



# MNS ACB Section Design for Emax2 Service and Maintenance Instruction



# MNS ACB section design for Emax2

## Service and Maintenance instruction

Erection, Commissioning, Operation and Maintenance

### Consequences in the event of non-compliance

ABB shall not assume any liability for any of the following events:

- Negligent handling of the low-voltage switchgear system and non-compliance with the safety and working regulations as amended from time to time.
- Insufficient maintenance, non-compliance with the recommendations given herein or inappropriate repairs by personnel without the necessary training or adequate equipment.
- Transport damages of any kind.
- Inappropriate use.
- Modifications of the low-voltage switchgear systems which were not made by authorized specialized personnel.

### Technical reservations

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# 1 Related document references

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This Service and Maintenance Instruction for MNS ACB section designs for Emax2 refers to following documents:

<b>Num.</b>	<b>Document</b>	<b>Reference number</b>
1	Service manual – Low voltage switchgear MNS Rev 03, September 2012, or later.	1TGC902006M0403
2	E1.2 – Installation, operation and maintenance instructions for the installer and the user	1SDH000999R0002
3	E2.2 / E4.2 / E6.2 – Installation, operation and maintenance instructions for the installer and the user	1SDH001000R0002

Note: MNS Service Manual 1TGC902006M0403 on page 24 the table with values for weights per section is further expanded with values for weights for the Emax2 solution covered in this Service and Maintenance instruction ACB section designs.

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## 2 Safety requirements when working on electrical systems

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### 2.1 Understanding and managing the risk

Any person working on or near electrical systems is required to understand the danger and risk such work may impose to his/her life as well as to any person and property in the vicinity.

It is of utmost importance that the danger of electrical energy is understood and following characteristics associated with electrical energy should be noted:

- Electrical energy cannot be seen, heard or smelt, with the result that it is not possible to determine whether a circuit is alive or dead by relying on senses. Electrical apparatus must therefore always be considered **LIVE** until it is proved to be dead.
- Note, **DEAD** means zero volts between conductor and earth is confirmed.
- LIVE or DEAD status is determined and confirmed by equipment specifically designed for the purpose, NEVER by touch.

Persons must keep clear of electrical apparatus until authorized to work thereon and until it has been proved to be safe to work on. In order to prevent accidental contact access, the following must be controlled:

- Any prohibited area,
- Compartments containing potentially live apparatus/conductors/and terminals.

Electrical energy will follow along the path of least resistance. This may include all metallic and conductive components, the human body and many fluids. Conditions that influence the flow of electrical energy are:

- **Intact Insulation.** Under these conditions the circuit fulfils its designed function and the flow of energy can be predicted.
- **Breached Insulation.** Under these conditions the circuit may be short-circuited, by tools or by human body. This could prove hazardous to life and property. The flow of energy is random and may not be predictable. Damaged insulation must always be reported. There are two reasons for accidental contact with live parts:
  - Apparatus being made live whilst others are working on it,
  - Incompetence and unsafe or careless attitudes.

The highest danger to human life and property is in case of an electrical arcs. An electric arc is a dangerous release of energy created by an electrical fault or short circuit. It contains thermal energy, pressure waves, acoustic energy and debris. The intense energy and very short duration of an electric arc flash represents a very unique event. The temperature of an electric arc can reach up to 20 000 °C (35 000 °F), or two to three times the surface temperature of the sun! Exposure to these extreme temperatures both burns the skin directly and causes ignition of clothing, which adds to the burn injuries.

An electrical arc flash describes an explosive electrical event that presents an extremely significant hazard to people and property. It is of vital importance to use suitable tools and instruments as well as personal protection equipment for commissioning, inspection or any kind of maintenance work on electrical systems.

## **2.2 Basic principles and precautions to be observed**

In accordance with the valid local regulations, all installation and maintenance work involving MNS low voltage switchgear systems may only be performed by skilled and qualified personnel. For work at low voltage electrical system and components, the component to be modified or worked on must be isolated and confirmed dead.

The mandatory guideline for working in electrical systems in EN50110-1 2013. Minimum precautions are to be observed:

- THINK – The greatest safety asset is an alert, focused mind,
- Maintain strict discipline regarding safety procedures,
- Use appropriate personnel protection equipment and tools,
- Communicate clearly and ensure all communications are fully understood,
- Query all instructions that are unclear, not understood or that appear to be in breach of safety requirements,
- Prove all circuits to be safe if they have been unattended for a period of time,
- Maintain safety clearance (air Insulation) when working in the proximity of live conductors,
- Do not improvise. Use purpose designed equipment and tools,
- Use the pre-start checklist prior to starting or commencing any work.

## 2.3 Areas of work

Working on electrical systems may occur at different times and different conditions. Clearly understand the conditions helps to understand and eliminate any risk. In low voltage switchgear systems following work conditions are defined:

- Operation (operation of circuit breaker, main switch or push button while all doors and compartments are closed – closed door condition),
- Visual inspection (open doors and compartments to perform any visual inspection, no parts are touched and no physical work is performed on the electrical system - open door condition),
- Any other maintenance and work (e.g. modification, extensions, cable connection) on low voltage electrical system (either open or closed door condition),

The procedure for performing switching operations is defined by the instruction EN50110-1 2013 'Operation of electrical installations'.

## 2.4 Five safety rules

The DEAD circuit condition must be established prior to commencement of work and must be ensured at the place of work for the duration of work in compliance with the five safety rules (EN50110-1 2013 chapter 6.2):

- 1) Disconnect completely,
- 2) Secure against re-connection,
- 3) Verify that the installation is dead,
- 4) Carry out earthing and short-circuiting <sup>1</sup>,
- 5) Provide protection against adjacent live parts.

Any circuit that has not been proven dead is to be seen as LIVE.

## 2.5 Permit to work

Permission to start work shall be given by nominated person in control of electrical installation, (site or plant-responsible-person or PrP) to the nominated person in control of any work activity (work-responsible-person or WrP). The permit to start working must be recorded and signed by all parties in a Safety Permit to Work document.

<sup>1</sup> Earthing and short-circuiting is not mandatory as per EN 50110-1 2013 chapter 6.2.5.2. However, earthing becomes mandatory under the risks described therein and if also requested by local requirements or customer guidelines and where provision is made for earthing or other proper means are available.



## 2.6 Personal protection equipment

Personal protection equipment refers to clothing and additional devices to enhance personal protection to a safe level while working on electrical systems. Depending on the area of work certain level of PPE is required (see table below).

When working on or near live parts the minimum standard for clothing is that products shall be capable of withstanding e.g. electrical arc with an incident energy of 8cal/ cm<sup>2</sup>. For the majority of work on or near energized systems, this means that the clothing provided must be manufactured and tested to the following standards:

- For IEC: Class 1 Garments to IEC 61482-1-2 (Formerly ENV 50354 and CLC/TS 50354).

Required minimum PPE for the areas of work:

Hazard level	Activities	AC Main voltage level			
		< 25V ±20% and < 13A	< 25V ±20% and > 13A	> 25V ±20%...240/415V and < 63A	220/415/690V...1 000V and ≥ 63A
Open door, working on live parts	Confirming dead condition, other work on live parts			Work not executed unless technically required. Requires management approval, special training and tools.	
Open door, working near live parts	Working in switchgear when other live parts are covered			Arc flash PPE: Long sleeve shirt and trousers or coveralls, class 1 (IEC) or hazard cat 2 (8 cal/cm <sup>2</sup> ) NFPA, safety boots, safety visor and balaclava, helmet with hazard cat 2 (8 cal/cm <sup>2</sup> ), hearing protectors and insulated gloves class 0...1 000V	
Open door, visual inspection on or near live parts	Working in switchgear to verify condition e.g. thermal scanning				
Close door, procedures to achieve safe working condition	Operation of circuit breaker, main switch, pushbutton				
Working in dead condition	Working on switchgear where the current has been isolated and no access to operating parts			No requirement for arc flash PPE PPE to be selected in accordance to work (long sleeve shirt, trouser, safety boots)	

## 2.7 Safety relevance

This Service and Maintenance instruction contains further safety relevant aspects in the document. This is highlighted with the following symbol:



When working on specific tasks or areas in the switchgear it is mandatory to follow the safety requirements and advises outlined in this document.

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## 3 Packing and transport

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### 3.1 General

In all cases the ACB must be transported separately from the section. It is not allowed to transport it within the section. The ACB requires special attention during transport and handling. Please refer to original manuals 1SDH000999R0002 and 1SDH001000R0002, Chapter 2: Transport and checking on receipt, page 7.



**Remove all ACBs from sections and transport them separately!**

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If not special instructions are given by the customer, packing is carried out based on ABB shipping guidelines and a suitable method of shipping is selected.

Approximate values for weights per section **without** ACB:

ACB section	EQ [mm]	Approximate weight of one section [kg]
E1.2 up to 800 A 4P	400	400
	600	450
E1.2 up to 1600 A 4P	400	400
	600	450
E2.2 up to 1000 A 4P	400	400
	600	450
E2.2 up to 1600 A 4P	400	450
	600	500
E2.2 up to 2000 A 4P	400	500
	600	550
E2.2 up to 2500 A 4P	400	600
	600	650
E4.2 up to 2500 A 4P	400	700
	600	750
E4.2 up to 3200 A 4P	400	800
	600	850
E4.2 up to 4000 A 4P	400	800
	600	850
E6.2 up to 5000 A 4P	400	1 100
	600	1 150
E6.2 up to 6300 A 4P	600	1 200

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## 4 Erection and Commissioning

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### 4.1 IP cover: Impact to emergency escape paths

If the IP cover is applied and installed in the assembly of the ACB section for Emax2 (project dependent), as per IEC 60364 the distance for an evacuation route must consider the circuit breaker in its fully withdrawn position. Accordingly the IP cover size must be considered for calculation of switchgear room arrangement dimensions.

This applies to the Pagoda dimensions as well.

### 4.2 Surge Protection Device (SPD) Compartment and check of SPD function

If the SPD compartment with SPD and back-up protection is applied and installed in the assembly of ACB section for Emax2 (project dependent), and equipment is being installed, removed or maintained in the SPD compartment ensure the safety guidelines are followed.



**Observe all safety rules for working on electrical equipment!**

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Steps to follow to check proper conditions of SPD and back-up protection:

- 1) Ensure main backup protection MCB/ MCCB is not tripped/open
- 2) Ensure main backup protection fuses are not blown
- 3) Ensure SPD end of life indicator is not activated
- 4) Ensure SPD other indication doesn't indicate fault state

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#### **Hazard of electrical shock!**



- The equipment must only be installed and serviced by qualified and skilled personnel.
  - Before working on or inside the compartment turn off all power supplying this equipment.
  - Always use a properly rated voltage sensing device to confirm power is off and equipment is in dead condition.
  - The electrical system or equipment to be worked on must be effectively grounded per all applicable codes.
  - Failure to follow these instructions may result in serious injury or death!
-

### 4.3 Minimum amount of main cables

To comply with cross section for current ratings the minimum amount of external I/O main cables must be connected to the cable connection units (CCUs).

Type of Emax	Minimum recommended amount of cables							
	per 25% PE		per 50% PEN / N		per one phase or 100% N			
	300 mm <sup>2</sup>	500 / 630 mm <sup>2</sup>	300 mm <sup>2</sup>	500 / 630 mm <sup>2</sup>	300 mm <sup>2</sup>	500 / 630 mm <sup>2</sup>		
E1.2 630 A	1		2	1	4	2		
E1.2 800 A								
E1.2 1000 A								
E1.2 1250 A								
E1.2 1600 A	2	1	3	2	6	4		
E2.2 1600 A								
E2.2 2000 A								
E2.2 800 A			2		1	4	2	
E2.2 1000 A								
E2.2 1250 A			3		2	6	3	
E2.2 1600 A								
E2.2 2000 A			4	2	3	8	4	
E2.2 2500 A								
E4.2 2000 A			2	1	4	2	8	4
E4.2 2500 A								
E4.2 3200 A			3	2	6	3	12	6
E4.2 4000 A								
E6.2 4000 A								
E6.2 5000 A	4	3	8	6	16	11		
E6.2 6300 A	6			4	7	24	12	

Connection point for main cables is designed for cable lugs acc. DIN 46235.

For 300 mm<sup>2</sup> cables the hole in CCU is Ø14 mm for M12 bolts.

For 500/630 mm<sup>2</sup> cables the hole in CCU is Ø22 mm for M20 bolts.

## 4.4 Location of external main cable connection point

For external main cables, cable connection units (CCUs) are designed according connection type, i.e top or bottom entry.

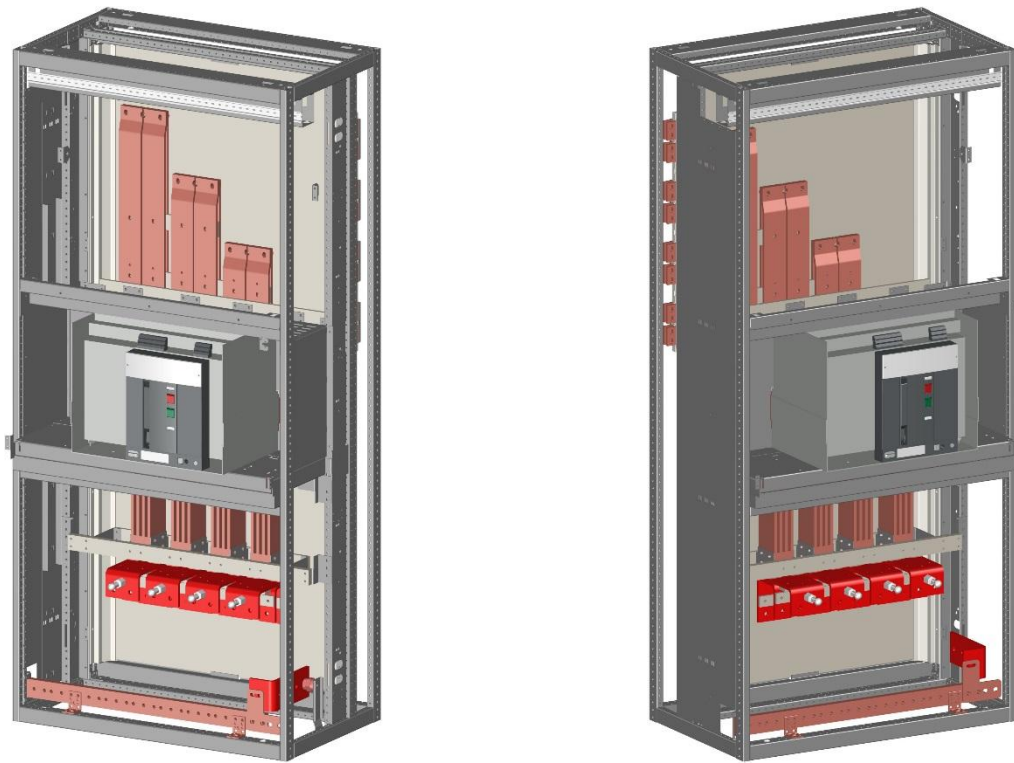


Figure 1: Location of cable bars, connection type BBT/IOB

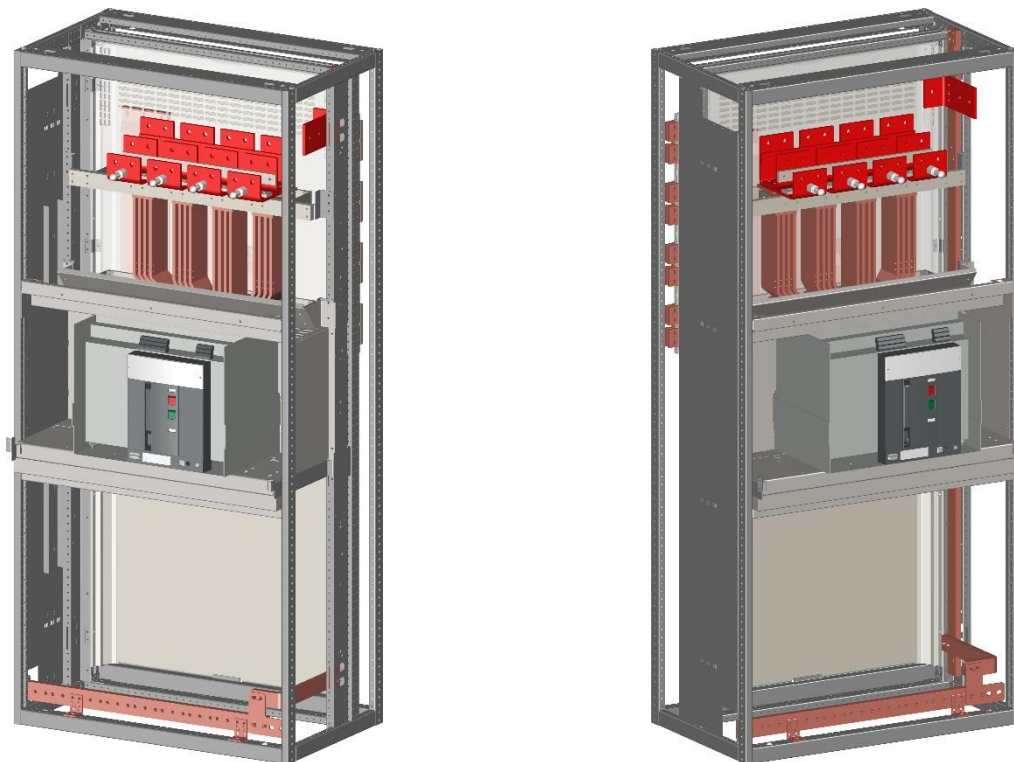
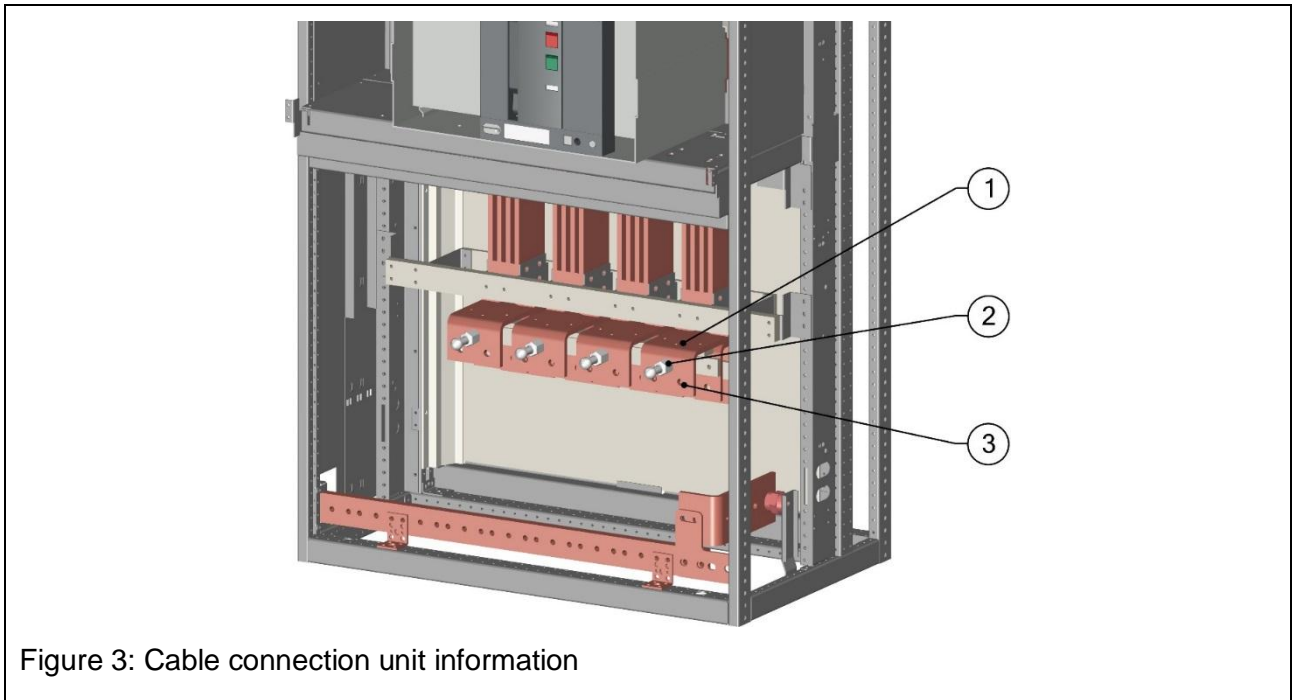
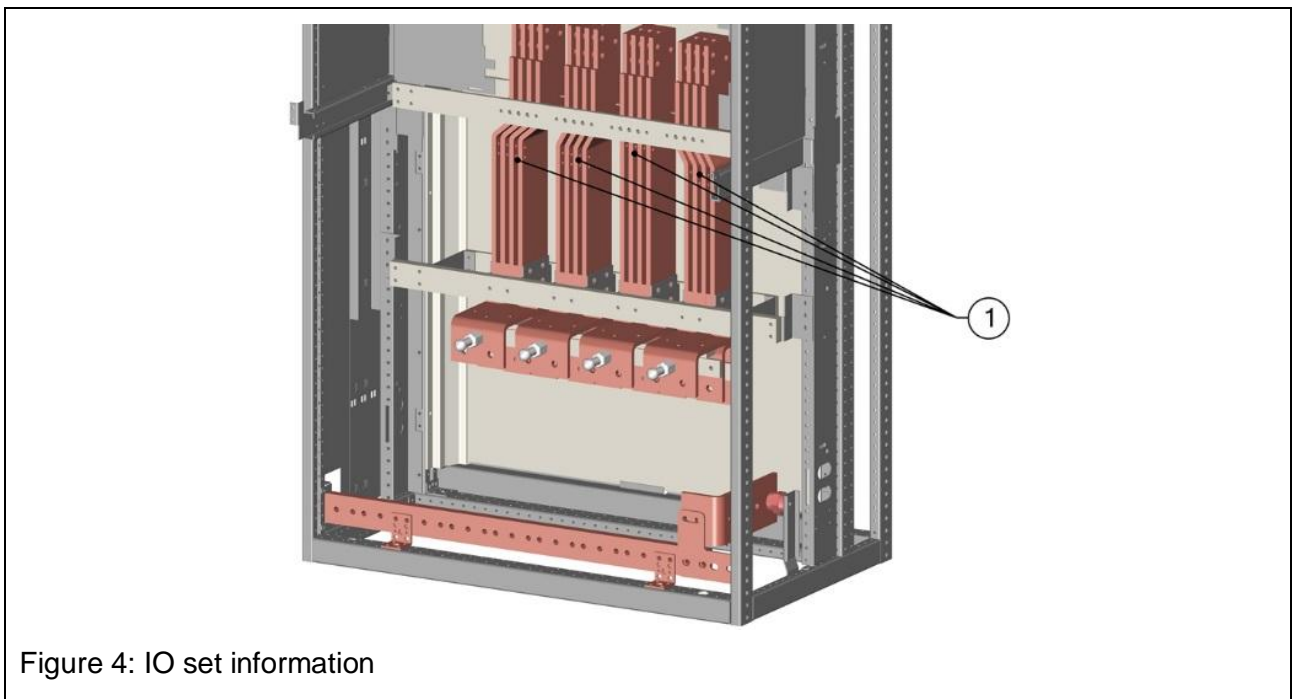


Figure 2: Location of cable bars, connection type BBT/IOT



Cable connection unit parts:

- 1) Voltage tap (in most cases of CCUs)
- 2) Earthing bolt
- 3) Cable connection



IO set parts:

- 1) Voltage tap (always)

## 4.5 Location of external control cables

For external control cables there are two wiring ducts situated in section. The vertical on the right side and the horizontal on the top of the section. The vertical wiring duct on the right side consists of three plastic tubes with external diameter 25 mm. If the section is the last one in the switchgear line up the external diameter of tubes is 20 mm.

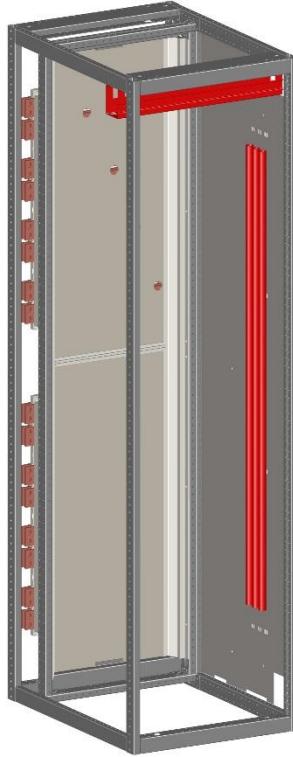


Figure 5: Position of vertical and horizontal wiring duct for customer external cables

### **Important:**

It might be required to separate control and serial communication cables. Consider this requirement before using all tubes for control cabling.

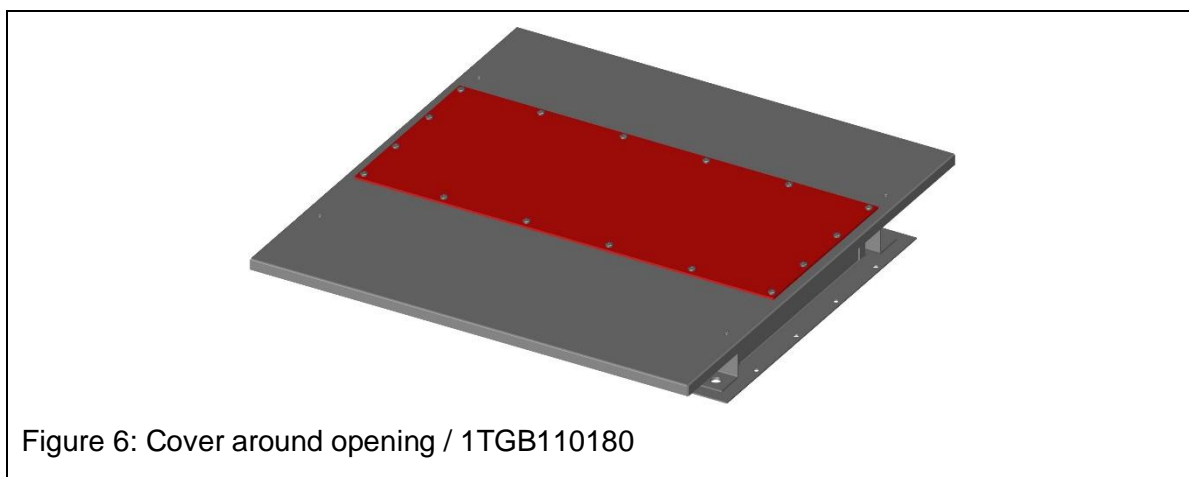
## 4.6 Extra length of control cables

With installation of control cables into auxiliary recesses always consider extra length of this cables because of auxiliary recesses operation movement. Minimum recommendation is 0,5 m.

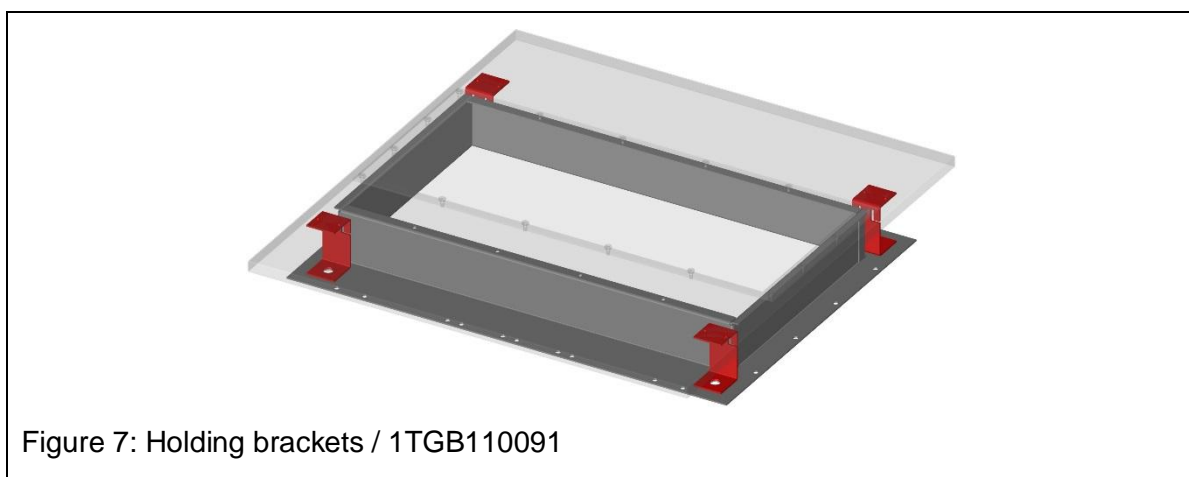


## 4.7 Assembly instruction for raised roof plates

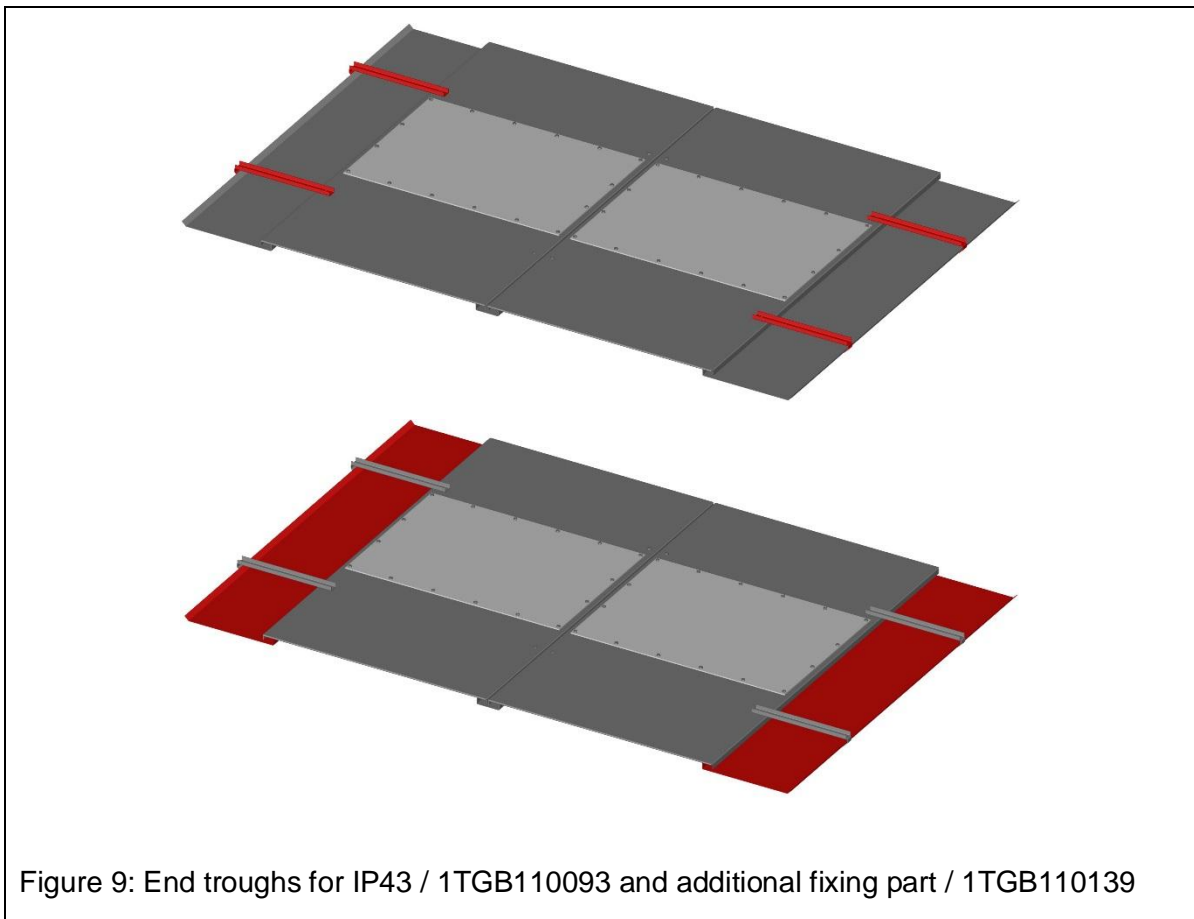
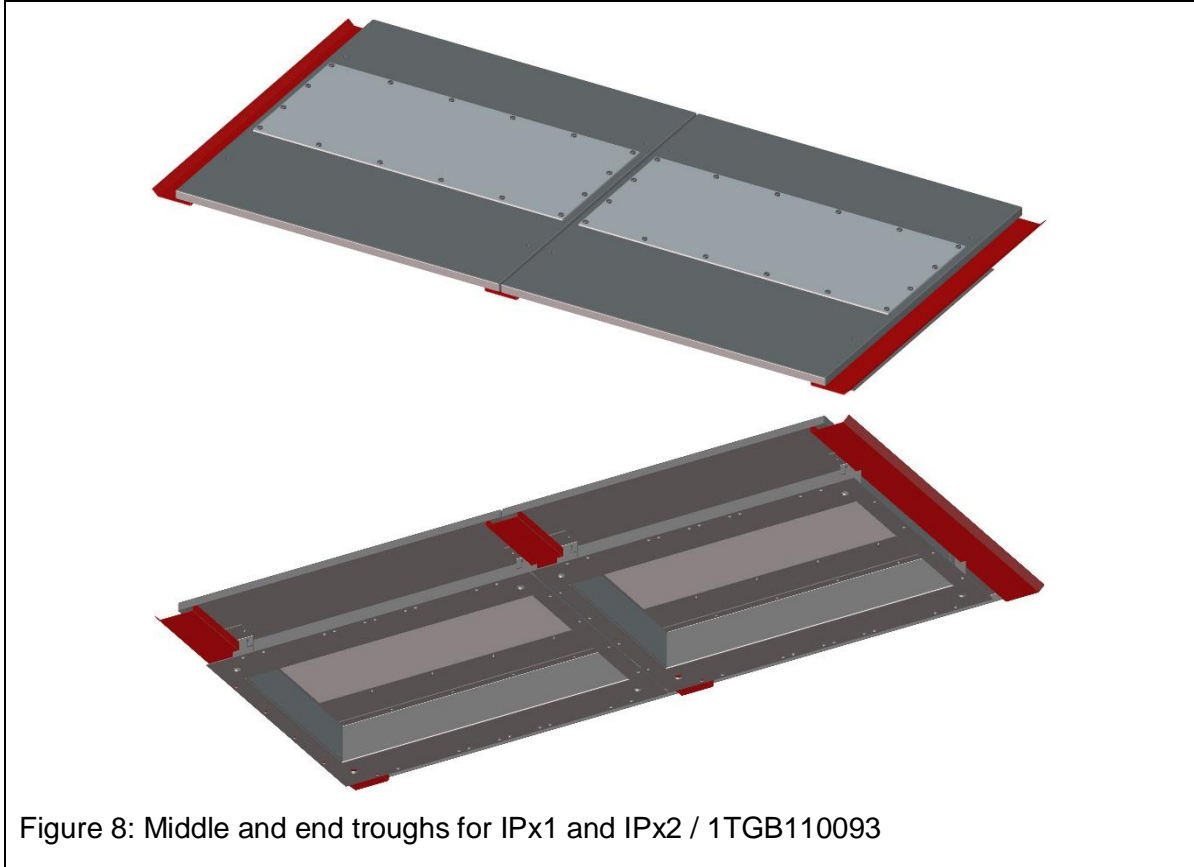
- The raised roof plate cannot be assembled in the factory, and needs to be installed during the erection phase of the switchgear, due to the fact that access is required at the lifting points.
- Examine the state of the material received and its consistency with the content of the delivery schedule. Should any damage or errors be found during unpacking, please report this to the ABB point of contact for the project.
- For the designs with top entry a cover is mounted around the opening introduction the cables, see pictures below.



- The holding brackets are fitted to each of the four holes for the lifting angle bars at the plant side and takes up the roof plate, see picture below.



- The gaps at the connections between the sections are bridged by middle and end troughs for IPx1/IPx2/IP43 and must be provided accordingly at the sections.



- It is absolutely necessary to attach the supplied labels „Keep off“ due to the risks associated when accessing the roof. The roof plate is not designed to be load bearing. Do not place any heavy objects on the roof plate during assembly, because this will result in deformation forming Indents / depression water will accumulate here, and will result in damage through corrosion.



Figure 10: Danger sign “KEEP OFF” / 1TGB000064U0001

- **IPx1/x2**

The height of the assembly is increased by 100 mm (3) with the raised roof plate. Since the roof plate overlaps the switchgear section in order to achieve degree of protection, the assembly will be 100 mm (2) deeper than the section depth on the front and rear side, each. The width of the system is increased by 35 mm (1) each on the right and left hand side.

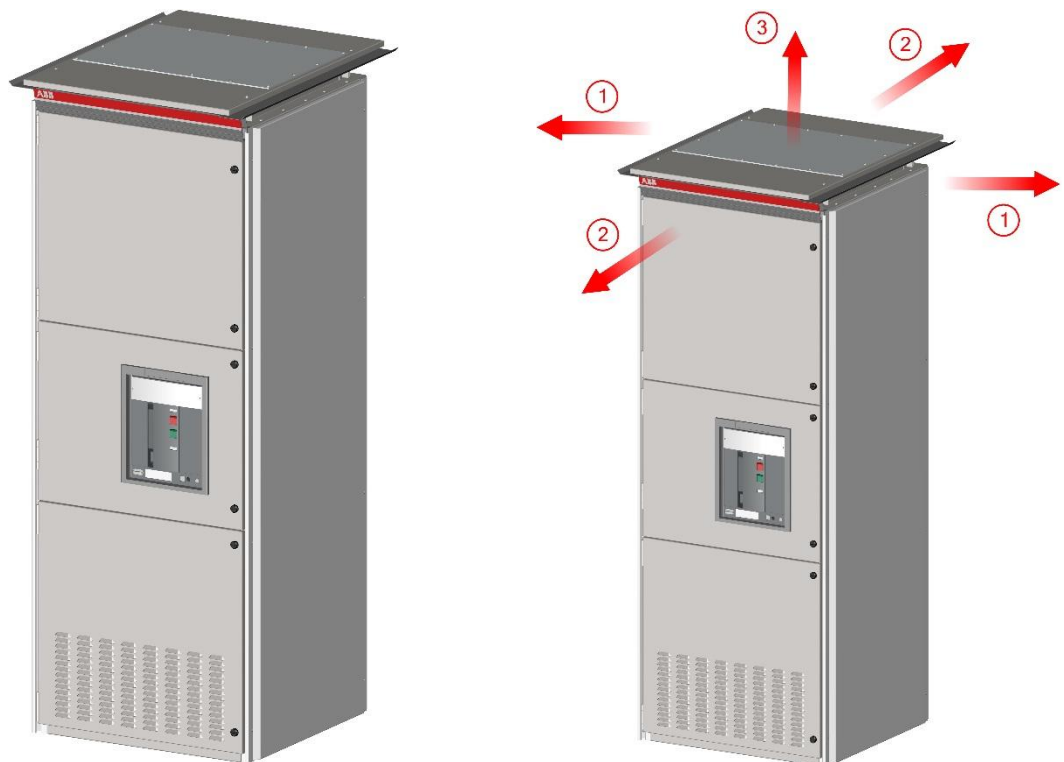


Figure 11: Section with IPx1/x2 raised roof plate

- **IP43**

The height of the assembly is increased by 100 mm (3) with the raised roof plate. Since the roof plate overlaps the switchgear section in order to achieve degree of protection, the assembly will be 300 mm (2) deeper than the section depth on the front and rear side, each. The width of the assembly is increased by 300 mm (1) on both the right and left hand side.

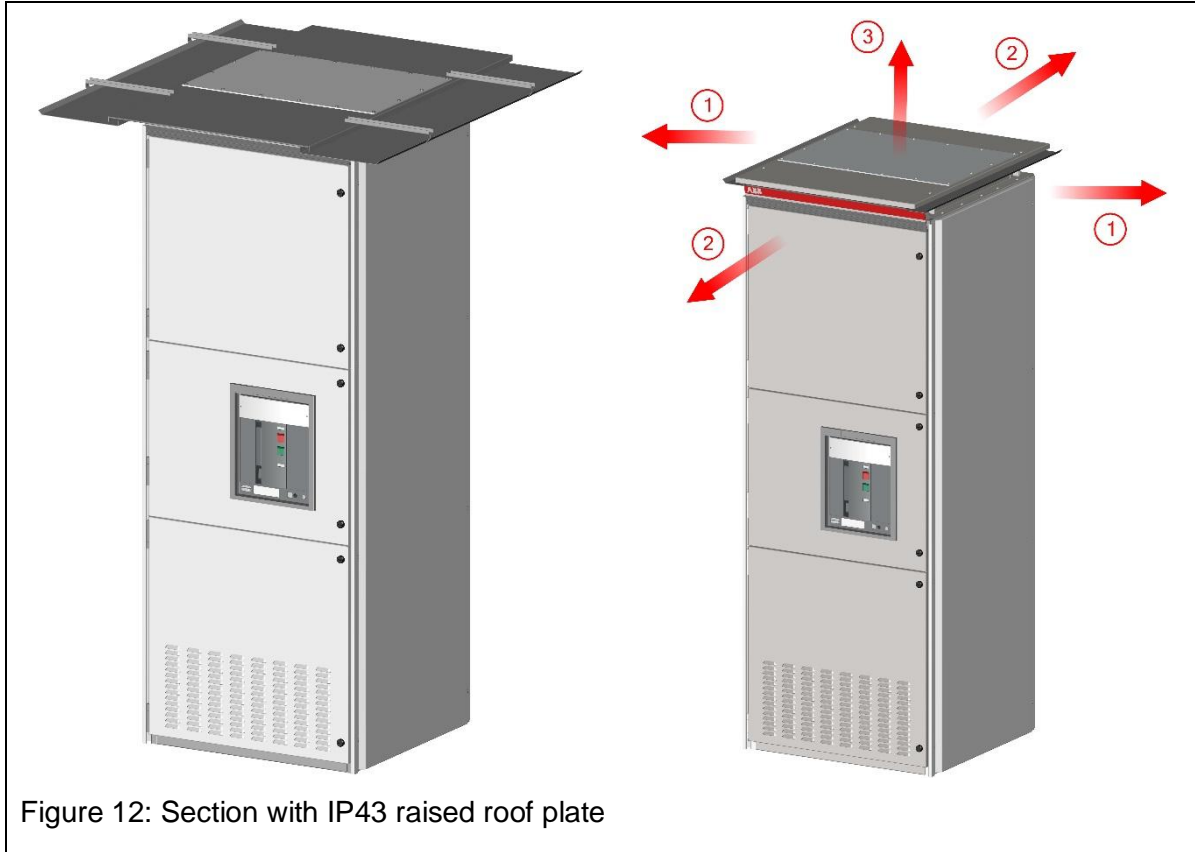


Figure 12: Section with IP43 raised roof plate

- In order to ensure an appropriate circulation of air, the minimum clearances defined in Section 3.4.2 of the Service Manual have to be observed. This is a strict requirement necessary to maintain the required clearances between the side panel and the rear of the assembly and the building wall which define the clearances between the roof and the wall. Otherwise, ventilation is obstructed and the systems thermal performance may be compromised.

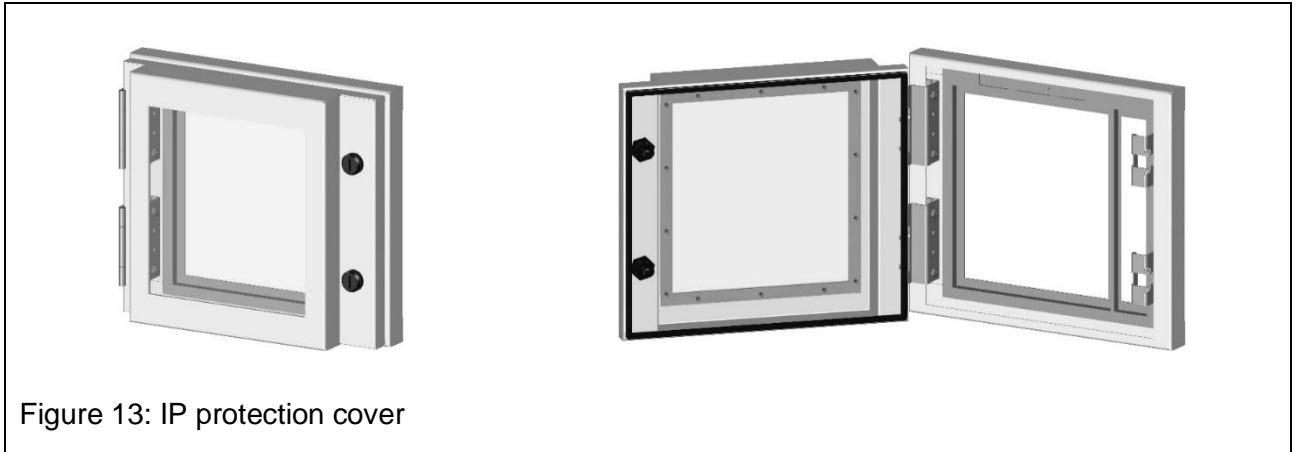
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## 5 Operation

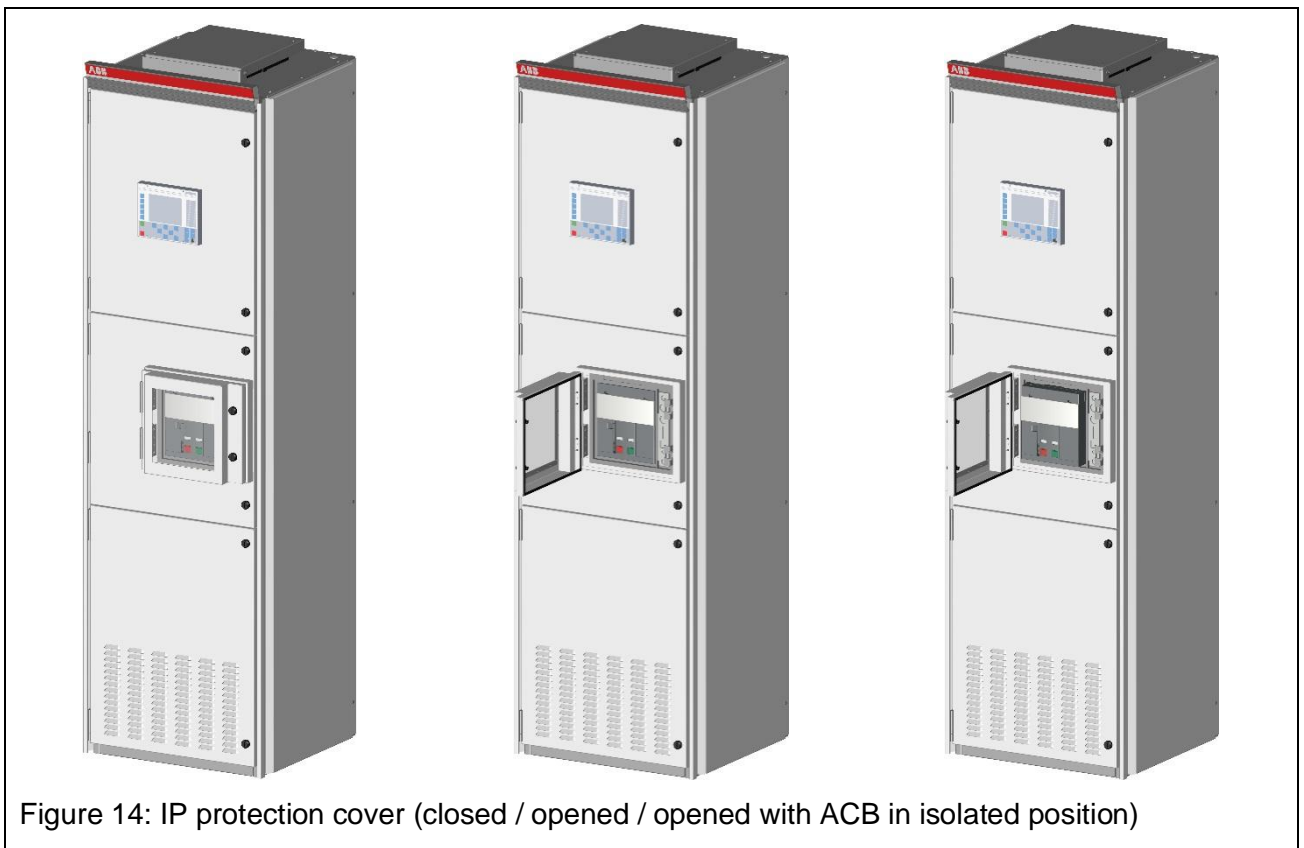
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### 5.1 IP protection cover

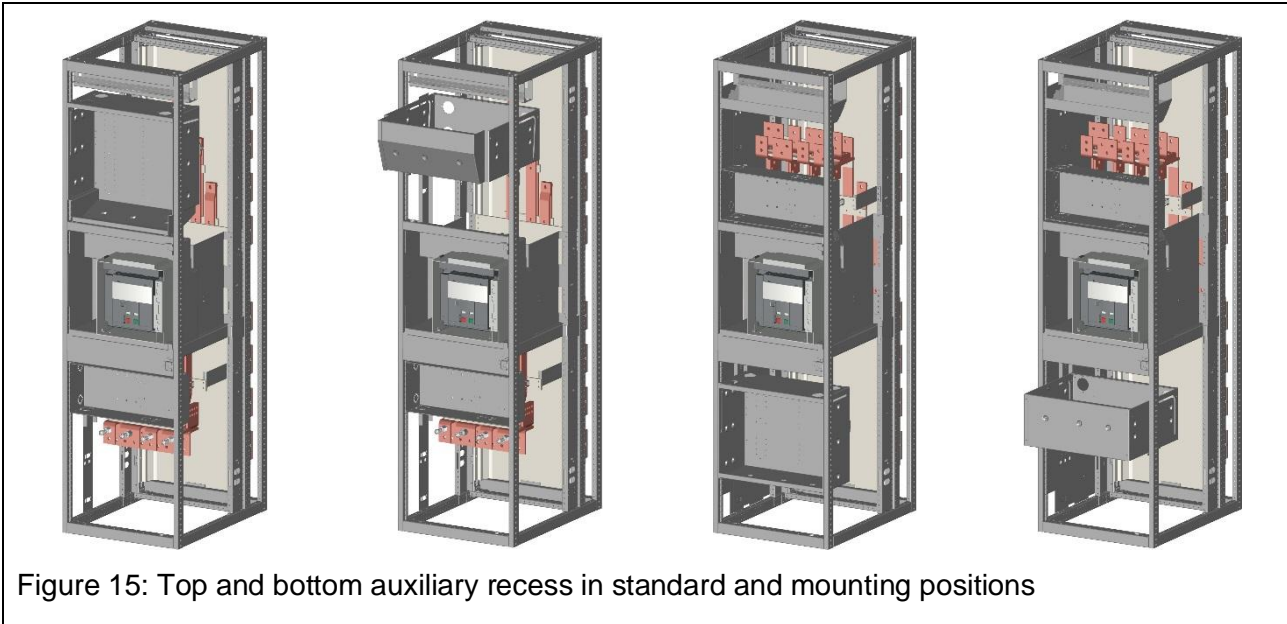
The IP protection cover is designed to protect the ACB front panel in section. Based on customer specification, it is installed in the ACB door. The IP protection cover is necessary to use for section IP rating IP31/41 to IP54, although in case of customer requirement it is possible to install for lower IP ratings.



Opening of the IP protection cover, allows the ACB to be moved to the isolated position. To completely remove the ACB, the ACB door must be open.



## 5.2 Handling procedures / positions of new auxiliary recesses



**Be careful whilst moving the auxiliary recess. Carelessness may cause trapping of hands!**



**Be careful whilst moving the auxiliary recess. The fully equipped auxiliary recess can weigh over 80 kg!**



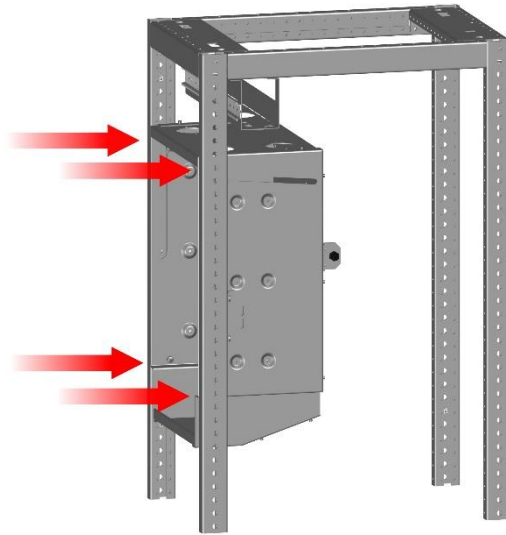
**Observe all safety rules for working on electrical equipment!**

## 5.3 Moving procedure steps

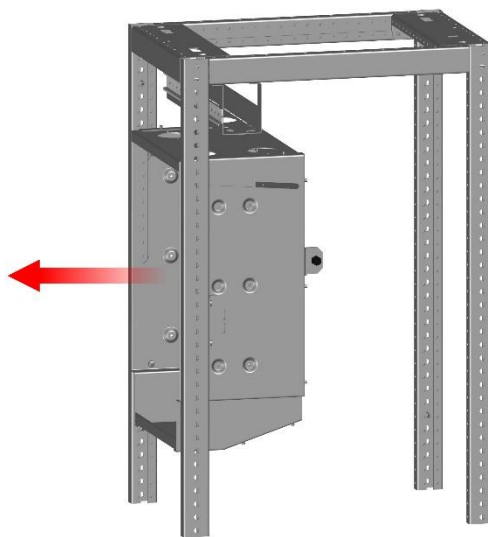
To achieve access to the rear area behind the auxiliary recess, follow the next steps.

### Note:

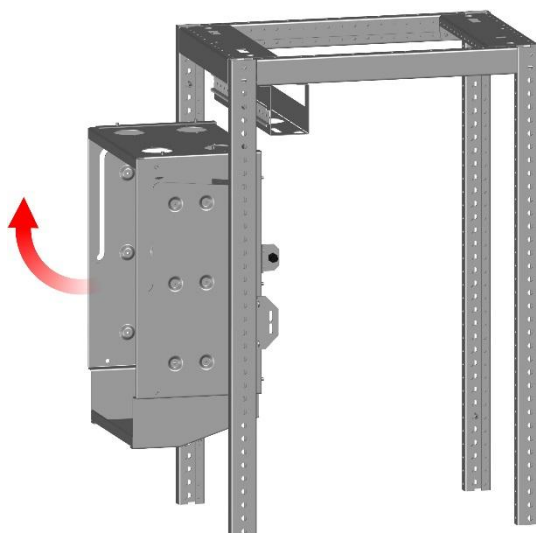
The guide rail is integrated into the auxiliary recess to ensure the path of moving process and prevent it from accidental falling. The auxiliary compartment is fixed to the C-profile by spring bolts. It can be placed back to its original position by doing the opposite of this process.



Step 1: Undo the four fixing bolts

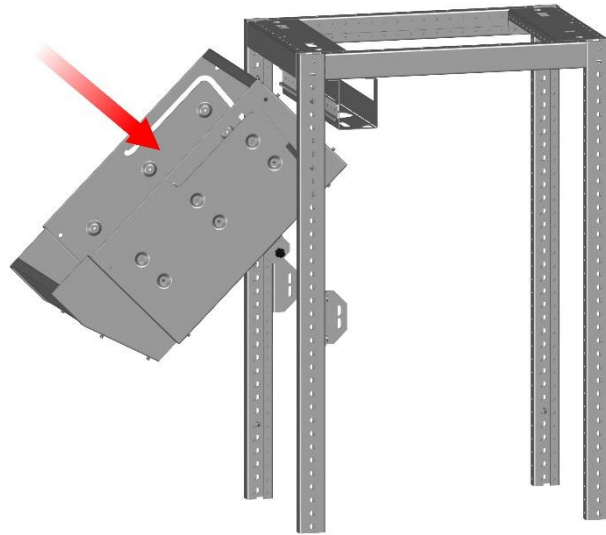


Step 2: Slide the recess out of the section with a forward motion

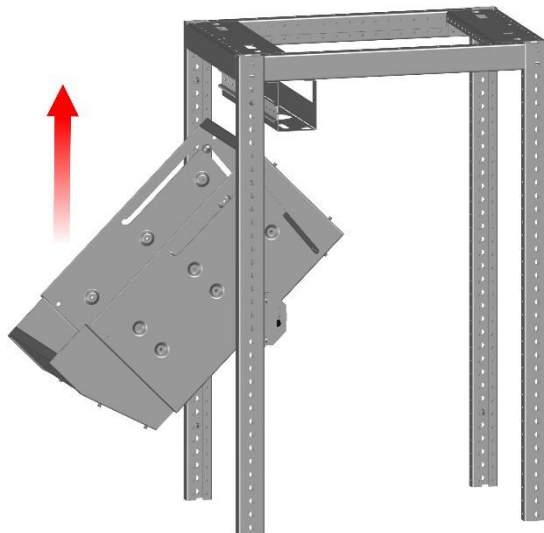


Step 3: Rotate from bottom with an upwards motion

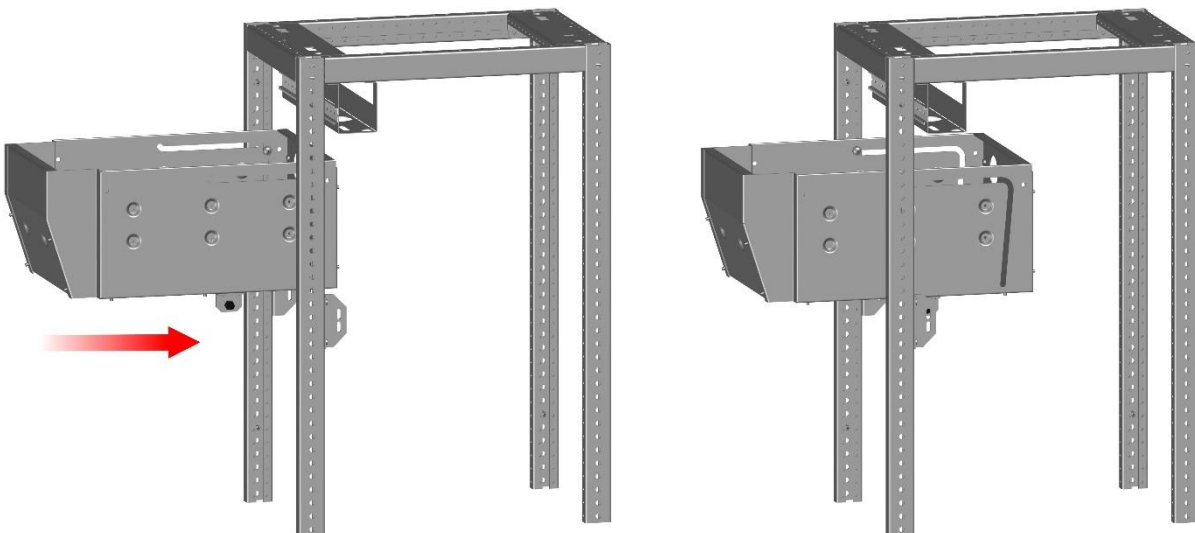




Step 4: The top of the recess rotates down

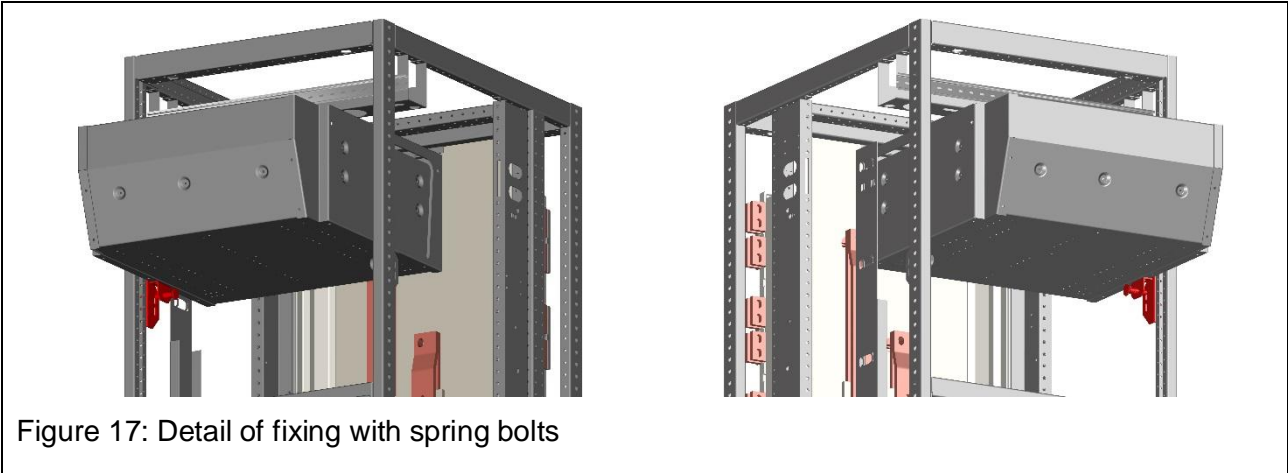
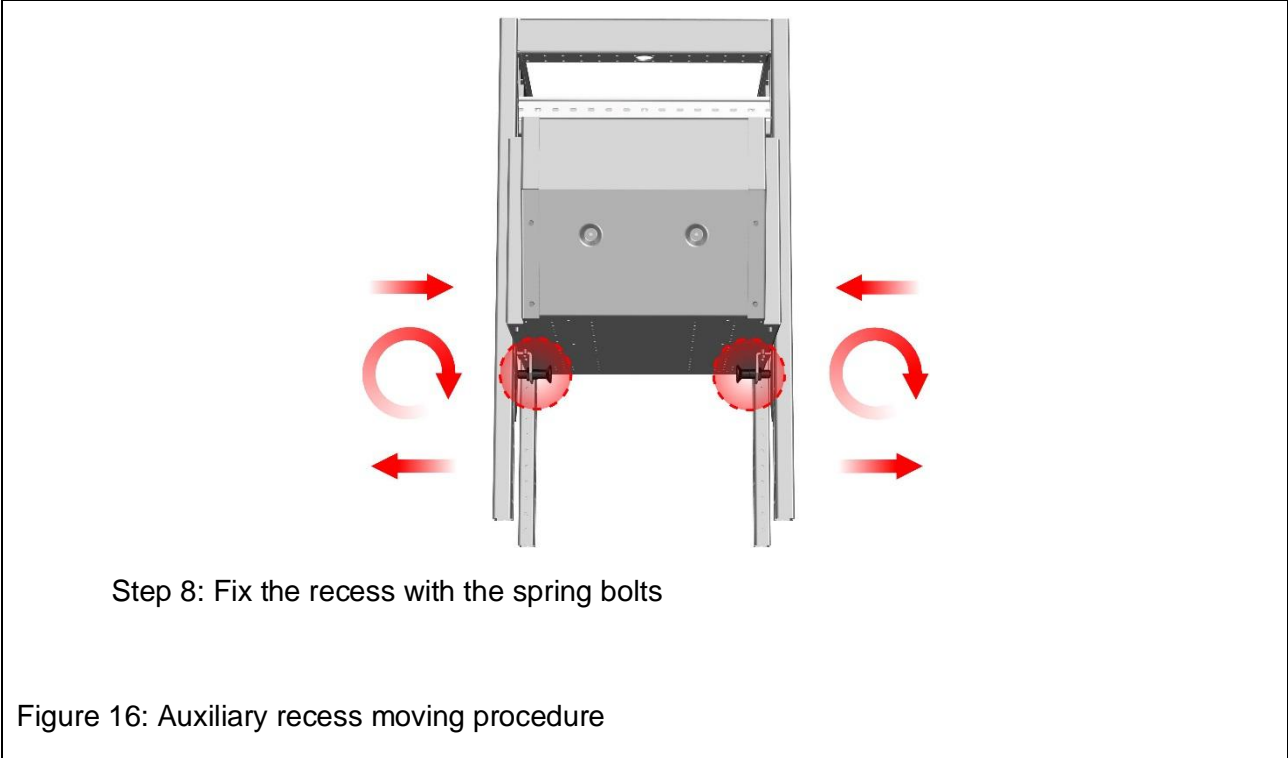


Step 5: It is then possible to move the recess upwards towards its final position



Step 6 and 7: Then slide the recess back into the section





## 5.4 Emax2 handle

The Emax2 handle enables the circuit breaker to be moved between the different operational, test and removed positions is now installed in the Emax2 movable part itself. After usage, the handle must be re-placed in the circuit breaker.

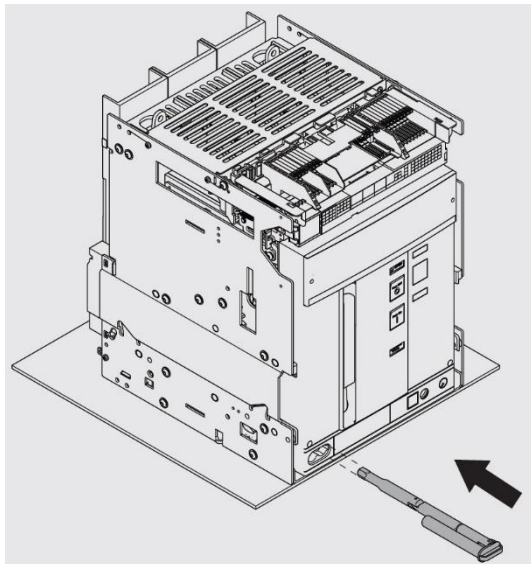


Figure 18: Place of Emax2 handle

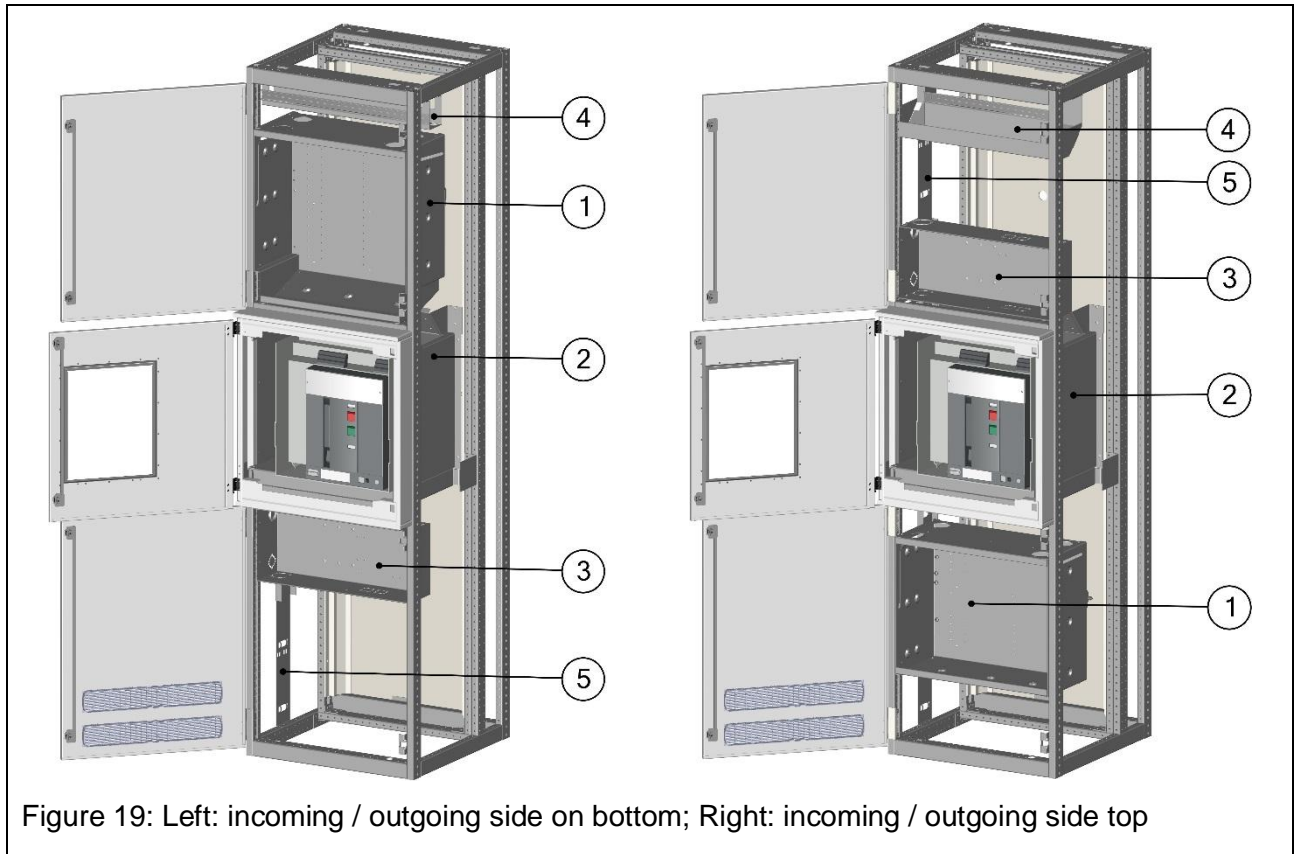
### **Important:**

After usage, the handle must be re-placed in the circuit breaker. If the handle is not in placed, IP class may be compromised.

## 6 Technical description

### 6.1 New ACB section description

Depending on the location of the incoming / outgoing (IOB / IOT) side of the section the auxiliary recess is located in the top or in the bottom position and the SPD compartment is located vice versa. Remaining components are in the same position.

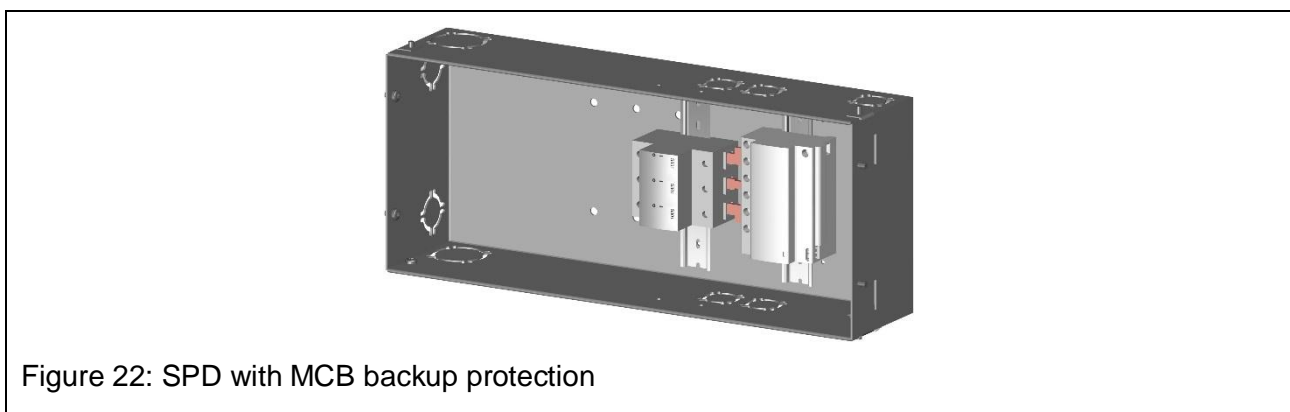
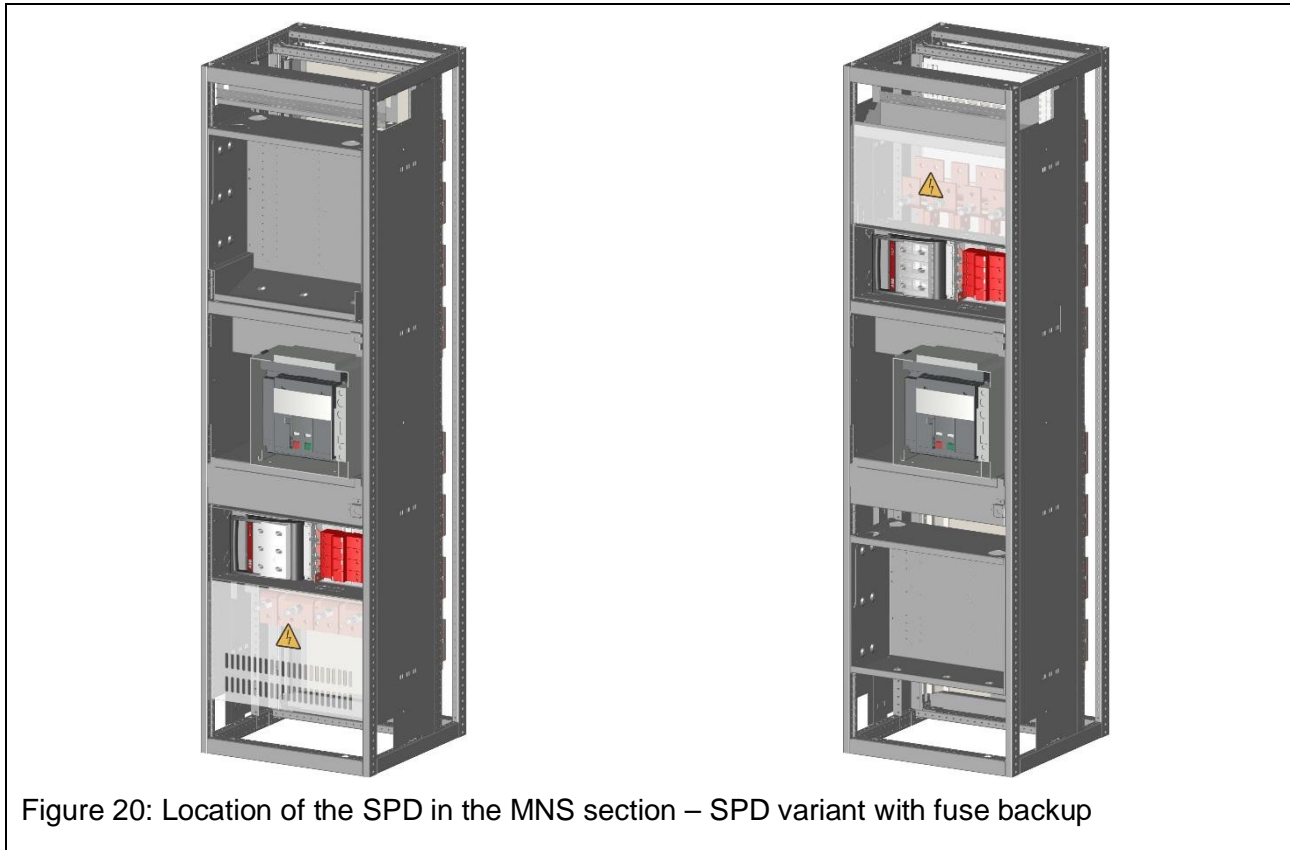


Description:

- 1) Auxiliary recess
- 2) ACB compartment
- 3) SPD compartment
- 4) Horizontal wiring duct
- 5) Vertical wiring duct left

## 6.2 SPD compartment description

Surge Protection Device (SPD), is being provided as an optional feature along with the ACB Emax2 integration with MNS.



# 7 Maintenance and inspection

## 7.1 Maintenance and inspection checklist

The recommend list below should be performed prior to commissioning, then in line with the maintenance frequency defined in the MNS Service Manual.

Items to be checked	Result	
<b><i>Instrument/control compartment:</i></b>		
Control fuses returned to operation position	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
Control circuit breakers returned to operation position	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
Current transformer links in correct operation position	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
Wiring termination secured	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
Protection shroud/barrier in operation position	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
Protection relay settings verified	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
Electrical functions checked	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
<b><i>ACB compartment:</i></b>		
Protection relay settings verified	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
Wiring termination secured	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
ACB movement function checked	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
ACB operation interlocks verified	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
Protection shroud/barrier in operation position	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
Electrical functions checked	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
<b><i>ACB service recommended by ABB:</i></b>		
Number of operation cycle exceeded	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
ACB contact wear alarm indicated	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
Other alarm indicated	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
Contact grease condition inspected	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
<b><i>Surge Protection Device (SPD) compartment:</i></b>		
Backup fuse disconnecter closed	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
Backup fuses present/not blown	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
Backup circuit breaker not tripped	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
Surge Protection Device (SPD) indicator healthy	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
<b><i>Cable connection compartment:</i></b>		
Cable connection torque checked	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
Cable entry point sealed to site requirement	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
Protection shroud/barrier in operation position	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
<b><i>Switchboard overall cladding:</i></b>		
All doors secured	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
Roof plate secured	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
Ventilation mesh cleaned	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
Passage way cleared	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
Rusted panels treated	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
IP rating of the section is maintained	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
<b><i>Operation observations:</i></b>		
High switchboard surface temperature	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Abnormal noise generated	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Vibration	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<b><i>Any Yes in the last group requires immediate investigation!</i></b>		

## 7.2 Maintenance of door gaskets

For improved operation, lubrication of door gaskets is recommended. This helps maintain the IP class and reduces friction of the door gaskets particularly on the area where gasket seals against the hinges. It is recommended to lubricate this area during the manufacturing process and should be checked in line with routine maintenance measures.

Recommended lubricant:

Molykote Omnigliss – manufacturer Dow Corning.



**Use lubricators or aerosols containing silicon should be avoided!**

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It is recommended to lubricate door sealing at the location of the hinges. Sealing to be lubricated on all doors and on the IP protection cover where indicated below.

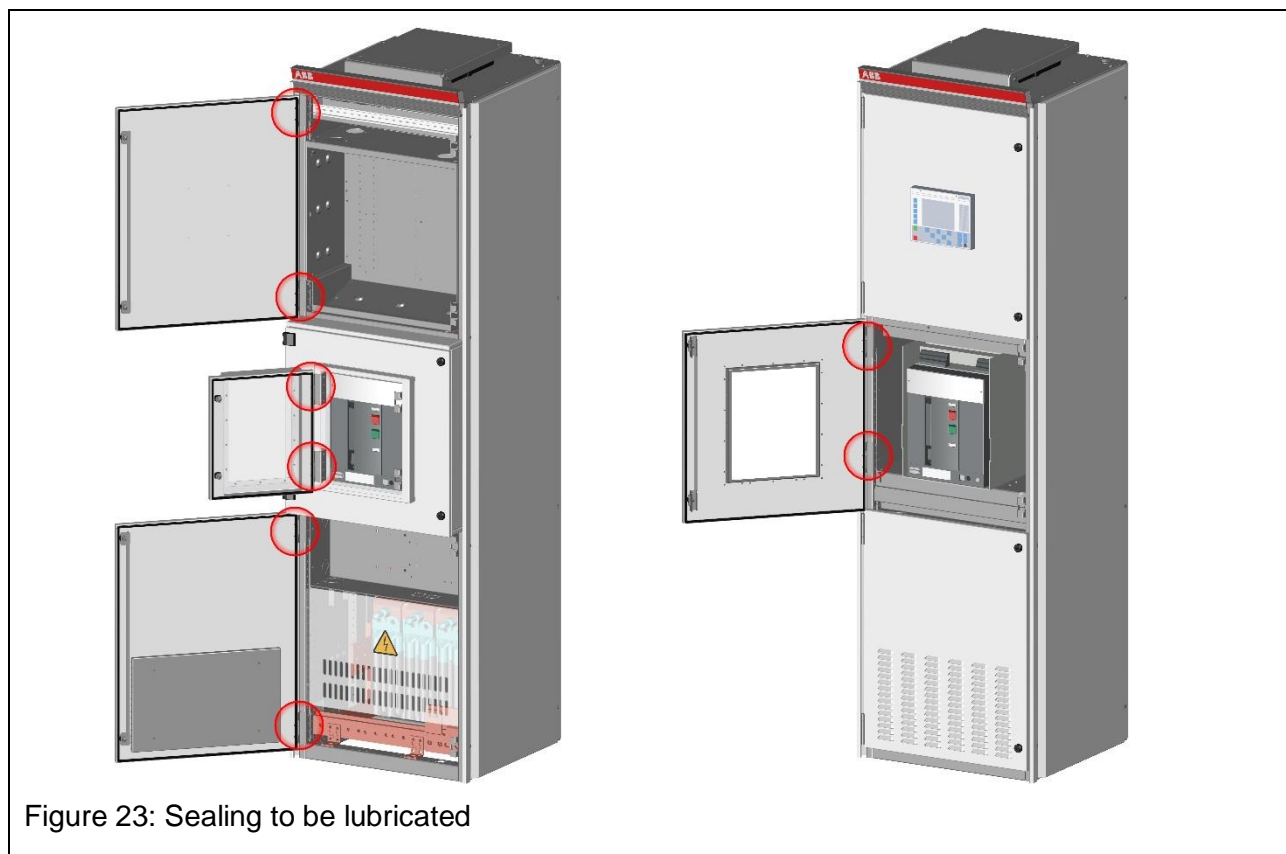


Figure 23: Sealing to be lubricated

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# Contact

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## **ABB Low Voltage Systems**

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