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 must occur on the surfaces of equipment at operating voltage. This can, for example, be detected by characteristic noises, a clearly perceptible smell of ozone, or visible glowing in the dark
- Visually checking the contact system. We recommend to check isolating contact is housed, are fully intact and do not show any sign of damage

- The contact points should be cleaned if signs of overheating (discolored surface) are visible. If any irregular conditions are detected, then relevant repair measures must be taken.

9.3 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 in general:
 - Weakly adhering dry dust deposits: with a soft dry cloth.
 - More strongly adherent grime: with mildly alkaline household cleanser or 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 partial discharges occur as a result of condensation, application of a thin silicone film on the surface concerned is often effective as a temporary remedy. It is advisable to ask our after-sales service department for advice regarding permanent solutions to this type of unusual problem

9.4 Repair

9.4.1 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 anti-rust 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 color, or the relevant special color
- Carefully remove any white rust on aluminum/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 aluminum spray for color 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

9.5 Testing with withdrawable parts

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

9.5.1 Withdrawable parts

Carry out testing for manually operated withdrawable parts:

- Turn hand crank 121 in the required direction
- Ensure that the spindle nut is correctly lubricated

9.5.2 Checking auxiliary switch settings on withdrawable parts

Compliance with the interlock conditions in the test/disconnected and service position areas is ensured by position signaling switches located in the withdrawable assembly and are factory-set. During testing operations, the withdrawable part must be moved by hand with the crank 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 crank
- 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 crank
 - Slowly move the withdrawable part forward again to the stop. Auxiliary switch at service must then switch over just before the stop is reached.

9.5.3 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.

4. The control wiring plug must previously have been inserted.

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 apply in the same way, in this case by means of test position auxiliary switch in the withdrawable assembly.

5. It must only be possible to open the circuit-breaker (manually) when the withdrawable part is in the service position and the control voltage has failed.

9.6 Spare parts, auxiliary materials, lubricants

9.6.1 Spare parts

A spare parts list is available on request for procurement of spare parts. It basically includes moving parts and parts subject to wear. When parts are required, the serial number of the relative switchgear or switching device should always be quoted.

9.6.2 Auxiliary materials, lubricants

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

10 Product quality and environmental protection

The ZN1 panels are produced in compliance with the requirements of international standards for the quality management system and environmental management system. In these fields, the excellent level is proved by quality certificates according to ISO 9001 and by the EMS according to ISO 14001.

End of life of product.

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

During disposal of product, it is always necessary to act in accordance with local legal requirements in force. We have the following methods of disposal:

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

Raw material	Recommended method of disposal
Metal material (Fe, Cu, Al, Ag, Zn, W, others)	Separation and recycling
Thermoplasts	Recycling or disposal
Epoxy resin	Separation of metal material and the disposal of rest
Rubber	Disposal
Packing material — wood	Recycling or disposal

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

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