

PIX

Air Insulated Switchgear (Roll on Floor Circuit Breaker) 12-17.5 kV (≤ 40 kA) Installation, Operation, and Maintenance Guide

04/2017



The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein. This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications. It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof. Neither Schneider Electric nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information contained herein. If you have any suggestions for improvements or amendments or have found errors in this publication, please notify us.

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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

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Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.



The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER

DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

WARNING

WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

CAUTION

CAUTION indicates a hazardous situation which, if not avoided, **could result in** minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

About the Book



At a Glance

Document Scope

This technical guide describes installation, operation, and maintenance of air-insulated medium voltage switchgear units of the series PIX.

It is exclusively intended for use by the qualified personnel certified for the PIX series (training certificate).

The operations described in this guide may only be performed by the qualified personnel with proven experience regarding:

- The PIX series (training certificate)
- All relevant safety provisions

This guide is the integral part of the product and must be stored such that it is all times readily accessible and can be used by persons who are to work on the switchgear. If the switchgear is relocated to another site, this technical guide must be passed on to the new operator along with the unit.

This guide does not describe every imaginable individual case or every customer-specific version of the product. Contact the manufacturer for more information that is not included in the guide.

This guide does not include information regarding the safety of the building in case of internal faults detected (pressure load of the switchgear room and necessary pressure relief ports). Pressure calculations for switchgear rooms including recommendations regarding pressure relief ports can be provided on request against a fee. For further details, contact the manufacturer.

Validity Note

This guide is valid for PIX with a roll on floor circuit breaker. The design provides easy rack-in/rack-out operation without the need for a separate trolley. It is an extension of the standard PIX range and delivers performances up to 12 kV/40 kA/3150 A and 17.5 kV/31.5 kA/2500 A. It is equipped with a Vacuum Circuit Breaker and has other functional trolleys like the earthing truck, the metering truck, and the link truck

For product compliance and environmental information (RoHS, REACh, PEP, EOLI, etc.), go to www.schneider-electric.com/green-premium.

The technical characteristics of the devices described in this document also appear online. To access this information online:

Step	Action
1	Go to the Schneider Electric home page www.schneider-electric.com .
2	In the Search box type the reference of a product or the name of a product range. <ul style="list-style-type: none">• Do not include blank spaces in the reference or product range.• To get information on grouping similar modules, use asterisks (*).
3	If you entered a reference, go to the Product Datasheets search results and click on the reference that interests you. If you entered the name of a product range, go to the Product Ranges search results and click on the product range that interests you.
4	If more than one reference appears in the Products search results, click on the reference that interests you.
5	Depending on the size of your screen, you may need to scroll down to see the data sheet.
6	To save or print a data sheet as a .pdf file, click Download XXX product datasheet .

The characteristics that are presented in this manual should be the same as those characteristics that appear online. In line with our policy of constant improvement, we may revise content over time to improve clarity and accuracy. If you see a difference between the manual and online information, use the online information as your reference.

Related Documents

Title of documentation	Reference number
HVX - Vacuum circuit-breaker 12...17.5 kV (≤ 3150 A, ≤ 40 kA) Installation Operation Maintenance Technical instruction	VDRKOMM01
CVX - Vacuum contactor with Fuse 7.2 kV (≤ 400 A) Installation Operation Maintenance Technical instruction	VDRKOMM02
ETX - Earthing Truck ≤ 40 kA Installation Operation Maintenance Technical instruction	VDRK00400

You can download these technical publications and other technical information from our website at <http://download.schneider-electric.com>.

Product Related Information

Air-insulated medium-voltage switchgear units of the PIX series are designed exclusively for switching and distributing electrical power. They may only be used in the scope of the specified standards and the switchgear-specific technical data. Any other utilization constitutes improper use and may result in dangers and damage.

Chapter 1

General

Safety Provisions

General

The assembly and maintenance operations described in this user guide should be performed by the qualified personnel having experience of PIX series and the applicable safety provisions. Read the complete guide carefully before working with the switchgear.

Applicable Standards and Regulations

The following are the applicable standards and regulations for metal-enclosed AC switchgear (rated voltage: >1 kV to 52 kV) as per IEC 62271-200 standard:

- Must be complied with the locally applicable accident prevention, operating and work instructions.
- Assembly and maintenance: IEC 61936-1/HD 637 S⁽¹⁾
- Operation of electrical equipment EN 50110-1⁽¹⁾

NOTE: (1) Must be complied with the national standards applicable in the country where the equipment is to be installed.

Before working on the panel, it is necessary to comply with the following instructions.

DANGER

RISK OF FATALITIES DUE TO HIGH VOLTAGE

Make sure to isolate from high voltage and grounding before performing assembly or maintenance work.

Failure to follow these instructions will result in death or serious injury.

WARNING

RISK OF INTERNAL ARCS

To safeguard the operator from internal arcs:

- Isolate the switchgear from the power supply before removing the covers of the switchgear unit.
- Ground the switchgear during assembly and maintenance work.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

DANGER

RISK OF FATALITIES DUE TO SUPPLY VOLTAGE

Make sure to isolate from the supply voltage before performing assembly and maintenance work.

Failure to follow these instructions will result in death or serious injury.

WARNING

RISK OF INJURY DUE TO MOVABLE PARTS IN MECHANICAL DRIVES

For maintenance work, make sure to:

- Isolate from supply voltage
- Release the circuit breaker energy storing device by switching it ON-OFF-ON
- Close the make-proof earthing switch

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Behavior in Case of Incidents or Accidents

In case internal fault is detected, the PIX switchgear pressure relief ports helps to prevent the panel and switchgear unit from bursting.

In case of fire or internal faults detected, toxic and caustic decomposition products are produced. Comply with the locally applicable accident and safety provisions.

In case of personal injury, take first-aid measures.

Chapter 2

Design and Description

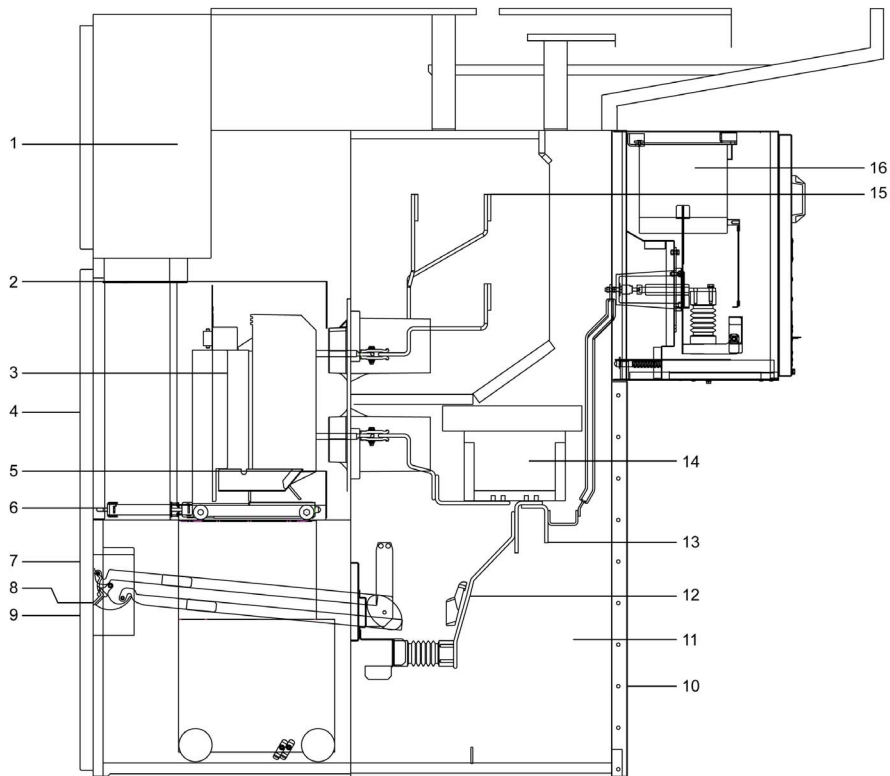
What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Panel Design	12
Panel Variants	13
Dimensions and Weights	15
Applied Standards	16
Environmental and Operating Conditions	17
Ratings of the PIX Series	18
Nameplate	19
Technical Data	20
Disposal of Switchgear Unit	21

Panel Design

PIX with Roll on Floor Circuit Breaker Truck



- 1 Low voltage cabinet with control device
- 2 Metallic shutter for busbar side arm of breaker connecting to moulded seal-off spouts
- 3 Circuit breaker truck HVX
- 4 Front door
- 5 Metallic shutter for line side arm of breaker connecting to moulded seal-off spouts
- 6 Breaker guiding rails
- 7 Earthing switch position indicator
- 8 Insertion opening for operating lever of the earthing switch
- 9 Mechanical interlock of insertion port for the earthing switch
- 10 Cable compartment cover
- 11 Cable compartment
- 12 Make proof earthing switch
- 13 Cable connections
- 14 Current transformers
- 15 Busbars
- 16 Potential transformer with primary fuse

Panel Variants

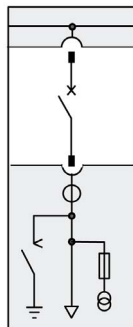
Overview

The illustrations show the panel types with their respective basic equipment without pressure relief duct or deflectors. Customized models or add-on elements are described in the switchgear-specific document.

Branch Circuit Panel with Switching Devices

The branch circuit panels consists of:

- Circuit breaker truck HVX
- Optional voltage transformers

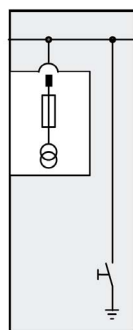


Single Line

Metering Panel

The metering panels consists of:

- Withdrawable VT Trolley MTX
- Busbar earthing switch

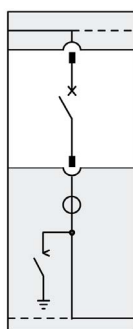


Single Line

Bus Coupler

The bus coupler panels consists of:

- Circuit breaker truck HVX
- Current transformers
- Earthing switch

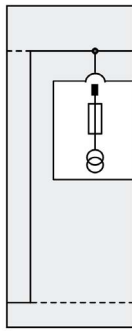


Single Line

Bus Riser

The bus riser consists of:

- Withdrawable VT Trolley (optional)



Single Line

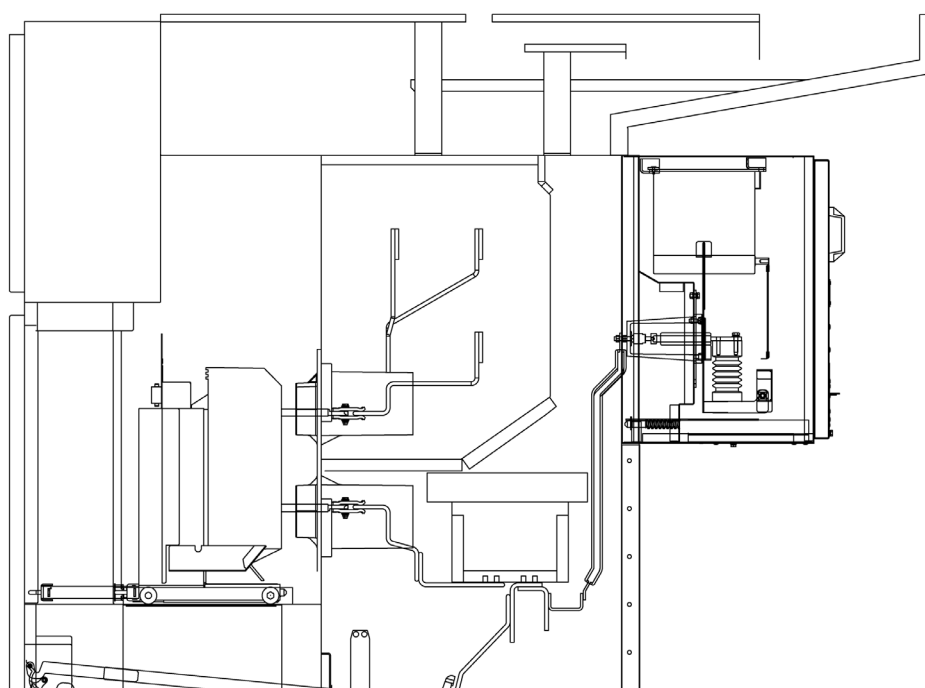
Dimensions and Weights

Introduction

For the precise panel dimensions, refer to the switchgear-specific document. The dimensions and weight depends on:

- The rated voltage
- The rated normal current
- The rated short-time current
- Additional equipment
- Voltage transformer (optional)

Depth and Height of Panel ⁽¹⁾	
Panel depth	1650 mm - Standard 2150 mm - Optional (for two current transformers per phase)
Panel height	2300 mm - Standard (low voltage cabinet = 730)
(1) For depth and height of panel, refer to the following figure	



Panel type	Rated Current ⁽¹⁾	Panel Width ⁽²⁾	Weight ⁽³⁾ (approx.)
Feeder Panel with HVX circuit breaker	≤ 1250 A	600 mm	800 kg
Bus section coupler with HVX circuit breaker	2000/2500 A	800 mm	1200 kg
	3150 A	1000 mm	1500 kg
Bus riser panel	≤ 1250 A	600 mm	650 kg
	2000/2500 A	800 mm	1000 kg
	3150 A	1000 mm	1350 kg
Busbar metering panel	-	600/800/1000 mm	650/1000/1350 kg
(1) Rated current refers to the feeder circuit			
(2) For panel width, refer to the following figure			
(3) Includes low voltage cabinet with average extent of equipment mounted. 3 x voltage transformer (optional): + approximate 120 kg			

Applied Standards

Introduction

Switchgear units of the PIX series are:

- Metal enclosed, no availability of service continuity category according to IEC 62271-200: LSC 2B-PM
- Type tested
- Tested for internal faults (qualification IAC AFLR)
- Dimensioned for indoor installation

Standards and Regulations

PIX switchgear units meet the following standards and regulations:

Designation	IEC Standard	EN Standard
Switchgear	IEC 62271-200 IEC 62271-1	EN 62271-200 EN 62271-1
Internal arc classification (IAC)	IEC 62271-200	EN 62271-200
Circuit breaker	IEC 62271-100	EN 62271-100
Earthing switch	IEC 62271-102	EN 62271-102
Isolating truck	IEC 62271-102	EN 62271-102
Current transformers	IEC 61869-2	EN 61869-2
Voltage transformers	IEC 61869-3	EN 61869-3
Voltage detecting systems	IEC 61243-5 IEC 61958	EN 61243-5 EN 61958
Protection against accidental contact, foreign bodies, and water	IEC 60529	EN 60529

The following table shows the degree of protection against accidental contacts and foreign objects according to IEC 62271-200 and IEC 60529.

Degree of protection	
Degree of protection of switchgear enclosure	IP4X ⁽¹⁾
Degree of protection of the accessible claddings in the panel	IP2X
(1) Other values available on request	

Environmental and Operating Conditions

Overview

PIX is an indoor switchgear and is only operated under normal conditions according to IEC 62271-1.

Operation under conditions deviating from these is only admissible subject to consultation with and written approval from the manufacturer.

Ambient conditions in accordance with IEC 62271-1	
Temperature class	-5 indoors ⁽¹⁾
Minimum/maximum ambient temperature	-5/+40 °C ⁽¹⁾
Average value over 24 hours	≤ 35 °C ⁽¹⁾
Average relative humidity: 24 hour/1 month	≤ 95%/ ≤ 90%
Installation altitude above sea level	≤ 1000 m ⁽¹⁾
(1) Other values available on request	

Ratings of the PIX Series

Ratings

Switchgear panel			
Rated voltage U_r		12 kV	17.5 kV
Rated lightning impulse withstand voltage U_p		75 kV	95 kV
Rated normal current I_r	Busbar	≤ 3150 A	≤ 2500 A
	Feeder panel	≤ 3150 A	≤ 2500 A
Rated peak withstand current $I_p^{(1)}$		100 kAp	66/80 kAp
Rated short-time current $IK^{(1)}$		40 (3 s) kA	25/31.5 (3 s) kA
Rated frequency F_r		50 Hz	50/60 Hz
(1) The short-circuit capability of the current transformers must be considered separately.			

The applicable panel-specific technical data is indicated on the nameplate and in the switchgear-specific document.

The technical data of the switching device (HVX) are indicated on the nameplate and in the operating manual of the device concerned.

Technical Data

Overview

Switchgear panel is designed on the principle to permit manual operation.

The drive mechanisms of the individual switching devices can be equipped depending on the specific customer model, with additional electrical control and operating devices. This information is given in the switchgear-specific circuit diagram. For more information, refer to switchgear document.

The component fitting options are:

- Blocking coil (optional)
The blocking coil helps to prevent manual actuation of the earthing switch. If the supply voltage is not available, all blocking coils are in blocked position.
- Auxiliary switches
Auxiliary switches are always directly actuated by the truck or by the switch shaft through an intermediate linkage. Their position always corresponds to that of the main contacts. The switching functions are set in the factory according to the circuit diagram.
- Micro switches
Micro switches are used depending on the customized panel models

Rated Supply Voltages

Rated supply voltages						
Direct voltage DC	24 V	28 V	60 V	110 V	125 V	220 V
Alternating Voltage AC	(110)/120 V			(220)/230 V		

Power Consumption

Device	Power Consumption	
	DC approximate (W)	AC 50/60 Hz approximate (VA)
Blocking coil	12	

Information about the power consumption of solenoids and the motor is available from the manufacturer.

Technical Data - Auxiliary Switch for Earthing Switch

Rated supply voltage	220 Vdc
Switching capacity (NC contact)	2 A
Time constant T=L/R	20 ms

Trucks

Electrical control and operating devices of the truck are described in respective technical manuals.

Technical manuals	Reference number
HVX - Vacuum circuit-breaker 12...17.5 kV (≤ 3150 A, ≤ 40 kA) Installation Operation Maintenance Technical instruction	VDRKOMM01
CVX - Vacuum contactor with Fuse 7.2 kV (≤ 400 A) Installation Operation Maintenance Technical instruction	VDRKOMM02
ETX - Earthing Truck ≤ 40 kA Installation Operation Maintenance Technical instruction	VDRK00400

Disposal of Switchgear Unit

Disposal After the End of Service Life

A material and recycling data sheet can be provided on request for the disposal of switchgear units of the PIX series at the end of their service life.

Disposal is performed as a service by the manufacturer service center and is subject to the fees

Chapter 3

Packaging, Transport, and Storage

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Shipping Units	24
Transport	25
Warehousing	26

Shipping Units

Overview

The following points are considered while shipping the units:

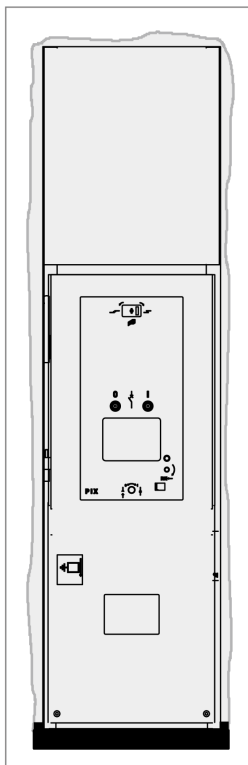
- The condition and the type of transport is stipulated in the contract details. The type of packaging depends on the type of transport and the storage conditions.
- The panels are delivered individually and fastened on the pallets.
- The trucks are delivered within the panels and are in connected positions.
- The standard accessories are included.
- The panels are delivered in upright position.

NOTE: The weight of the entire transport unit is indicated on the packaging.

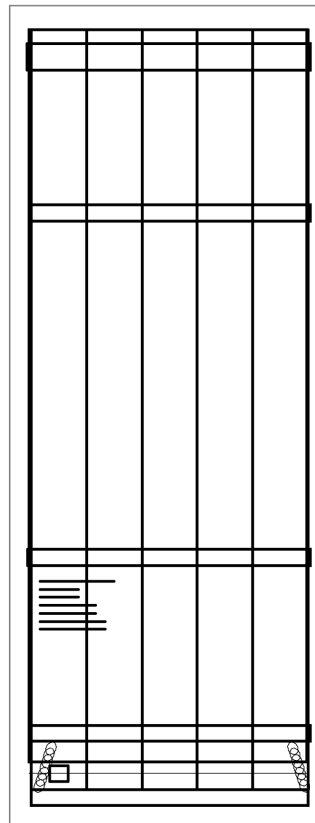
Packaging

While packaging, following points are considered:

- If packed exclusively for land-based transport, the panels are delivered on a pallet with PE protection film as shown in the following figure.
- For sea or air transport, the units are packed in sealed aluminum foil with desiccant and in a closed wooden case with tightly closed wooden base as shown in the following figure.



Packed in PE protective film on a pallet



Packed suitable for sea worthy transport

Transport

Transport Using a Forklift Truck

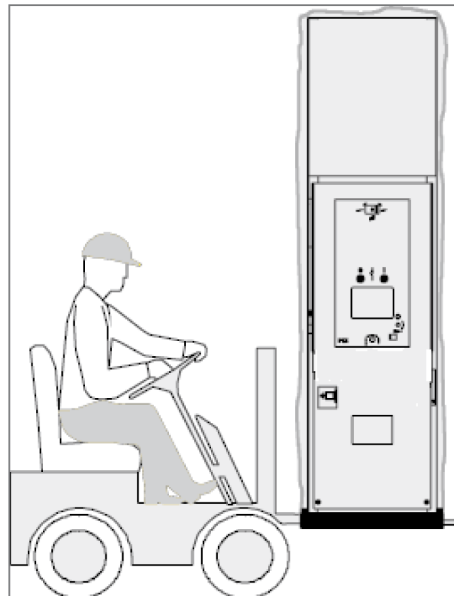
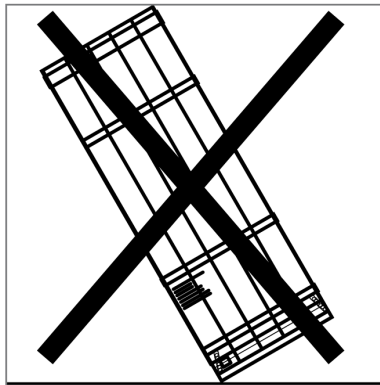
The panel is transported on the pallet. The entire length of the forks must be placed under the transport unit.

⚠ WARNING

RISK OF LOAD TIPPING OVER

Transport unit must be secured sufficiently during transport to avoid slipping and tipping over.

Failure to follow these instructions can result in death, serious injury, or equipment damage.



Delivery

Consider the following points while delivering the units:

- Handle shipping units carefully when unloading and unpacking time.
- Shipping unit must be checked upon receipt for any damage. Any damage occurred in transit must be recorded and reported to the manufacturer immediately.
- Check completeness of consignment based on the transport documents. The supplier must be notified in writing without delay about any possible deviations.

Warehousing

Overview

WARNING

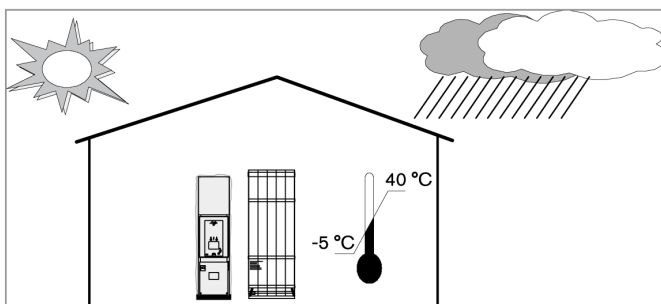
RISK OF ACCIDENTS

Sufficient stability and evenness of the supporting area must be ensured.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

If the panels are not installed immediately after delivery, they can be stored under the following conditions:

- Panels must be stored in vertical positions and must not be stacked.
- Indoor storage is only admissible.
- Switchgear and accessories must be sealed with desiccants in aluminum foil and packed in a wooden crate (storage for maximum two years after the date of packaging).



Chapter 4

Access to Main Circuit Compartment

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Safety Provisions and Important Information	28
Access to the Circuit Breaker Compartment	29
Access to Cable Connection Compartment	33
Access to Busbar Compartment	34

Safety Provisions and Important Information

Overview

 WARNING
--

RISK OF INJURY

Comply with the safety provisions. For more information, refer Safety Provisions (<i>see page 9</i>).

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NOTE: The panels may be equipped with additional interlocks to lock the cable compartment cover and the front door. For more information, refer Racking-out the Truck from Service into Disconnected Position (*see page 77*)

Access to the Circuit Breaker Compartment

Opening and Closing the Front Door

⚠ DANGER

RISK OF FATALITIES DUE TO HIGH VOLTAGE

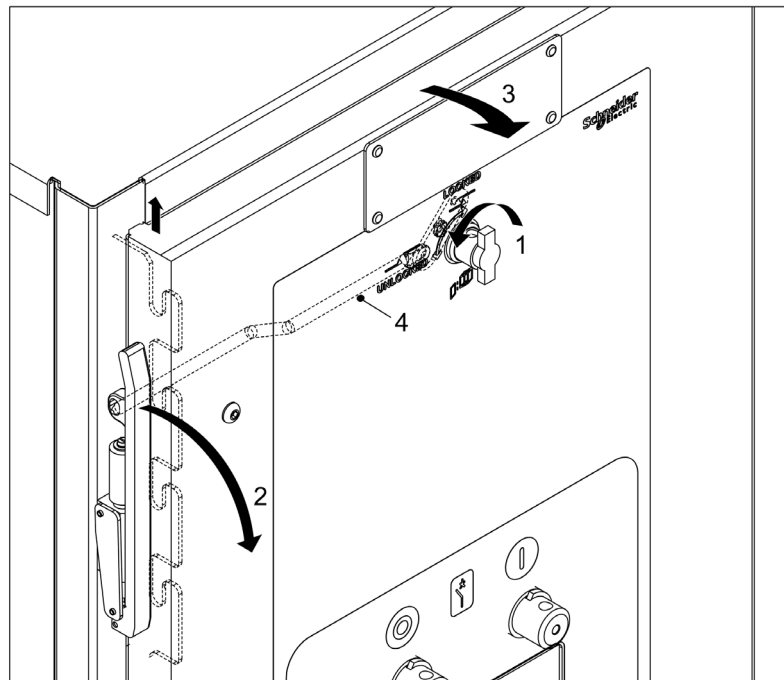
Open the front door only if the truck is in disconnected position. For more information, refer Racking-out the Truck from Service into Disconnected Position (*see page 77*)

Failure to follow these instructions will result in death or serious injury.

Follow the steps to open the front door:

Step	Action
1	Hold the knob (see item 1 in the following figure) of the front door and turn it 90° counter-clockwise. The lateral lever is unlocked.
2	Swing lateral lever (see item 2 in the following figure) down by approximately 180°. The front door is lifted until the detents are no longer engaged.
3	Open front door (see item 3 in the following figure). You can now access the switching device and the cable compartment.

NOTE: Front door with mechanical interlock between the truck and the front door (optional) must be unlocked additionally by a stick ($\varnothing \leq 6 \text{ mm}$) while opening the door lock⁽¹⁾ if no truck is provided (manual unlocking).



- 1 Lock and unlock knob
- 2 Lever to unlock the front door
- 3 The front door can be opened laterally
- 4 Opening for manual unlocking in case of optional truck/front door interlock

Follow the steps to close the front door:

Step	Action
1	Close the door completely
2	Swing lateral lever (see item 2 in the above figure) upwards. The front door is lowered.
3	Turn knob (see item 1 in the above figure) clockwise by 90° and remove it.

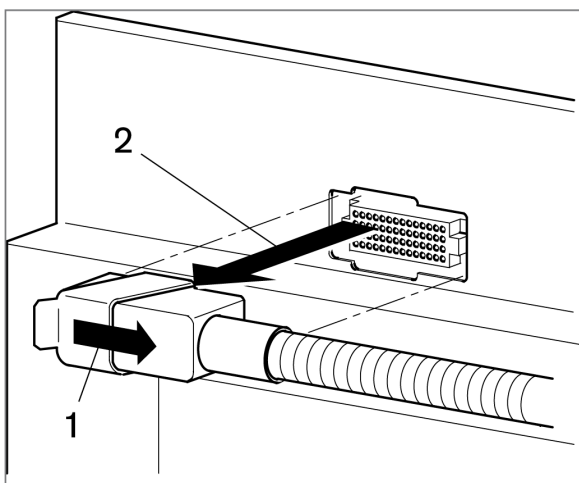
Removing and Connecting the Truck Low Voltage Connector

NOTE: The low voltage connector can be removed or inserted when the truck is in its disconnected position.

Follow the steps to remove the low voltage connector:

Step	Action
1	Pull interlocking slide of low voltage connector forward (see item 1 in the following figure) and remove the connector (see item 2 in the following figure) Insert figure 10
2	Store voltage connector in storage tray above the truck (see the figure below) Insert figure 11

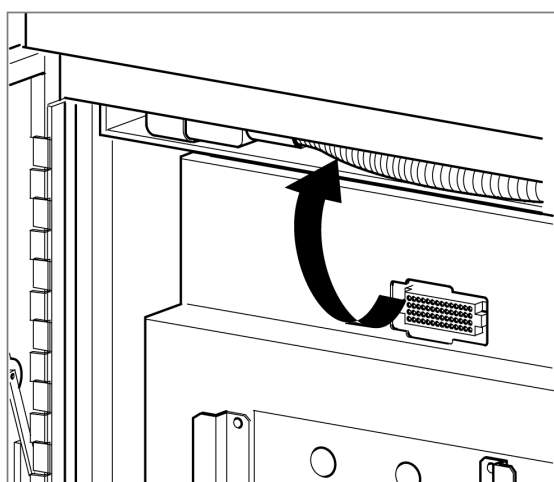
Removing the Low Voltage Connector



- 1 Unlock low-voltage connector
- 2 Remove low-voltage connector

Follow the steps for connecting the low voltage connector:

Step	Action
1	Take low voltage connector from the storage tray above the truck (see the following figure).
2	Insert low voltage connector into the truck and press interlocking slide forward. Insert figure - place low voltage connector in tray above the truck

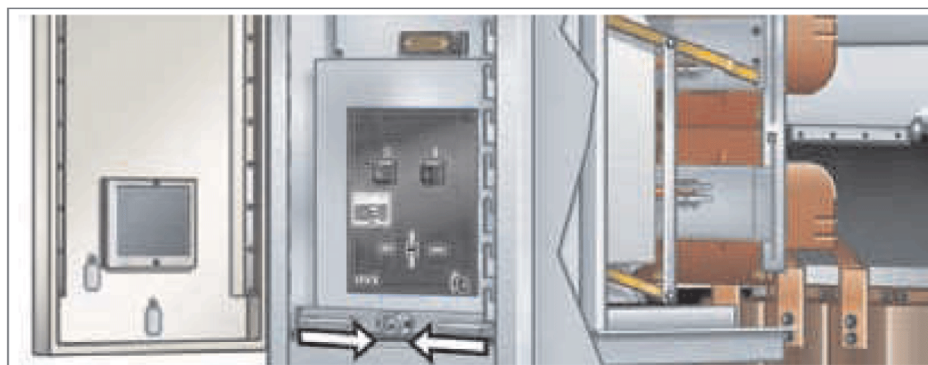
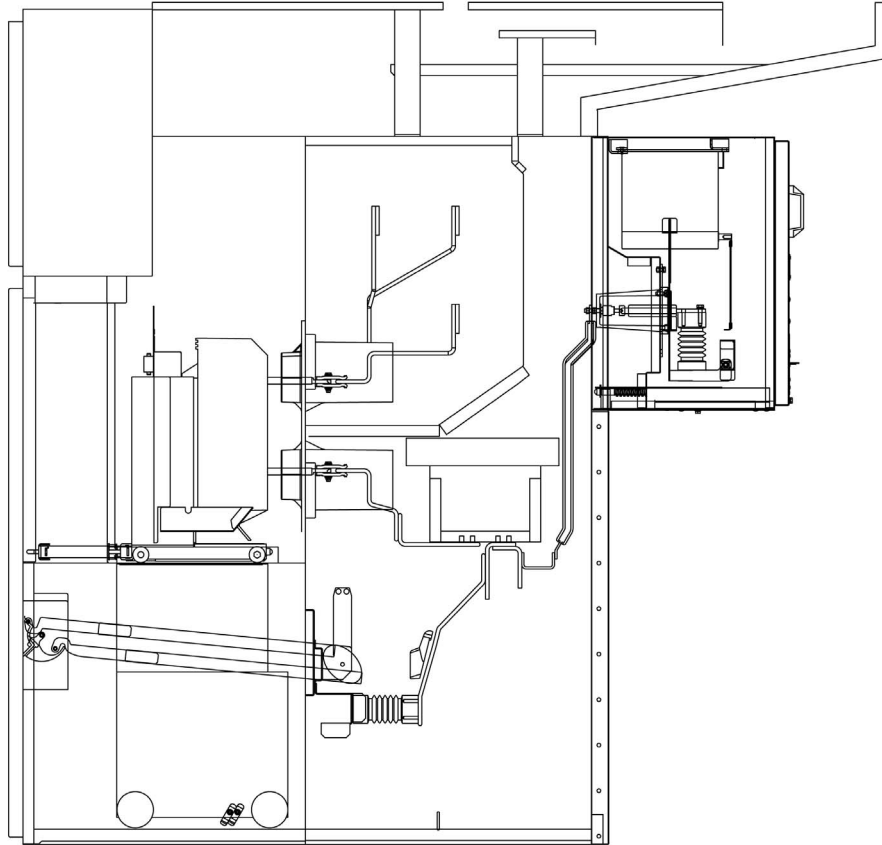


Removing the Truck from the Panel

Follow the steps for removing the truck from the panel:

Step	Action
1	Fix the ramp in front of the panel.
2	Move both truck handles inwards to unlock the truck in the panel (see the following figure).
3	Pull the truck carefully and remove it from the panel.

Unlocking the Truck in the Panel

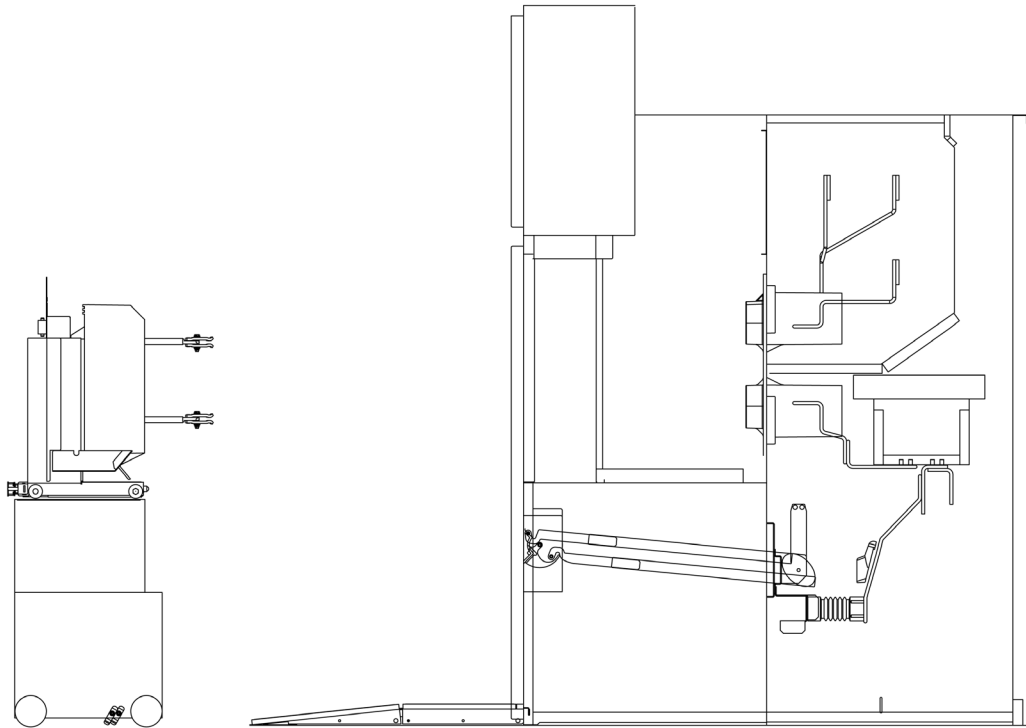


Inserting the Truck into the Panel

NOTE: Optionally, trucks, and panels can be given matching coding. This is to make sure that the truck is not racked completely into a panel if the ratings do not match.

Follow the steps to insert the truck into the panel:

Step	Action
1	Fix the ramp in front of the panel.
2	Move the truck to the front of the panel (see the following figure) Insert figure - moving the truck to the front of the panel
3	Push the trolley right up to the panel.
4	Move both truck handles outwards to lock the truck in the panel. Insert figure - locking the truck in the panel



Access to Cable Connection Compartment

Removing Cable Compartment Cover

⚠ DANGER

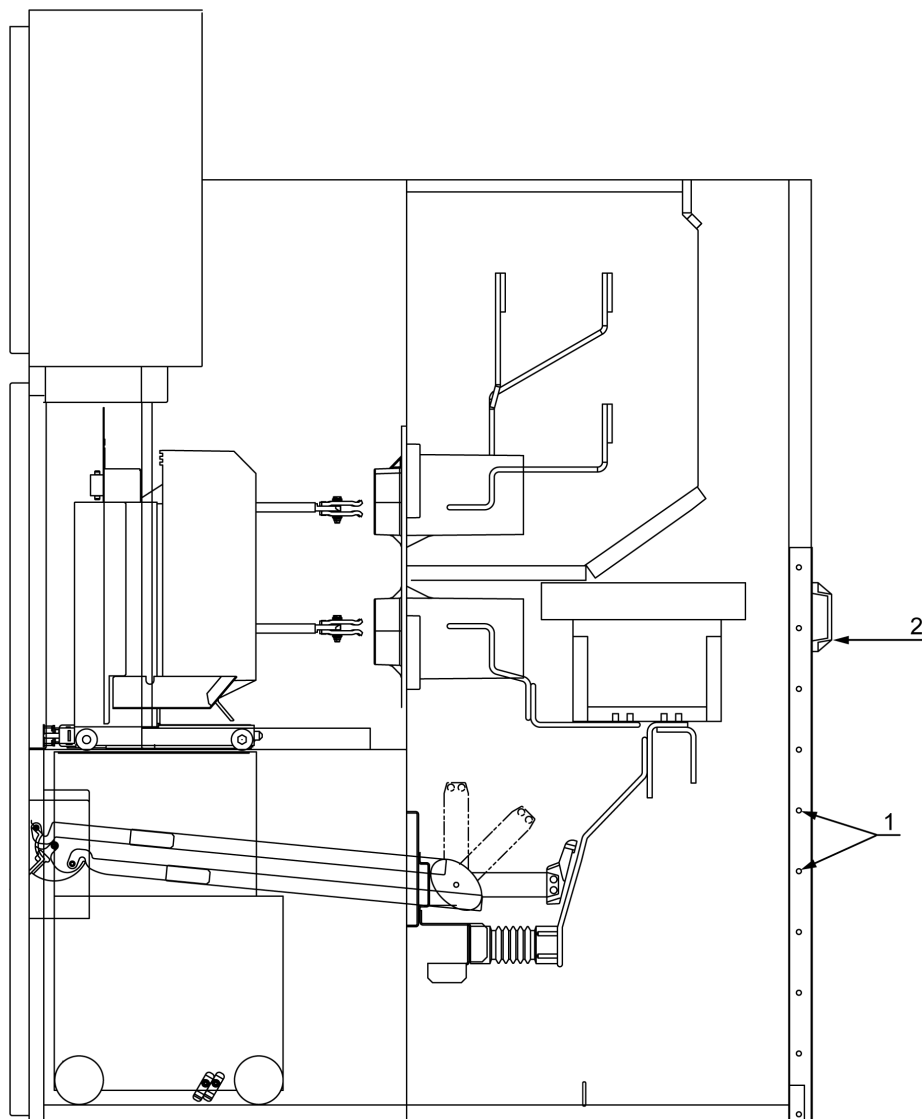
RISK OF FATALITIES DUE TO HIGH VOLTAGE

Open the cable connection compartment only if the earthing switch is ON.

Failure to follow these instructions will result in death or serious injury.

Follow the steps to remove cable compartment cover:

Step	Action
1	Remove the securing screws of the cable compartment cover (see item 1 in the following figure).
2	Remove the cable compartment cover (see item 2 in the following figure).



Mounting Cable Compartment Cover

After completing assembly work, place cable compartment cover on the panel and fasten it again using the securing screws.

⚠ DANGER

RISK OF FATALITIES DUE TO HIGH VOLTAGE

Turn OFF the earthing switch only if the cable connection compartment is closed.

Failure to follow these instructions will result in death or serious injury.

Access to Busbar Compartment

Remove Truck and Partition Plate

⚠ DANGER

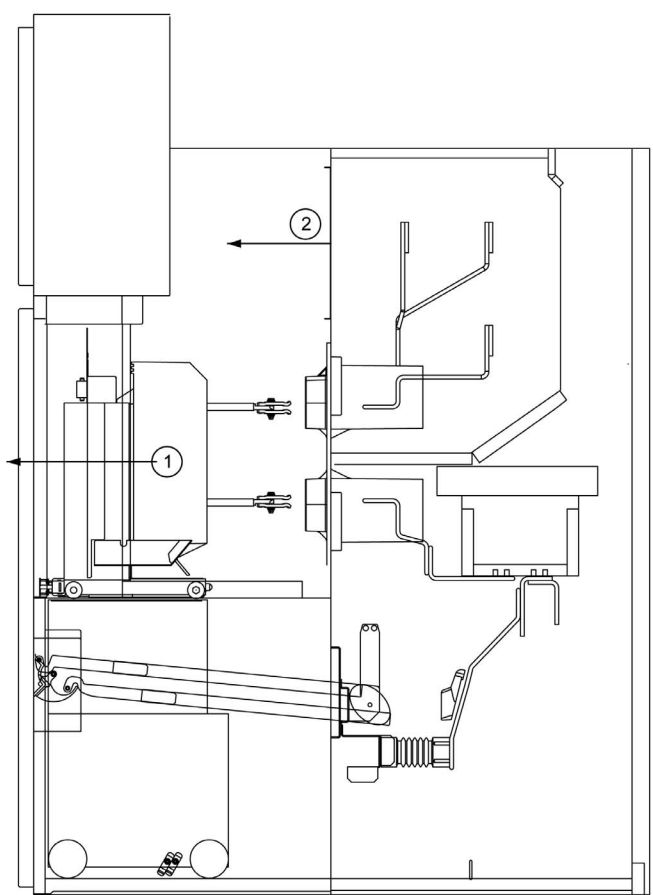
RISK OF FATALITIES DUE TO HIGH VOLTAGE

Open the busbar compartment only if the busbar is grounded. For more information, refer Operation (*see page 63*) and Maintenance (*see page 83*).

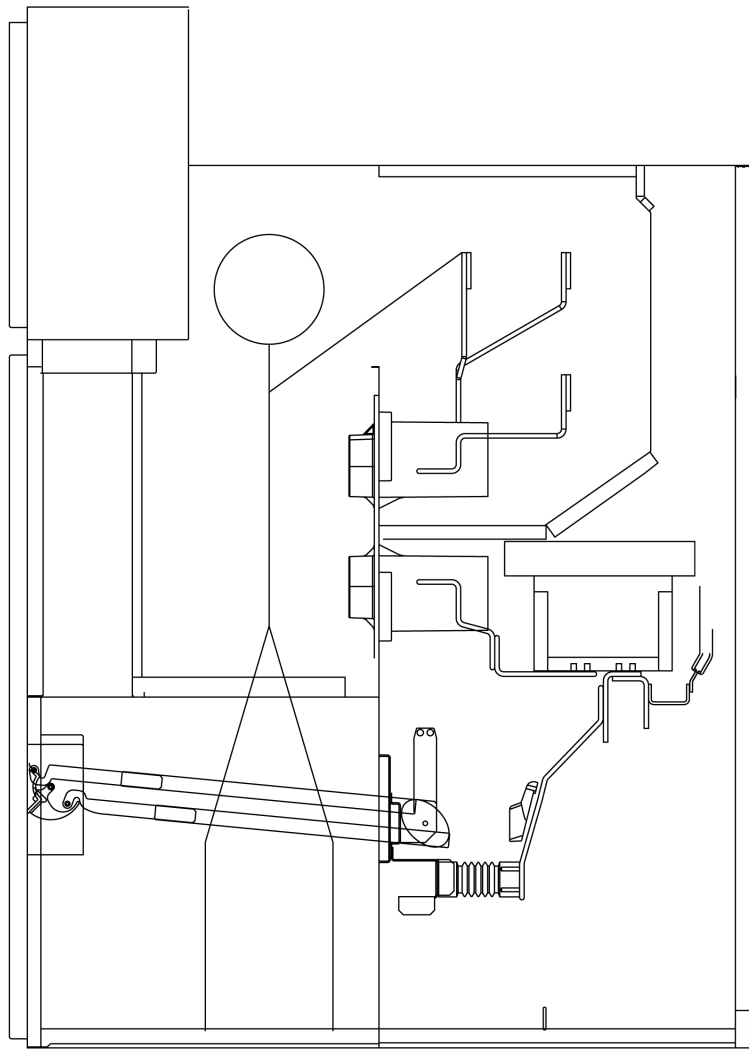
Failure to follow these instructions will result in death or serious injury.

Follow the steps to remove truck and partition plate:

Step	Action
1	Open the front door and remove the truck from the panel. For more information, refer Removing the Truck from the Panel (<i>see page 31</i>)
2	Remove partition plate between busbar compartment and circuit breaker compartment (see the following figures). The busbar compartment is now accessible.



- 1 Remove truck
- 2 Remove partition plate



Posture of worker during busbar mounting or checking

Remounting the Partition Plate

After completion of assembly work, reinsert the partition plate and fasten it using bolts.

Chapter 5

Assembly

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Safety Provisions and Important Instructions	38
Switchgear Room Requirements	39
Transport of Panels and Trucks	41
Fastening and Installation of Panels	43
Busbar Assembly	45
Earth Bus Assembly	46
Mounting the Deflectors	47

Safety Provisions and Important Instructions

Safety Provisions

The switchgear panels must be installed and assembled by the manufacturer staff or by the person who is certified to do the work.

PIX panels are delivered with the earthing switch OFF.

The circuit breakers are always shipped in open state (OFF) with the energy storing device released and in connected position.

 WARNING
--

RISK OF ACCIDENTS, FALLING, AND INJURY DUE TO MOVABLE PARTS IN MECHANICAL DRIVES

- | |
|--|
| <ul style="list-style-type: none">● Watch out for floor openings in the switchgear room.● Do not walk on the top sides of the panels. Temporarily position a solid base plate to step on when working on the top of the panel, for example, assembly of deflectors or pressure relief ducts.● Comply with the safety instructions given in Safety Provision (<i>see page 9</i>).● Do not tension the circuit breaker energy storing device and the earthing switch during assembly. |
|--|

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Important Instructions for Assembly

NOTE:

The following are the important instructions for assembly:

- Condensation, dirt, and dust during assembly should be avoided in order to prevent damage to the panels.
- For assembly, refer the assembly drawings provided with the equipment. Read them before you commence assembly work.
- For all screw connections, refer to the tightening torques specified in Appendix Specifications for Screw Connections. (*see page 98*)

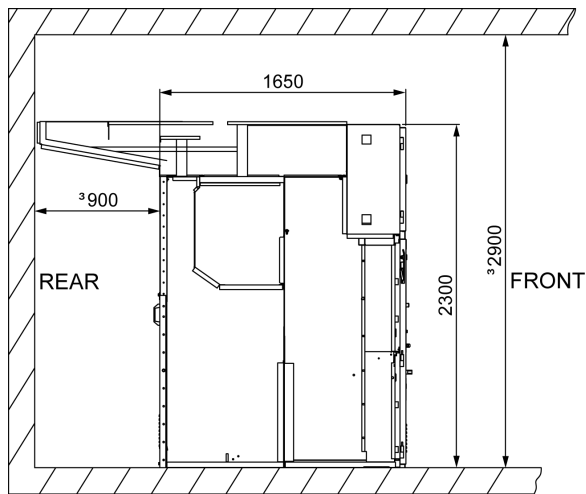
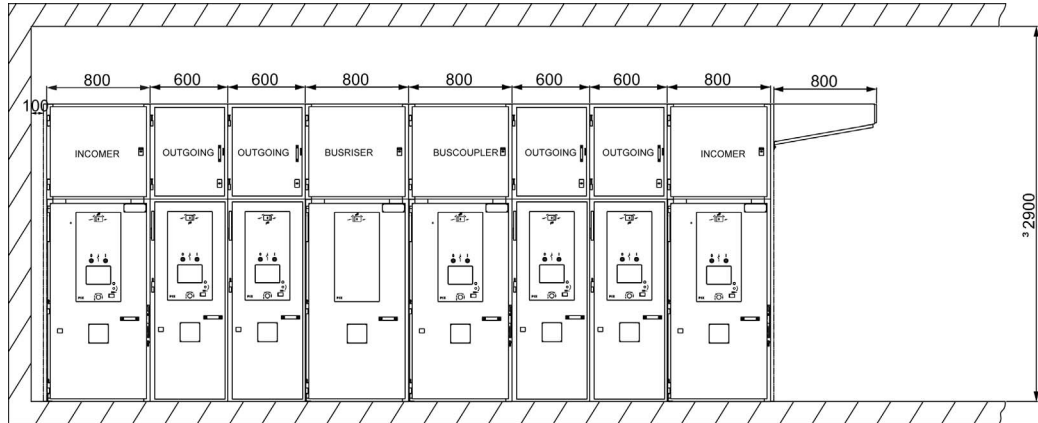
Switchgear Room Requirements

Overview

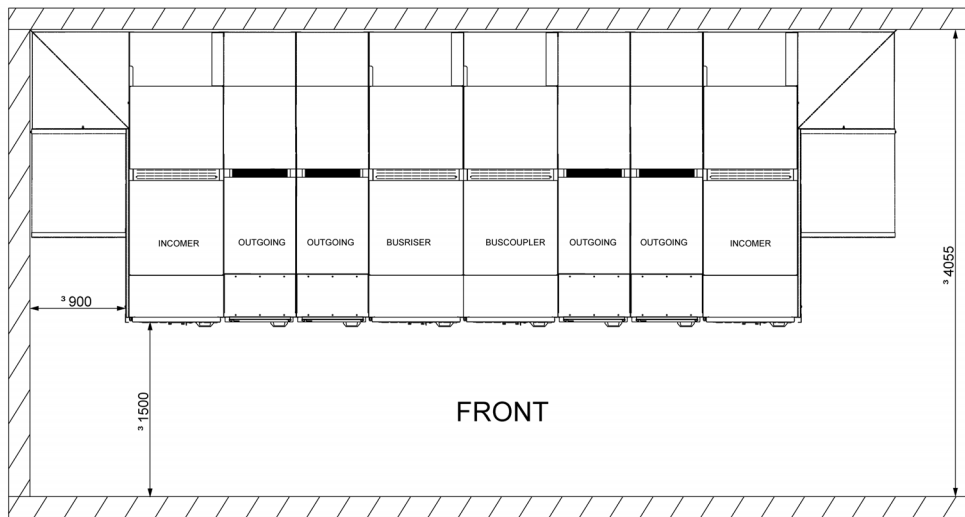
Before installing the switchgear panels, make sure that the switchgear room is checked according to the switchgear document.

- Observe the minimum distance between the switchgear and the wall of the building.
- The load bearing capacity of the fastening area must correspond to the weight of the switchgear (perform the stress analysis of the building).
- Check base frame (if used) for dimensions and positional tolerances
- Check position of floor openings for high voltage and low voltage cables.

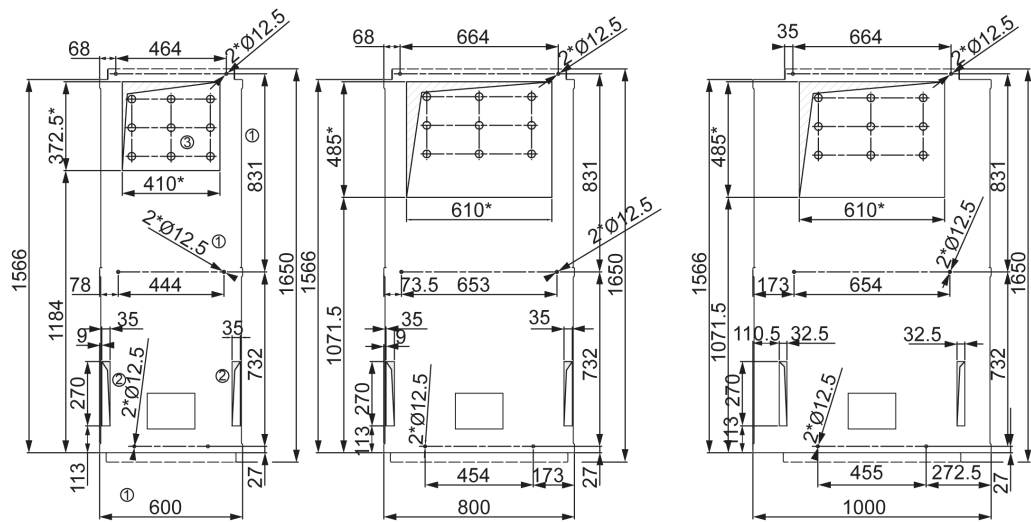
Before the switchgear is positioned at its site of installation, check that the fastening points are at level. Unevenness must not exceed ± 2 mm/meter and 6 mm difference in height over the entire switchgear width



Dimensions in the switchgear room



Ground plan of a PIX Switchgear within a switchgear room



Ground plan of a PIX panel

Transport of Panels and Trucks

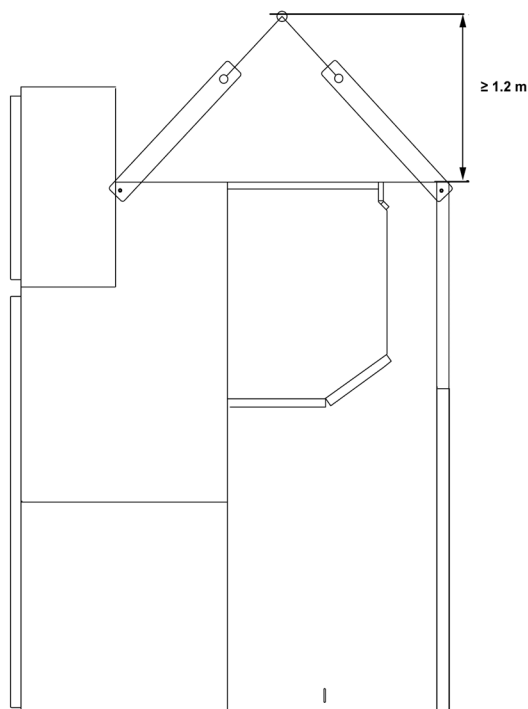
Overview

⚠ WARNING	
RISK OF ACCIDENTS	
<ul style="list-style-type: none"> • Make sure that the rope or chain is strong enough to bear the weight of the panel and truck. Comply with the relevant provisions for hoisting equipment. • On lowering the panels and the trucks, make sure that the supporting platform is sufficiently stable and even. • Pay attention for floor openings. 	
Failure to follow these instructions can result in death, serious injury, or equipment damage.	

Transport of Panel Using a Crane

Consider the following sequence while transporting panel using a crane:

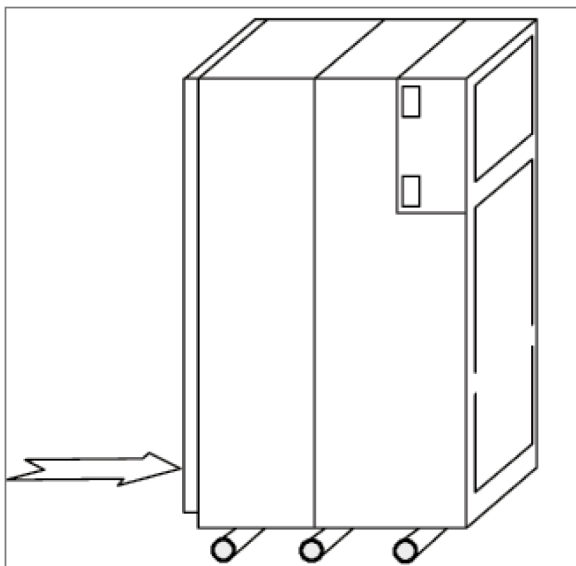
Step	Action
1	Remove transport packaging and protective film from the cubicle.
2	Screw-fasten four lifting brackets laterally to the cubicle (see the following figure).
3	Attach four crane ropes/chains through hooks (observing minimum carrying capacity and length). Release the cubicle fastening on the pallet.
4	Lift the module carefully and keep it slowly on the floor at the intended location. Remove the lifting brackets.



Transport of Panel on Floor

If the panel needs to be moved on the floor:

- Use three rollers with the minimum diameter of 30 mm. Evenness and stability of the supporting area (floor) must be ensured.
- Move the panel on the rollers to the final site of installation.



Fastening and Installation of Panels

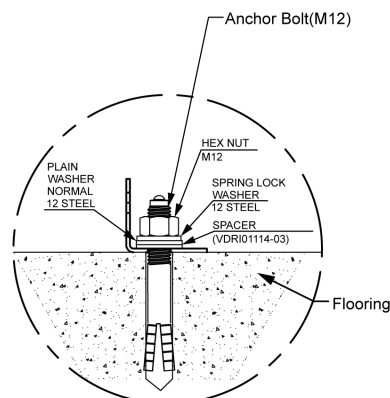
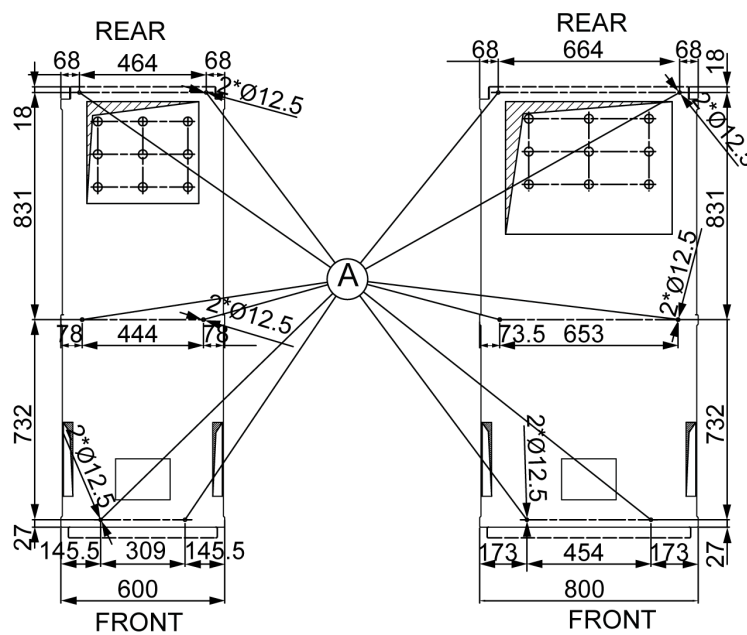
Installation of Panels

NOTE: The position of the first panel is decisive for placement of the subsequent panels. Thus, measuring must be done with the utmost precision. Refer the following figure.

Fastening on Concrete Foundation

Follow the steps to fasten the panel on concrete foundation:

Step	Action
1	Position the first panel on the foundation in accordance with the switchgear-specific space assignment plan.
2	Open the circuit breaker door and cable compartment cover.
3	Align the panel. Check the panel front for correct horizontal and vertical position. If applicable, lift the panel and place shims in the direct vicinity of the fastening areas until the horizontal position has been reached.
4	Screw-fasten the panel to the two fastening points provided on the front and two fastening points on the rear (see the following figure).



Screw-fastening the Panels to One Another

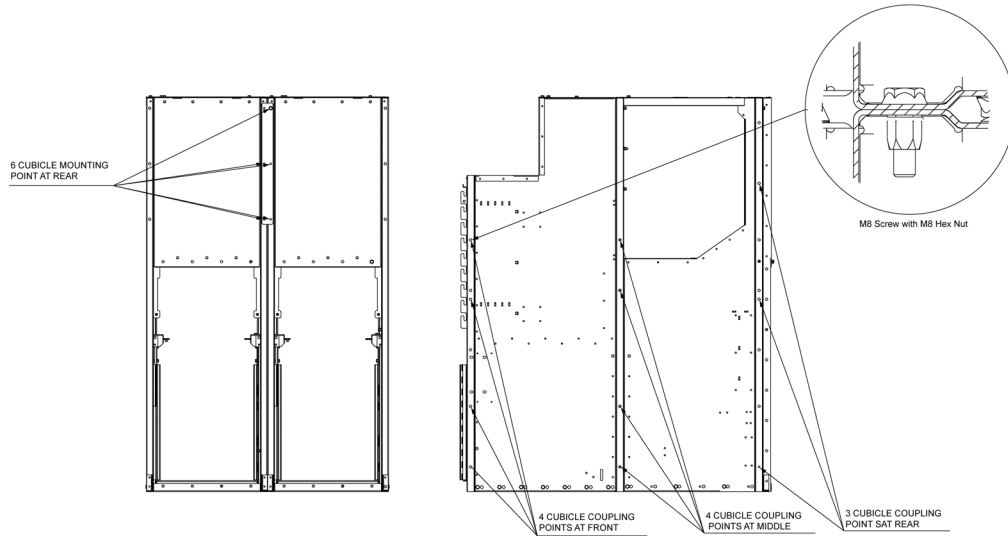
Position the next panel to the previous one in accordance with the assignment plan and align it. Refer the following figure.

Interconnection of Switchgear Panels

Refer the following figure.

Follow the steps to interconnect the switchgear panels:

Step	Action
1	Position the panel next to the previous one according to switchgear room assignment plan and align the panel corresponding to the previous panel.
2	Screw-fasten the panel according to the following figure.



Busbar Assembly

Access to Busbar Compartment

For details on accessing the busbar compartment, refer Access to Busbar Compartment (*see page 34*)







Busbar Compartment Section Segregation (Optional)

The section segregation for the bus bar compartment and for the bus section coupler is mounted to the left-hand panel side (except for left-hand end panel).

Normally, the busbar segregation plate is pre-assembled in the factory.

Busbar Assembly

Arrangement of busbars in circuit panels is shown in the following table.

		Number of busbars per phase		
		1 ≤ 1250 A	2 2000 A/2500 A	3 3150 A
Number of outgoing feeder bars per phase	1 ≤ 1250 A			
	2 2000 A/2500 A	-		
	3 3150 A	-		

For more information, refer Appendix B (*see page 101*).

NOTE:

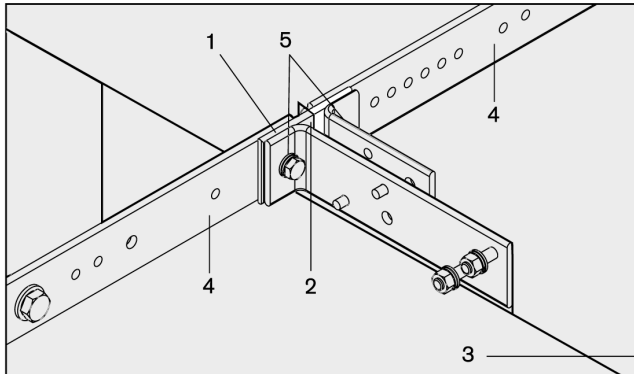
The following are the points to be considered for busbar assembly:

- Comply with the specifications on treatment of contact surfaces and the tightening torques for busbar screw-fastening given in Appendix B (*see page 101*).
- Comply with the position and direction of screws and nuts as shown in the diagram.

Earth Bus Assembly

Assembly of the Earth Bus

Earth bars are screw-fastened between the switchgear panels using connection bars.



- 1 Connecting bar
- 2 Cut-out in panel supporting structure
- 3 Adjacent panel
- 4 Earthing bars in the panels
- 5 Screw fastening of connecting bars to the earthing bars

NOTE: Comply with the specifications on treatment of contact surfaces and the tightening torques for screw-fastenings in Appendix B Busbar Connection ([see page 101](#)).

Follow the steps to assemble the earth bus:

Step	Action
1	Clean all contact areas of the connecting bar and the appropriate earth bar in the switchgear panels and coat them with synthetic lubricant (see Auxiliary Products (see page 96))
2	Slip the connecting bar (see item 1 in the figure above) into the adjacent panel (see item 3) through the cut-out in the panel supporting structure (see item 2).
3	Screw-fasten (item 5) connecting bar on both sides to the earth bar (item 4)
4	Connect earth bus (see following figure) to the earthing system of the switchgear building (connecting lines and screw accessories are not included in the scope of supplies).



NOTE: Observe the specific standards referring to earthing system which apply in your country

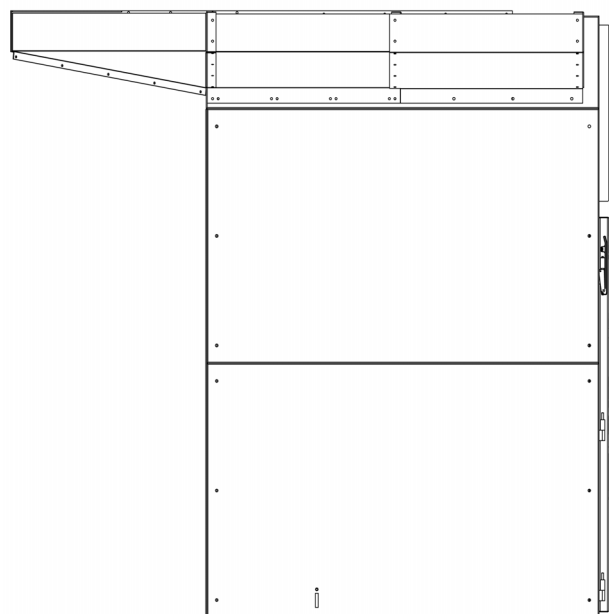
Mounting the Deflectors

Overview

Deflectors are required to ensure operator safety in case of internal faults in accordance with IEC 62271-200.

IAC: Internal arc classification: AFLR

NOTE: Check the correct position of deflectors and the gap covers in the switchgear document before mounting them.



1 Panel with deflector

For detailed deflector mounting procedure, refer Appendix C ([see page 110](#))

Chapter 6

High Voltage Connection

What Is in This Chapter?

This chapter contains the following topics:

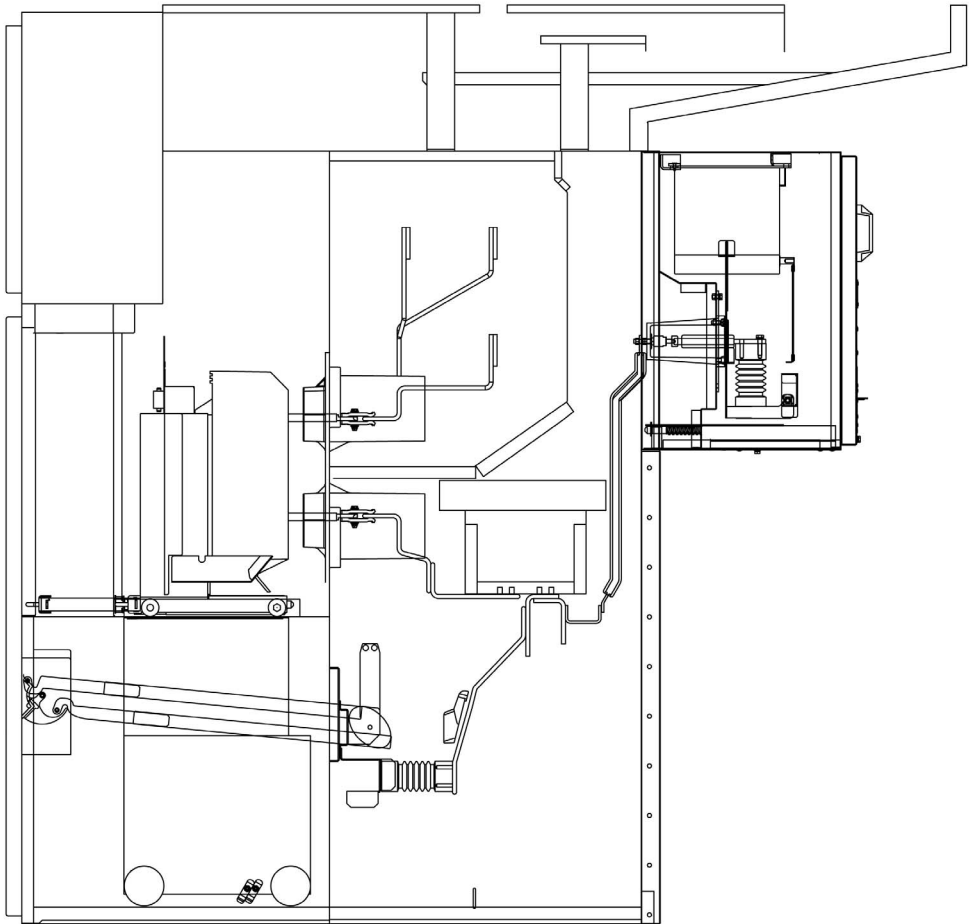
Topic	Page
Cable Connection Variant	50
Mounting High Voltage Cables	51

Cable Connection Variant

Overview

I_n panel	Panel width	Cables per phase
630 A	600 mm	1/2/3
1250 A	600 mm	1/2/3
2000 A	800 mm	2/3/4
2500 A	800 mm	3/4/5/6
3150 A	1000 mm	3/4/5/6

Connecting brackets available for cable connection 1-6 cables per phase maximum 300 mm² cable.



Mounting High Voltage Cables

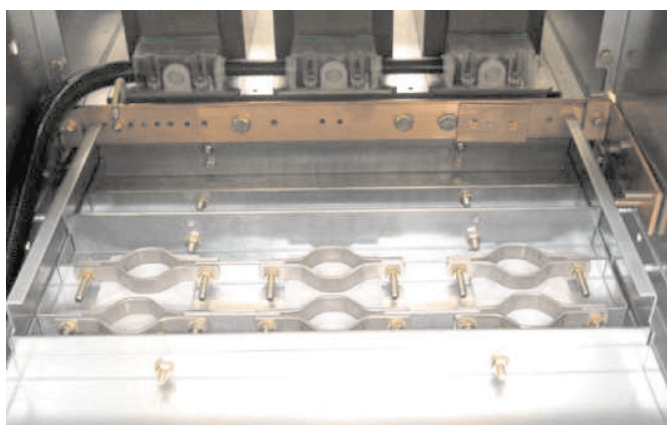
Overview

Provided with plain aluminum sheet, customer can accommodate the cable per phase as per requirement. For details on accessing cable compartments, refer to Access to Cable Connection Compartment. (*see page 33*)

Preparation of Cable Compartment

Follow the steps to prepare the cable compartment:

Step	Action
1	Remove plain gland plate and drill as per the cable requirement.
2	If necessary, remove the base plates (4).
3	Cable glands to be used suitable to cable and size of cable.



⚠ WARNING

RISK OF CONTACT CORROSION

Do not use aluminum cable lugs for the cable connection. There is the risk due to contact corrosion in case of inadmissible matching of materials.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

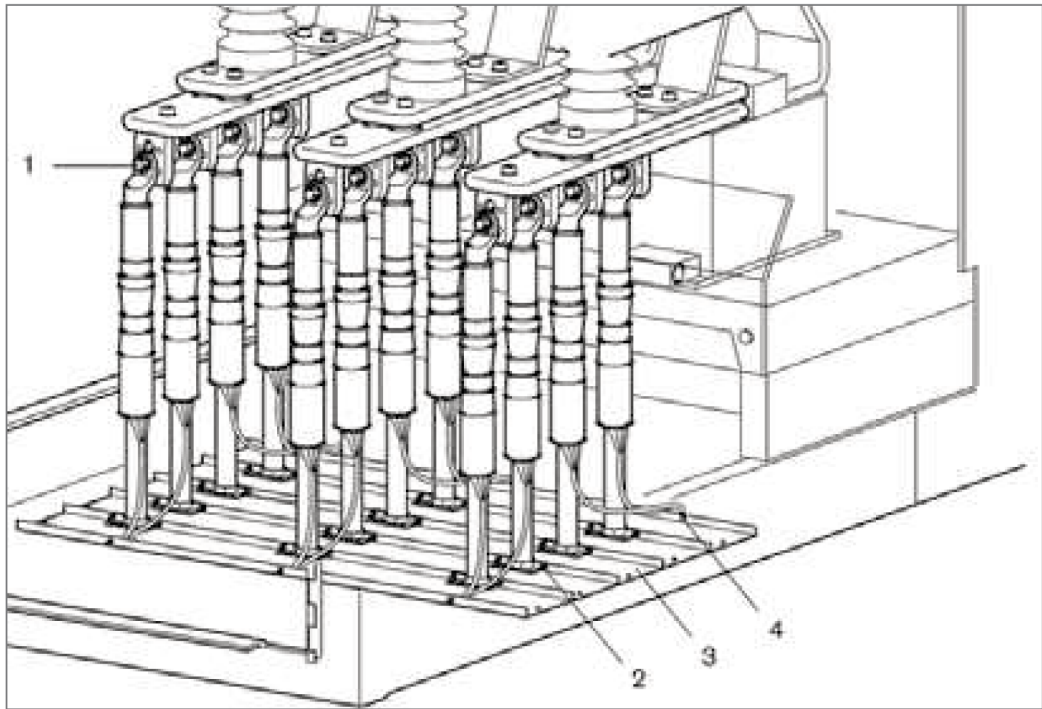
Connecting the Cables

NOTE:

- Unless otherwise specified by the cable manufacturer, comply with the specified tightening torques and pre-coat contact areas. For more information, refer Treating Contact Surfaces (*see page 97*).
- Observe the phase grouping of the switchgear panel.

Follow the steps to connect the cables:

Step	Action
1	Fasten the individual cables to the appropriate connection surfaces passing through cable gland mounted on gland plate (see item 1 of the following figure).
2	Tighten the cable through glands (double compressible type)
3	Connect the ground wires to the panel rack (see item 2 of the following figure).

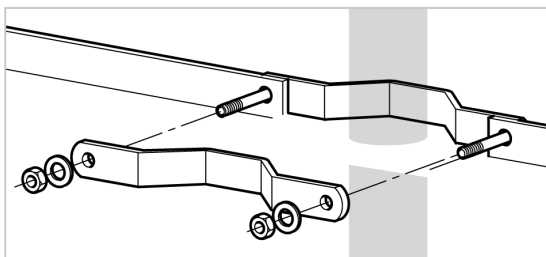


- 1 Cable connection on the panel
- 2 Cable holding with the compressible type gland
- 3 Compressible glands mounted on the plane gland plate
- 4 Connection of the ground wires to the panel

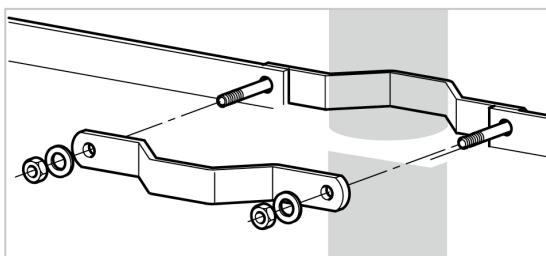
Clamping Assembly for the Cables

NOTE: Make sure that the sealing of cable floor is proper after installing the cables to avoid vermin and moisture entry.

Clamping assembly for cables with a diameter of ≥ 40 mm



Clamping assembly for cables with a diameter of ≥ 40 mm



Chapter 7

Low Voltage Terminal

What Is in This Chapter?

This chapter contains the following topics:

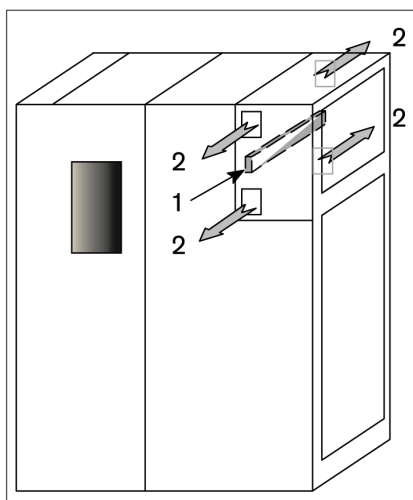
Topic	Page
Connecting Ring Circuits in Low Voltage Cabinet	54
Placing External Cables in the Switchgear Panel	55

Connecting Ring Circuits in Low Voltage Cabinet

Connecting Ring Circuits

Follow the steps to connect ring circuits in low voltage cabinet:

Step	Action
1	Route the ring circuits for the inter-panel wiring through the lateral openings of the low voltage cabinet (see item 2 in the following figure).
2	Connect ring circuits to the appropriate terminal strips in the low voltage cabinet according to the circuit diagram.

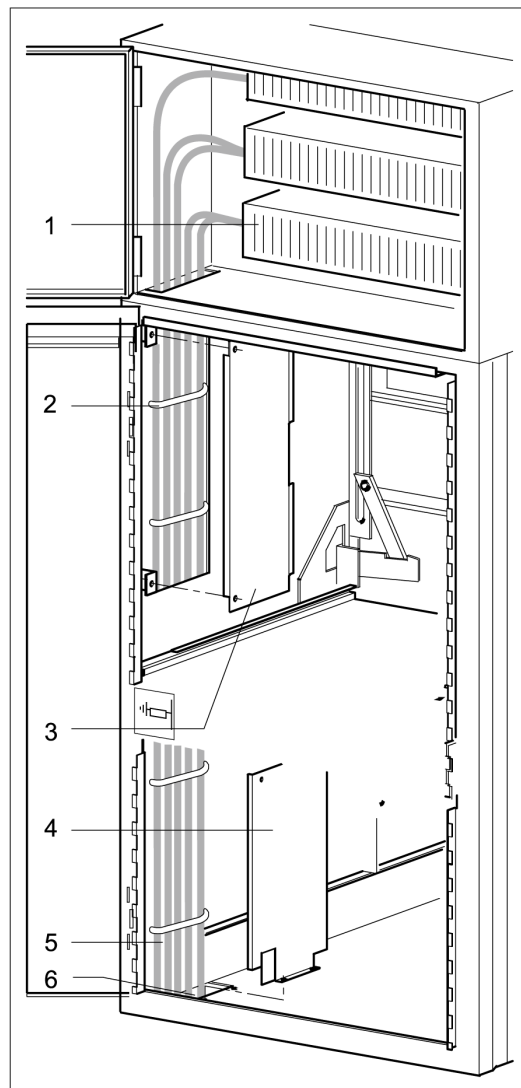


- 1 Terminal strip
- 2 Openings for ring circuits in the low voltage cabinet

Placing External Cables in the Switchgear Panel

Overview

Customized low voltage cables for control and measuring purposes can be placed for each panel on the left inside of the panels to the low voltage cabinet (see the following figure).



- 1 Connection to terminal strip in the low voltage cabinet
- 2 Cable clamp
- 3,4 Cable duct covers
- 5 Bus riser in cable duct
- 6 Cutout in the panel floor

Follow the steps to place external cables in the switchgear panel:

Step	Action
1	Remove the metal cable duct covers on the left side of the panel (see item 3, 4 in the above figure).
2	Route external cables (see item 5 in the above figure) from the cable basement through the cutout in the panel floor (see item 6). Route them in the cable duct to the low voltage cabinet. Fasten cables to the panel using cable clamps (see item 2).
3	Connect external cables to the terminal strip in the low voltage cabinet according to the circuit diagram (see item 1 in the above figure).
4	Reposition cable compartment covers.

NOTE: If the cables are to be routed into the low voltage cabinet from above, the cable fastening and protection equipment must be provided by the customer.

Chapter 8

Commissioning

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Commissioning Procedure	58
Checking Switching Functions and Interlocks	59
Power Frequency Test of Busbar (Optional)	60

Commissioning Procedure

Overview

⚠ DANGER

RISK OF HIGH VOLTAGE SUPPLY

Do not connect the high voltage supply. All the active parts must be grounded.

Failure to follow these instructions will result in death or serious injury.

NOTE: Whenever anomalies are detected, faults found, or switchgear not functioning properly, do not commission the switchgear and inform the manufacturer.

Cleaning and Checking the Panel Assembly

Follow the steps to clean and check the panel assembly:

Step	Action
1	Clean the switchgear to remove contamination resulting from assembly work.
2	Remove all attached information tags, cards, brochures, and instructions no longer needed.
3	Check the tightening torques of all screw fastenings and connections established on the site of installation: <ul style="list-style-type: none"> ● High voltage connection ● Ground conductor ● Panel screw fastenings ● Busbar links ● Deflector fastening ● Special attachments

Damaged Paint

The panels are powder coated. Minor damage to the paint can be repaired using commercially available paint (standard color RAL 7032 or corresponding color).

Remounting the Covers

Follow the steps to remount the covers:

Step	Action
1	Use secondary cable duct cover. For more information, refer to Connecting the Cables. (<i>see page 55</i>)
2	Fix cable compartment cover. For more information, refer to Removing Cable Compartment Cover. (<i>see page 33</i>)
3	Remove temporary base from the panel top if such a base is used.
4	Remount cladding between busbar compartment and circuit breaker compartment.

Inspection

Follow the steps to inspect the switchgear:

Step	Action
1	Check the switchgear for damage due to transport or assembly work.
2	Compare data on nameplate to the required ratings.
3	Check the connected cables for phase coincidence.

Racking-in the Trucks

Rack the following components into the panel:

- Circuit breaker truck HVX
- Isolating truck UTX
- Withdrawable voltage transformer MTX
- Fused vacuum contactor CVX

Close front doors. For more information, refer to Opening and Closing the Front Door. (*see page 29*)

Checking Switching Functions and Interlocks

Checking Switching Functions and Interlocks

DANGER

RISK OF HIGH VOLTAGE SUPPLY

Do not connect the high supply voltage. All active parts must be grounded.

Failure to follow these instructions will result in death or serious injury.

Follow the steps to check switching functions and interlocks:

Step	Action
1	Apply supply voltage.
2	Perform several manual test operations with each switching device.
3	Check switch position indicators.
4	Check electrical functions of control and operating devices: <ul style="list-style-type: none"> ● Closing and opening releases for circuit breaker.
5	Check switch position indicators and interlocks (see Operation <i>(see page 64)</i>).

NOTE:

- For switching operations, see Operation *(see page 64)*.
- In case supply voltage is not available:
 - Blocking coils (optional; lock circuit breaker button and/or truck in disconnected position) are in locked position. Thus blocking manual switching operation.
 - There is dropped-out under-voltage release in the circuit breaker (optional).
- The energy storing devices of the circuit breaker drive is charged autonomously as soon as the supply voltage is applied.

Power Frequency Test of Busbar (Optional)

Overview

A test unit and test adapter (not included in scope of supplies) are required for the power frequency test.

⚠ WARNING

RISK OF HIGH POWER SUPPLY

Comply with the safety provisions given in Safety Provisions. *(see page 9)*

Failure to follow these instructions can result in death, serious injury, or equipment damage.

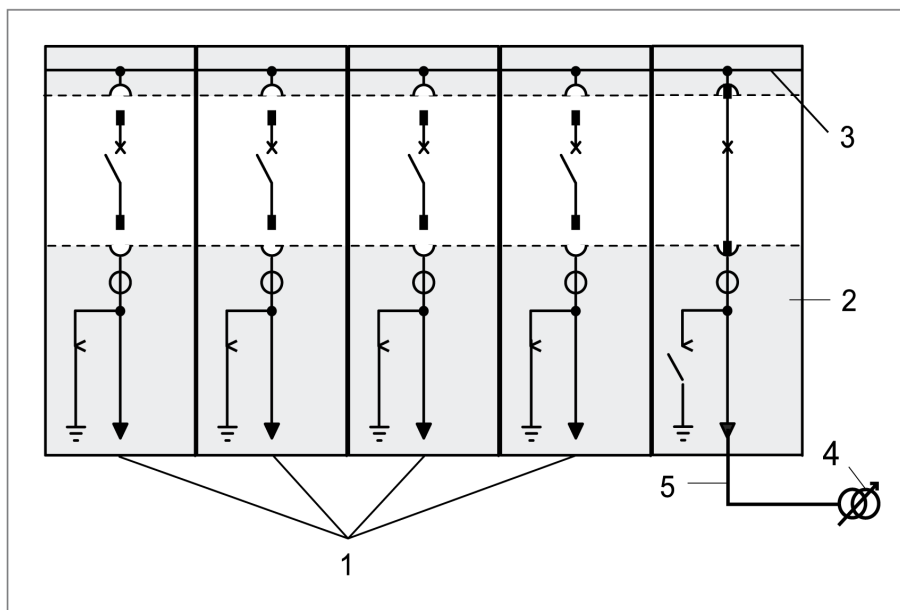
Preparation

Follow the steps to perform power frequency test of busbar:

Step	Action
1	All panels must be isolated from the power supply and grounded (see Standard Switching Operations <i>(see page 80)</i>).
2	Busbar: Disconnect voltage transformer, surge arrester, and ground voltage detection systems.
3	Incoming feeder panel for voltage test: Remove cable connection compartment cover and disconnect voltage transformer, surge arrester, and ground voltage detection systems. NOTE: Make sure that no high voltage cables are connected. Observe the assembly and operating instructions for the test unit and the test adapter.

Follow the steps to perform power frequency test of busbar on the feeder panel:

Step	Action
1	Connect test unit to the test cable.
2	Switch the earthing switch OFF.
3	Move circuit breaker truck HVX service position and switch circuit breaker ON.
4	Perform the power frequency test successfully for all three phases (L1, L2, L3) in accordance with the specifications of the test unit manufacturer. NOTE: Observe admissible test values for the switchgear and the admissible test values for power frequency tests after installation of switchgear in accordance with IEC 62271-200.



- 1 Branch circuit panels
- 2 Incoming feeder panel for test voltage
- 3 Busbar
- 4 Test unit (for example, high voltage source, test transformers)
- 5 Test cable

After Power Frequency Test

Follow the steps after the power frequency test:

Step	Action
1	Switch circuit breaker OFF and put circuit breaker truck to disconnected position. Switch earthing switch ON.
2	Remove test unit and test cables.
3	Reconnect disconnected voltage transformers and surge arresters.

Chapter 9

Operation

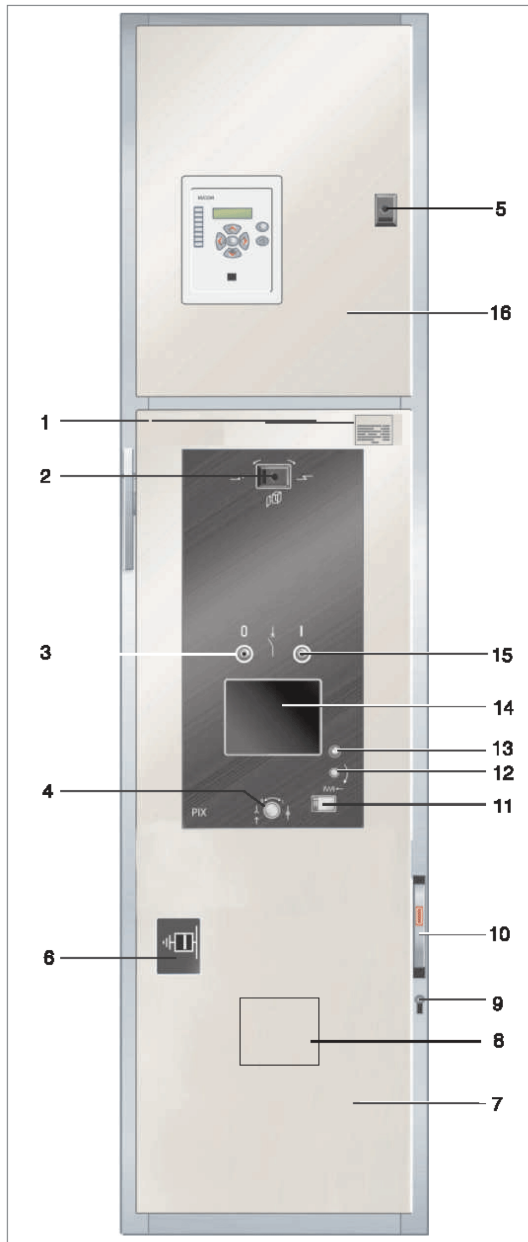
What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Operating Interface of the Panel	64
Truck for PIX Panels	65
Operation Accessories	67
Interlocks	68
Operating Specifications	71
Operating the Circuit Breaker	72
Moving Truck into Operating/Disconnected Position	76
Operating the Earthing Switch Manually	78
Standard Switching Operations	80

Operating Interface of the Panel

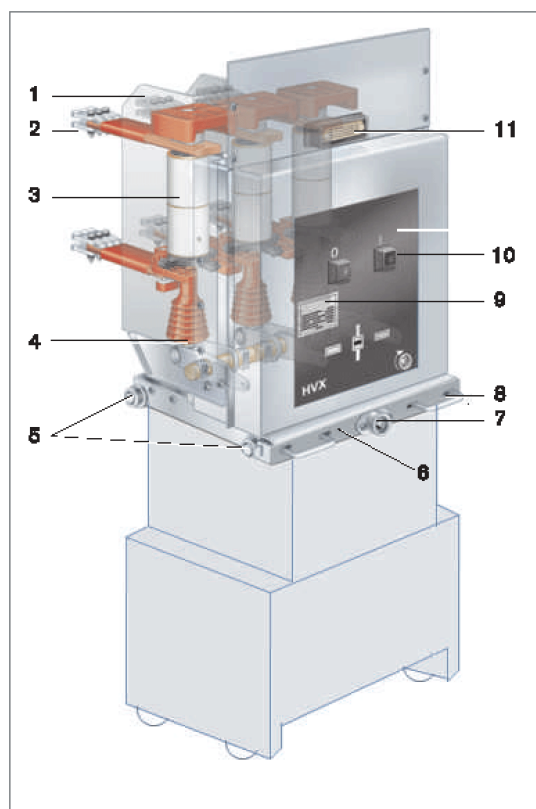
Overview



- 1 Feeder nameplate
- 2 Opening for door handle
- 3 Switching circuit breaker OFF (shown with operating rod; optionally through push button)
- 4 Insertion opening for racking the truck in/out manually
- 5 Locking for low voltage cabinet door
- 6 Earthing switch position indicator
- 7 Circuit breaker compartment door
- 8 Rating plate
- 9 Mechanical interrogation interlock of insertion port for the earthing switch
- 10 Insertion opening for operating lever of earthing switch
- 11 Slide for opening the insertion opening (4) for racking the truck in and out
- 12 Opening for manual charging of the circuit breaker energy storing device
- 13 Slide for opening the insertion opening (12) for manual spring charging handle
- 14 Inspection glass
- 15 Switching circuit breaker ON (shown with operating rod; optionally through push button)
- 16 Low voltage cabinet with control unit

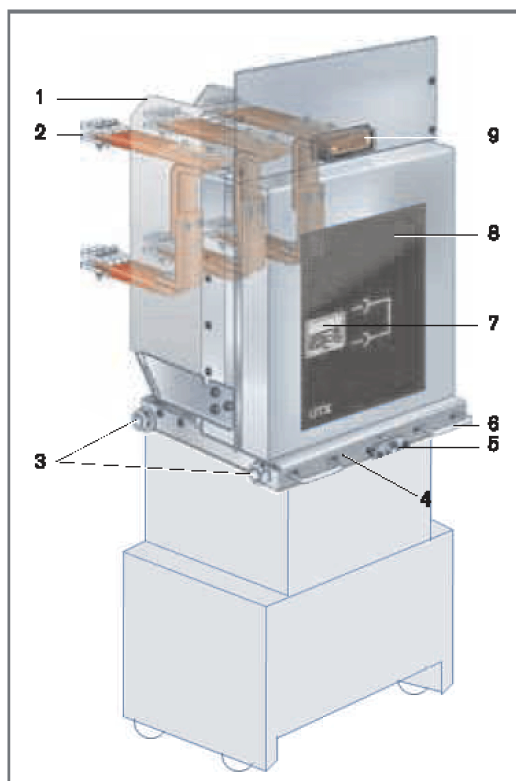
Truck for PIX Panels

Vacuum Circuit Breaker Truck HVX



- 1 Casing for high voltage components
- 2 Moving contacts
- 3 Vacuum interpreter chamber
- 4 Press rod (transfer of ON/OFF switching movement)
- 5 Truck rollers
- 6 Fixed front cross arm of the truck which is locked in the panel
- 7 Insertion point of the crank for racking the truck in and out manually
- 8 Handle to move the truck in and out of the panel and to lock truck in the panel
- 9 Nameplate
- 10 Operating interface
- 11 Low voltage terminal

Isolating Truck UTX

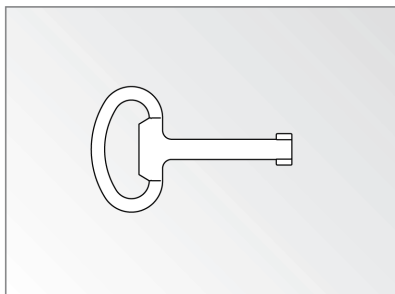


- 1 Casing for high voltage components
- 2 Moving contacts
- 3 Truck rollers
- 4 Fixed front cross arm of the truck which is locked in the panel
- 5 Insertion point of the crank for racking the truck in and out manually
- 6 Handle to move the truck in and out of the panel and to lock truck in the panel
- 7 Nameplate
- 8 Operating interface
- 9 Low voltage terminal

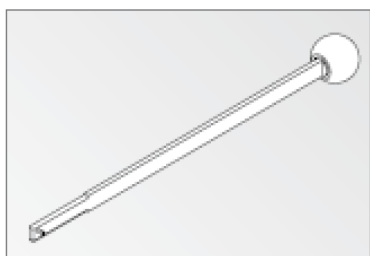
Operation Accessories

Overview

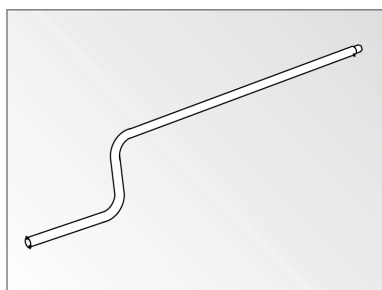
NOTE: The operation accessories are supplied with the panel. The panel is operated only by the means of these accessories.



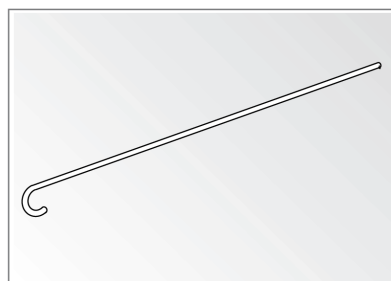
Standard double-bit key to lock/unlock the door of the low-voltage cabinet



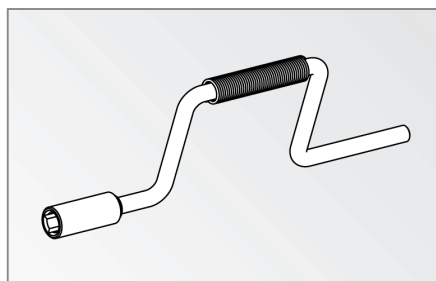
Operating lever for the earthing switch



Crank to charge the circuit breaker energy storing device



Operating rod to switch the circuit breaker ON and OFF



Crank for truck

Interlocks

Overview

NOTE: Complete switchgear interlocking can only be assured with complete locking devices.

PIX panels have mechanical basic interlocks which help avoid operating errors found. You must be familiar with these interlocks before operating panels.

Mechanical Interlocks

Interlocks	Function of Interlock	Method of Operation of Interlock
Between truck and low voltage connector	The truck cannot be actuated unless the low voltage connector is inserted.	The rotary movement of the truck crank is blocked after one rotation. Do not apply force.
	The low voltage plug cannot be removed when the truck is not in disconnected position.	The low voltage plug is locked.
Between truck and earthing switch	The truck cannot be racked in if the earthing switch is ON.	The opening in the front door for the truck crane is locked.
	The earthing switch can no longer be switched ON if the truck has left its disconnected position.	The slider near the earthing switch operating part is locked. The insertion of the earthing switch lever is blocked.
Between the circuit breaker and the truck	Circuit breaker cannot be racked in or out while it is switched ON	The rotary movement of the truck crank is blocked after one rotation. Do not apply force.
	Circuit breaker cannot be switched ON/OFF unless the truck is completely in its disconnected or service position.	The circuit breaker cannot be switched ON or OFF.
Between truck and cubicle	If the truck front frame is not locked in the cubicle, the truck cannot be actuated.	The crank cannot be inserted to the truck if both truck handles in the front frame are not moved outwards. Rotation of the crank not possible if both truck handles in the front frame are not moved outwards.
	If the truck has left its disconnected position the truck front frame cannot be unlocked in the cubicle.	Both truck handles in the front frame are locked.
Between the truck and front door (optional)	The front door can only be opened if the truck is in its disconnected position.	The double-bit key cannot be turned. Provision available in the front door to open the interlock.
	If the front door is opened, the truck cannot be moved into service position. This interlock is standard.	The crank cannot be inserted to the truck if the front door is opened.
	If the front door is not locked by rotating the knob, the truck cannot be actuated	The opening in the front door for the truck crank is locked.
For the truck disconnected position (optional castle lock)	Circuit breaker can be moved to service position only when key is inserted in the lock. Key is blocked in the lock when circuit breaker is in service position.	Low voltage plug insertion is blocked by the lock and is possible only when key is inserted. Key cannot be taken out unless low voltage plug is disconnected. Low voltage plug cannot be disconnected when circuit breaker is in service position.

Cable Earthing Switch Interlocks

Interlocks	Function of Interlock	Method of Operation of Interlock
Incoming/outgoing cubicle (mechanical key lock optional) Between truck and earthing switch	Key lock fixed on the cubicle. Key required to switch on earthing switch. Insertion of earthing switch operating handle is blocked by the key lock.	The key lock prevents the operation of earthing switch lever until key is inserted. (Key should be brought from upstream/downstream).
Incomer cubicle (electrical) Between truck and earthing switch	The insertion of the earthing switch operating handle is blocked using solenoid if the VDI shows the presence of voltage in incoming side. Also upstream circuit breaker should be in disconnected position	The solenoid plunger prevents the operation of earthing switch lever until it gets supply from the VDI auxiliary contacts and upstream disconnected position contact. Supply to the solenoid is possible when there is no presence of voltage in incoming side. Both the conditions should be fulfilled.
Outgoing cubicle (electrical) Optional Between truck and earthing switch	The insertion of the earthing switch operating handle is blocked using solenoid if the VDI shows the presence of voltage in outgoing	The solenoid plunger prevents the operation of earthing switch lever until it gets supply from the VDI auxiliary contacts. Supply to the solenoid is possible when there is no presence of voltage in incoming side.

Bus Earthing Switch Interlocks

Interlocks (Bus Earthing Switch in Outgoing feeder - Optional)

Interlocks	Function of Interlock	Method of Operation of Interlock
Cable earthing switch in outgoing cubicles used for bus earthing (mechanical) key lock Between incomer and other outgoing cubicle No electrical interlock available	The insertion of the earthing switch lever (mounted inside cubicle) is free with the use of Master key of key lock. The earthing switch can be switched ON when identified outgoing circuit breaker truck is in service position and closed condition which will earth the bus.	Set of keys gets free from all cubicles other than the identified outgoing cubicle when all circuit breakers are in disconnected position. The master key is released from the key junction box by inserting the above set of keys which is used for making the earthing switch lever free.

Bus Earthing Switch for Bus PT and Bus Coupler)

Interlocks	Function of Interlock	Method of Operation of Interlock
Bus PT and bus coupler cubicle (Mechanical) key lock All feeders of the same bus shall be in disconnected position No electrical interlock available	Key lock fixed on the cubicle Key required to switch ON earthing switch. Insertion of earth switch operating handle is blocked by the key lock	Set of keys gets free from all cubicles when all circuit breakers are in disconnected position. The master key is released from the key junction box by inserting the above set of keys which is used for switching earthing switch in bus PT or bus coupler cubicle.
Bus PT and bus coupler cubicle (Electrical) optional All feeders of the same bus shall be in disconnected position	The insertion of the earthing switch lever is blocked using solenoid unless all circuit breakers of all cubicles are completely in its disconnected position.	The solenoid plunger prevents the operation of earthing switch lever until it gets supply when all the circuit breakers of all the cubicles are completely in its disconnected position. Supply to the solenoid is possible when there is no presence of voltage in bus side.

Electromagnetic Interlocks (Optional)

Electromagnetic blocking coils can be used for inter-panel as well as interpanel interlocks:

- The circuit breakers ON and OFF push buttons are blocked.
- Manual actuation of the earthing switch is blocked.

NOTE:

- In case of no supply voltage available, all electrical interlocks are in their locked position.
Action: Re-establish power supply
- The purchase contract and the switchgear-specific circuit diagram as regard the design of the interlocking systematics.

Padlock

The holes are designed so that the shackles of padlocks with a diameter of maximum 8 mm can pass through them.



Manual racking-in of truck by padlock



Manual switching ON of circuit breaker locked by padlock



Manual switching OFF of circuit breaker locked by padlock

Operating Specifications

Overview

The switchgear unit may only be operated by the qualified personnel who have proven experience (training certificate) for the PIX series and all the relevant safety standards. Also refer to the safety provisions given in chapter Safety Provisions. *(see page 9)*

WARNING

RISK OF FAULTY SWITCHING OPERATIONS

To avoid faulty switching operations, the operating sequences described below must be complied with. Each switching operation must be completed.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

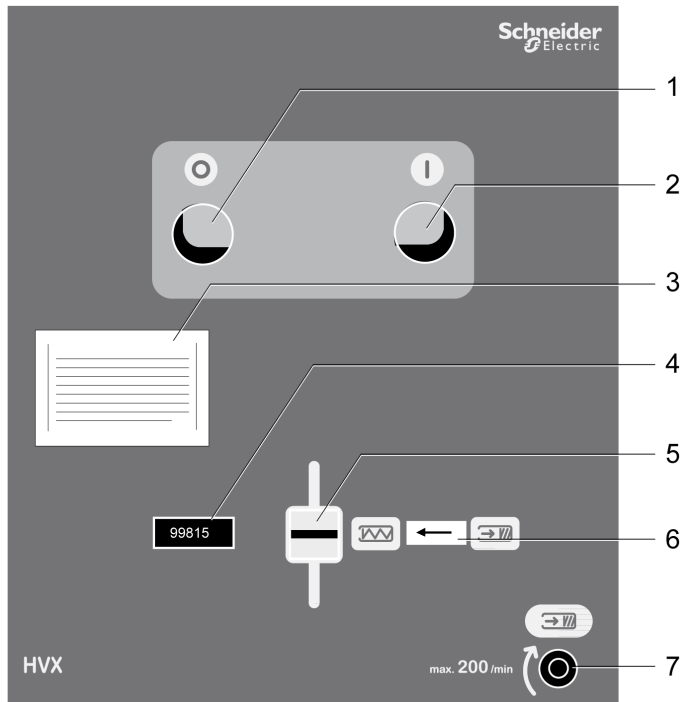
Check whether the supply voltage is ON.

NOTE:

- While the power supply is not available, blocking coils (locking the interrogation slides and circuit breaker push button, depending on design), are in locked position. An under-voltage release (optional) has dropped out.
Action: Re-establish the supply voltage.
- After each switching operation for which you have used a crank or a lever, remove this tool and store it in the tool board.

Operating the Circuit Breaker

Operator Interface



- 1 Button (rocker) "O", optionally: through push button to open the circuit breaker
- 2 Button (rocker) "I", optionally: through push button to close the circuit breaker
- 3 Name plate
- 4 Operations counter
- 5 Position indicator of circuit breaker
- 6 Position indicator of closing spring
- 7 Insertion opening for charging the energy storing device

Charging the Circuit Breaker Energy Storing Device

Initial situation:

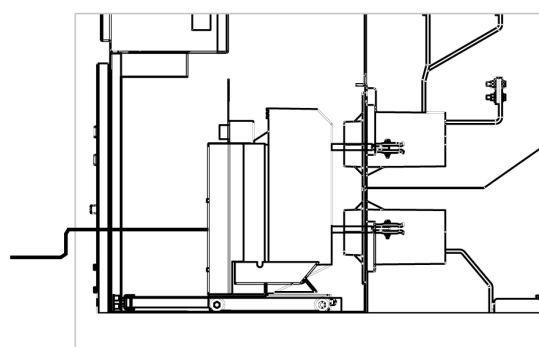
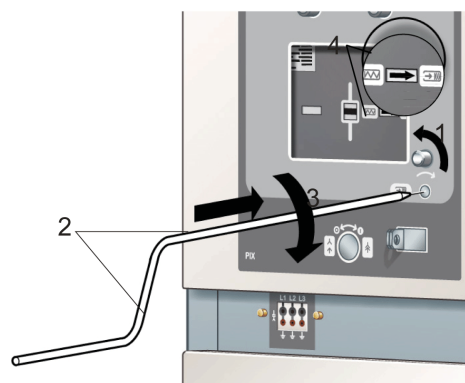
Circuit breaker: OFF

Energy storing device: Released

Charging By Hand

Follow the steps to charge by hand:

Step	Action
1	Open the cover (see item 1 in the following figure) and insert the crank (see 2 in the following figure)
2	Turn in direction of arrow (see 3 in the following figure) until the charge drive mechanism is uncoupled (sounds). The energy storing device indicates the "charged" condition (see 4 in the following figure)
3	Remove the crank.

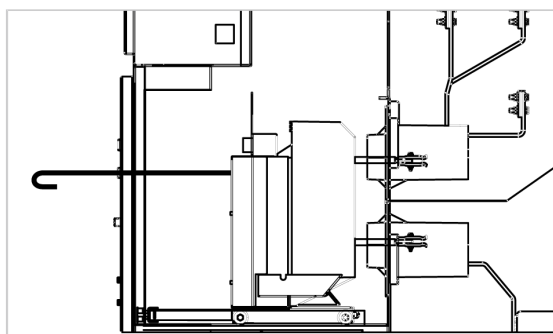


Charging Through Motor

The energy storing device is charged automatically as soon as the motor supply voltage is applied. The position indicator of the energy storing device the “charged” condition (see 4 in the above figure)

Switching the Circuit Breaker Manually

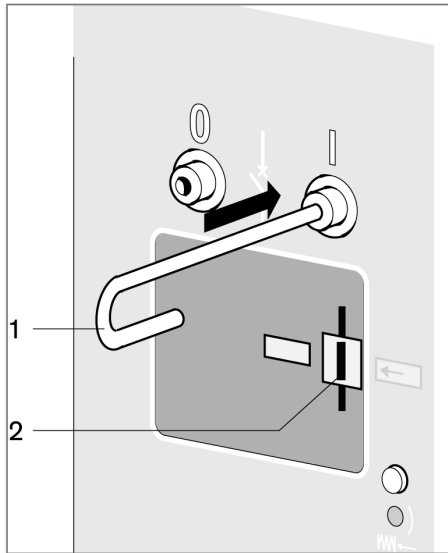
Variant Description



Switching ON Through the Operating Rod

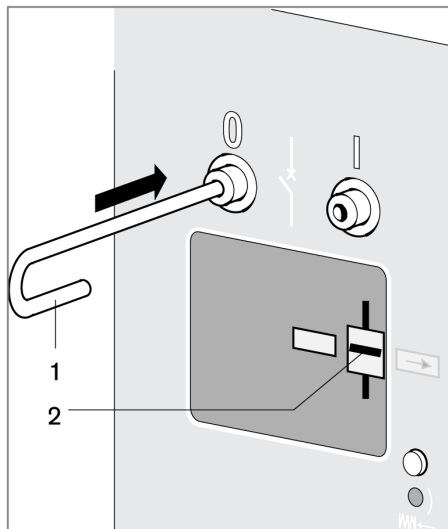
Insert the operating rod (see item 1 in the following figure) into the right-hand guide of the door and press it rearward to its stop. The circuit breaker is switched ON. The position indicator indicates ON (see item 2 in the following figure)

The energy storing device can be charged automatically after switching ON (manually or by motor). If supply voltage is present, the energy storing device is charged automatically.



Switching OFF Through the Operating Rod

Insert the operating rod (see item 1 in the following figure) into the left-hand guide of the door and press it rearward to its stop. The circuit breaker is switched OFF. The position indicator indicates OFF (see item 2 in the following figure)



Switching the Circuit Breaker Electrically

Switching ON (Closing)









Actuate closing release through bay computer or remote control.

The energy storing device can be charged immediately after switching ON (manually or by motor). If voltage is applied to the motor, charging is performed automatically.

Switching OFF (Opening)

- Actuate the opening release through bay computer or remote control.
- Under-voltage release or
- Secondary release

Position Indicators on Circuit Breaker and Possible Operating Sequences

Item	Position indicator energy storing device (closing spring)	Released	Position indicator On/OFF switch position		Possible operating sequence
1		Released		OFF	None
2		Changed		OFF	C-O
3		Released		ON	O
4		Changed		ON	O-C-O
C = Switching ON (Closing) O = Switching OFF (Opening)					

Moving Truck into Operating/Disconnected Position

Overview

⚠ WARNING

RISK OF ISOLATING TRUCK TO RACK IN OR OUT

Isolate truck UTX and truck with jumper to rack in or out only when the busbar and outgoing feeder cable are in de-energized condition.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

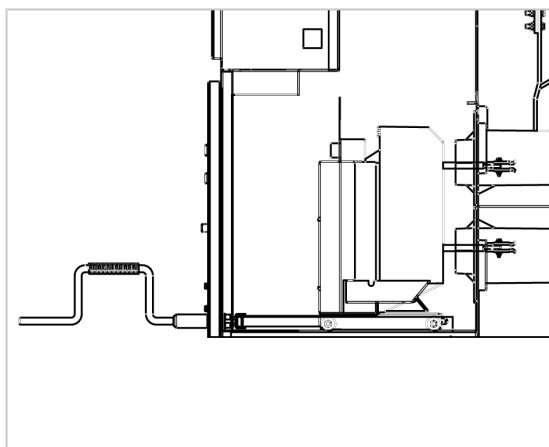
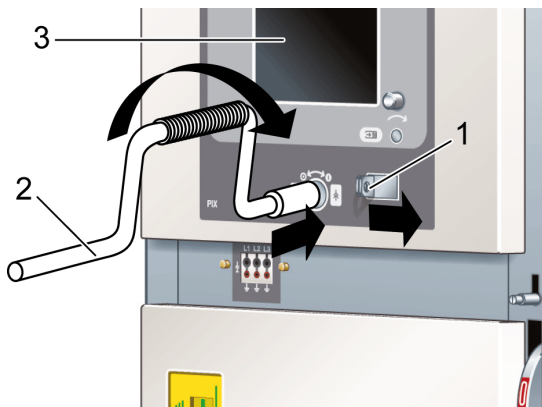
Initial Situation:

- Circuit breaker: OFF
- Earthing switch: OFF

Racking-in the Truck from Disconnected into Service Position

Follow the steps to rack in the truck from disconnected into service position:

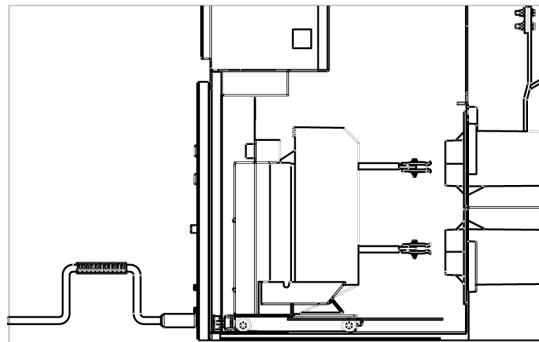
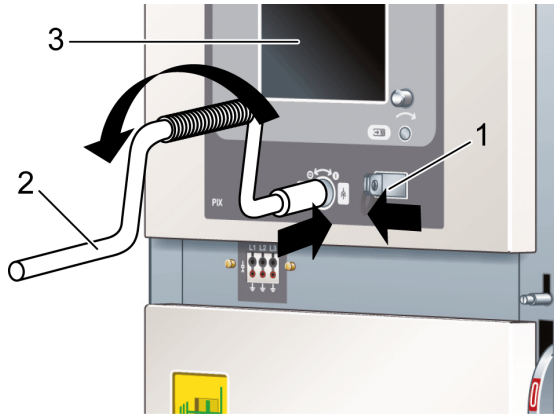
Step	Action
1	Press the slide (see 1 in the following figure) to the right and hold it. Insert crank through the opening in the door onto the drive shaft of the truck (see 2 in the following figure)
2	Turn crank clockwise until the truck has been racked in (see the following figure). Remove the crank.
3	Check position of truck through the inspection glass (see 3 in the following figure).



Racking-out the Truck from Service into Disconnected Position

Follow the steps to rack out the truck from service into disconnected position:

Step	Action
1	Press the slide (see 1 in the following figure) to the right and hold it. Insert crank through the opening in the door onto the drive shaft of the truck (see 2 in the following figure).
2	Turn crank counter-clockwise until the truck has been racked out (see the following figure). Remove the crank.
3	Check position of truck through the inspection glass (see 3 in the following figure).



Operating the Earthing Switch Manually

Switching the Earthing Switch ON

Initial Situation:

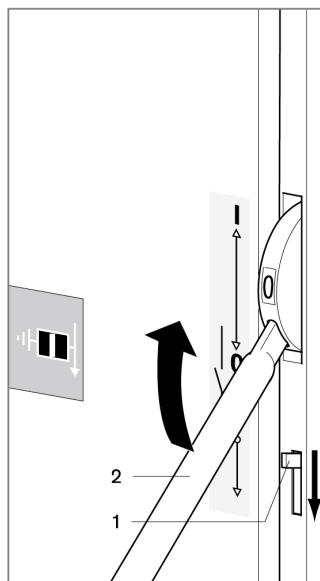
Circuit breaker: OFF

Earthing switch: OFF (see the following figure)

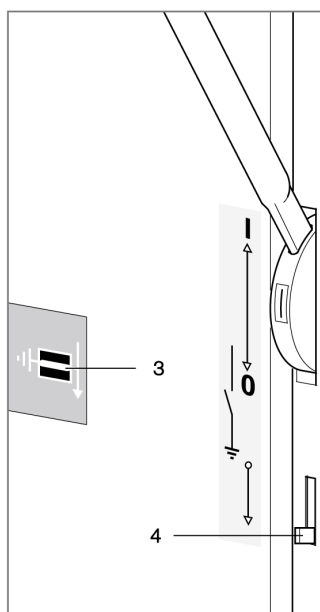
Truck: In disconnected position

Follow the steps to switch the earthing switch ON:

Step	Action
1	Press interlock slide (see item 1 in the following figure) downwards to unlock the earthing switch drive
2	Insert operating lever for earthing switch (see item 2 in the following figure) and pull it upwards. The position indicator indicates: Earthing switch ON. The interlock slide remains in its lower position (see item 4 in the following figure).



- 1 Interlock slide
- 2 Operating lever for earthing switch



- 3 Position indicator indicates: Earthing switch ON
- 4 Interlock slide remains in its lower position

Switching the Earthing Switch OFF

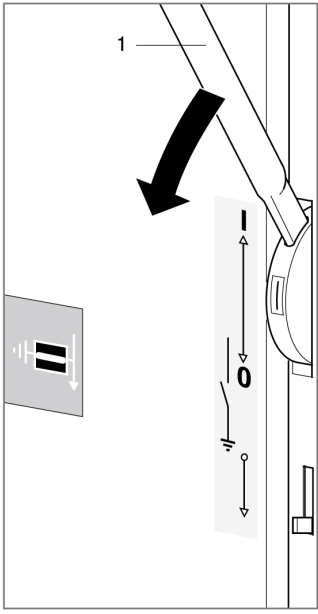
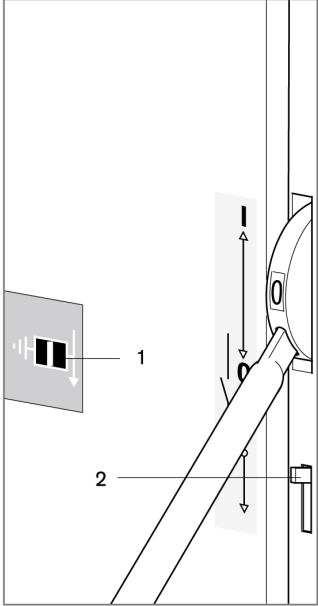
Initial Situation:

Circuit breaker: OFF

Earthing switch: ON (see the following figure)

Truck: In disconnected position

Follow the steps to switch the earthing switch ON:

Step	Action
1	<p>Insert operating lever for earthing switch (see the following figure) and pull it down.</p> 
2	<p>The position indicator (see item 1 in the following figure) indicates: Earthing switch OFF. The interlock slide remains in its lower position (see item 2 in the following figure).</p>  <p>1 Position indicator indicates: Earthing switch OFF 2 Interlock slide returns to its upper position</p>

Standard Switching Operations

Operating the Outgoing Feeder Cable

Initial Situation:

Circuit breaker: OFF

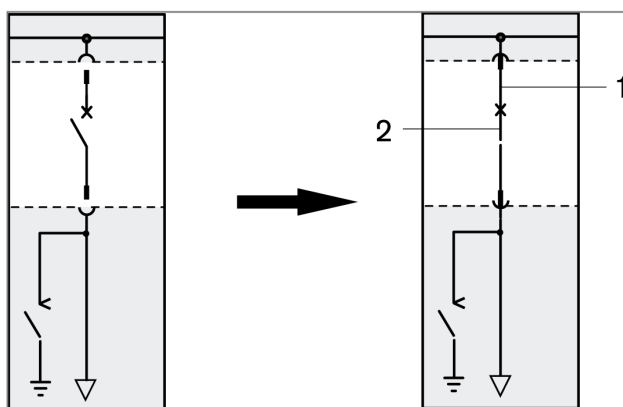
Truck HVX: In disconnected position

Earthing switch: OFF

Switching Outgoing Feeder Cable ON

Follow the steps to switch outgoing feeder cable ON:

Step	Action
1	Move truck into service position (see item 1 in the following figure).
2	Switch circuit breaker ON (see item 2 in the following figure).



Switching Outgoing Feeder Cable OFF

Follow the steps to switch outgoing feeder cable OFF:

Step	Action
1	Switch circuit breaker OFF.
2	Move truck into disconnected position.

Earthing the Outgoing Feeder Cable

Initial Situation:

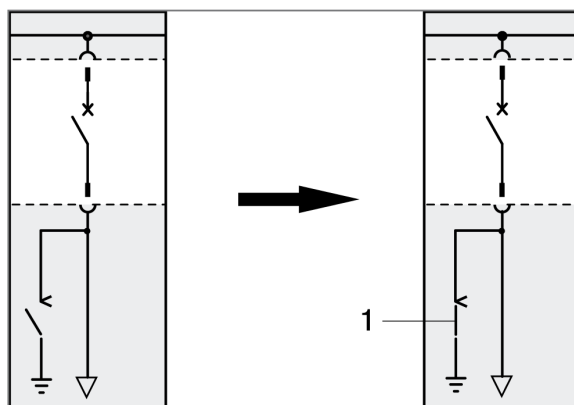
Circuit breaker: OFF

Truck HVX: In disconnected position

Earthing switch: OFF

Follow the steps to earth the outgoing feeder cable:

Step	Action
1	Check the branch circuit for zero voltage.
2	Switch the earthing switch ON (see item 1 in the following figure).



De-earthing

For de-earthing, switch the earthing switch OFF.

Coupling Busbar Sections Using the Bus Section Coupler

With HVX Truck and Direct Bus Riser

Initial Situation:

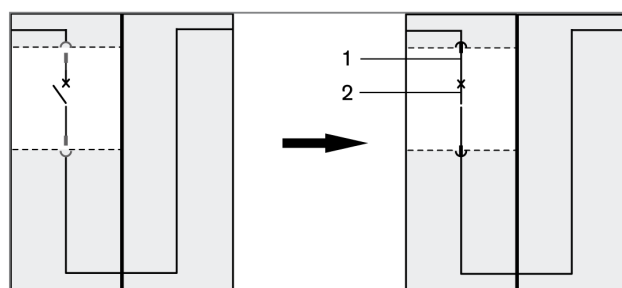
Circuit breaker: OFF

Truck HVX: In disconnected position

Coupling Busbar Sections

Follow the steps to couple the busbar sections:

Step	Action
1	Move truck into service position (see item 1 in the following figure).
2	Switch circuit breaker ON (see item 2 in the following figure).



Uncoupling Busbar Sections

Follow the steps to uncouple the busbar sections:

Step	Action
1	Switch circuit breaker OFF.
2	Move truck into disconnected position.

Earthing the Busbar with Busbar Earthing Switch

NOTE:

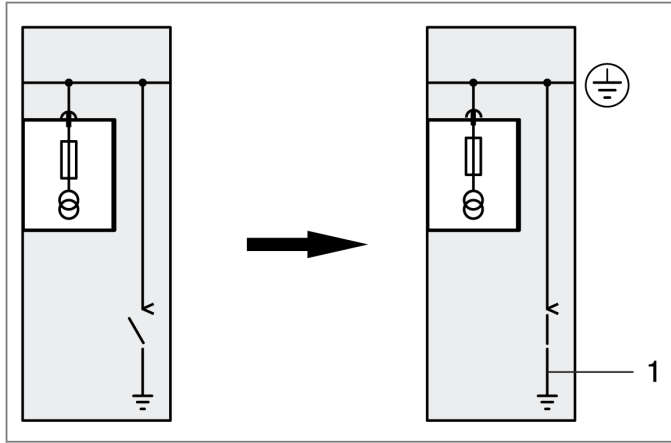
- Observe switching positions (*see page 72*) and interlocking conditions (*see page 68*)
- Check the busbar for zero voltage

Initial Situation:

Busbar earthing switch: OFF

Earthing the Busbar

To earth the busbar, switch the earthing switch ON (see item 1 in the following figure).



De-earthing the Busbar

To de-earth the busbar, switch the earthing switch OFF

Chapter 10

Maintenance

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Safety Provisions	84
Maintenance and Servicing Specifications	85
Cleaning	86
Avoiding Condensation	87
Corrosion Protection	88
Replacement of Components and Panels	89
Lubrication Instructions	90
Replace Fuses for Voltage Transformers	91

Safety Provisions

Overview

Maintenance and repair work must be performed by the qualified personnel who has proved experience with the PIX series and the applicable safety provisions.

 WARNING
--

RISK OF INJURY

Comply with the safety provisions given in Safety Provisions (<i>see page 9</i>).

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Maintenance and Servicing Specifications

Overview

PIX series indoor switchgear units have been designed for normal operating conditions in accordance with IEC 62271-1.

It is recommended to check the panels visually at regular intervals depending on the strain they are subject to during operation and in accordance with the national regulations.

NOTE: In case of frequent condensation or air pollution (dust, smoke, or corrosive gases), the maintenance intervals must be adapted to the actual conditions.

A visual inspection includes a complex check of the panels for contamination, condensation, and damage to be performed by certified staff. If there are traces of contamination or condensation, the panels must be cleaned in expert fashion (see topics Cleaning ([see page 86](#)) and Avoiding Condensation ([see page 87](#))) and after that the drives, interlocks, and position indicators must be checked for proper functioning (see chapter Operation ([see page 63](#))).

If damage is detected on the panels, it must be repaired or components be replaced (see chapter Corrosion Protection ([see page 88](#)), Replacement of Components and Panels ([see page 89](#))).

In case of ambiguities or irregularities, contact the manufacturer service center immediately.

Maintenance Interval	Work to be carried out	Qualification/work performed by
4 years	<ul style="list-style-type: none"> ● Clean and grease drives and movable main current contacts (see chapter 10.7) ● Check releases and blocking coils for proper function 	Qualified personnel who have been certified for this work
After 1000 actuations of the truck or the earthing switch	Replacement of the concerned switching device	Qualified personnel who have been certified for this work
Truck <ul style="list-style-type: none"> ● Circuit breaker HVX ● Withdrawable VT MTX ● Isolating truck UTX ● Fused vacuum contactor CVX 	Refer to the applicable instruction manual for the truck concerned	Service center manufacturer

Cleaning

Overview

WARNING

RISK OF INJURY

Do not disassemble the drives for service and maintenance work.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

To ensure the specified insulating level, the insulating components must be clean. On principle, cleanliness deserves utmost care.

When deposited dirt is detected, the panels must be cleaned in an expert fashion.

When cleaning, make sure that the lubrication in the drive mechanism is not removed. If the drive mechanisms are no longer sufficiently lubricated, new lubrication must be applied.

When cleaning the deposited dirt:

- Use the dry cleaning cloth to remove slight soiling
 - Clean using a dry, lint free cloth. Depending on the degree of soiling, replace cloth as often as necessary.
- Use cleaning agent for severe soiling
 - Use cleaning agent 1 litre can (see topic Lubrication Instructions (*see page 90*)). The use of other cleaning agent is not admissible.
 - Wear protective gloves.
 - Use cleaning agent according to manufacturer instructions.
 - Soak the cloth thoroughly and wipe the insulating components. Keep duration of exposure as short as possible.
 - Expose the cleaned surface to the air for at least two hours.

Avoiding Condensation

Overview

To ensure the specified insulating level, the switchgear panels, especially their insulating components, must not be exposed to condensation.

Measures to take in case of condensation:

- If condensation is detected in or on the panels, clean the panels in accordance with steps given in *Cleaning (see page 86)*.
- Installation or inspection of panel heating: It must provide a sufficient heating performance to prevent condensation on the panels.
- Condensation can also be avoided by providing suitable ventilation and heating of the station or by using de-humidification devices.

Corrosion Protection

Overview

Drive mechanisms and covers have a long-term protection against corrosion.

Any damage to the paint, scratches, and other damage must be repaired immediately to avoid corrosion.

Replacement of Components and Panels

Overview

The drive mechanisms, current transformers, and voltage transformers as well as testing and monitoring systems can be replaced if necessary. Also either panels can be replaced.

For any queries regarding replacement of components or panels, contact the manufacturer service center.

The data on the nameplate are relevant for replacement of components or panels or in case of any queries.

For more information on name plate, refer to Nameplate. (*see page 19*)

Lubrication Instructions

Overview

NOTE:

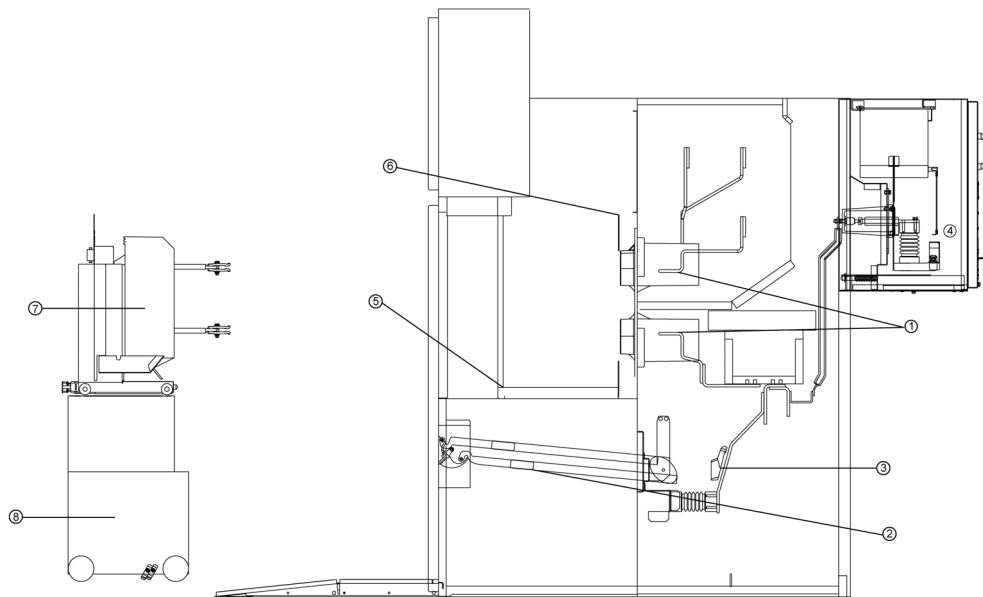
- The bearings and joints must not be washed out by the cleaning agents.
- The following elements must not be lubricated:
 - Motor
 - Ball bearings
 - Auxiliary releases
 - Push switches
 - Blocking coils
 - Auxiliary switches
- Only approved lubricants must be used.

Lubrication

Lubrication points (also see figure 69)	Lubricants (refer to appendix)	Lubrication procedure
Sliding contact surfaces	Synthetic lubricant	Apply a thin and uniform film of lubricant
All accessible friction points and sliding surfaces	Synthetic lubricant	Clean lubrication points with lint-free cotton cloth. Apply a thin film of lubricant (using a paint brush)
Bearings and joints	Liquid lubricant	Pour drops of liquid lubricant (oil can, drip feed lubricator) into the bearing gap. Liquid lubricant gets between the bearing surfaces due to the capillary effect. In case of inaccessible lubricating points, use an extension tube or spray.

After the maintenance work is complete:

- Remove all the tools and auxiliary equipment used.
- Reinsert truck into the panel. For details, refer to Inserting the Truck into the Panel.
- Reposition covers, close doors, and check switching functions. For more information, refer to chapter Commissioning. (*see page 57*)



- 1 Fixed contacts for the trucks
- 2 Earthing switch drive
- 3 Earthing switch contacts
- 4 Withdrawable voltage transformers (optional)
- 5 Tracks for the truck
- 6 Shutter mechanism
- 7 Truck (lubricate in accordance with lubricating instructions in the appropriate operating manual)
- 8 Trolley

Replace Fuses for Voltage Transformers

Replace Fuses for Voltage Transformers

Follow the steps to replace fuses for voltage transformers in outgoing feeder cable:

Step	Action
1	Isolate the voltage transformer.
2	Remove voltage transformer compartment cover.
3	Remove the copper flex connection from voltage transformer. Pull fuse carefully.
4	Coat all contact areas (see Appendix A (see page 95)) and insert new fuses.
5	Mount flex connection and applicable voltage transformer insulating shrouds.

Appendices



What Is in This Appendix?

The appendix contains the following chapters:

Chapter	Chapter Name	Page
A	Auxiliary Products and Required Tools	95
B	Busbar Connections	101
C	Deflector Assembly Procedures	109

Appendix A

Auxiliary Products and Required Tools

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Auxiliary Products	96
Treating Contact Surfaces	97
Specifications for Screw Connections	98
Required Tools	99

Auxiliary Products

Overview

The auxiliary products are available from the manufacturer. The use of alternative auxiliary products is not permissible.

WARNING

RISK OF INJURY

Do not disassemble the drives for service and maintenance work.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Auxiliary products	Reference number
Cleaning agent	S 008 152
Synthetic lubricant, 0.5 kg can	ST 312-111-835
Liquid lubricant FL, 0.5 kg can	S008153
Touch up pen RAL 9003, signal white, 50 ml	ST0430 and ST0431
Touch up pen, special paint (specify color shade)	S 009 562

Treating Contact Surfaces

Overview

NOTE:

- Be careful when handling bars insulated by heat-shrinkable sleeves. The heat-shrinkable sleeves must not get into contact with lubricant (swelling).
- Contact areas coated with synthetic lubricant should not be touched if possible.

To treat the contact surfaces:

- Contact areas must be subjected to preliminary treatment before screw fastening
- Immediately after the pre-treatment, coat the contact surfaces sparingly with a thin and uniform film of synthetic lubricant. This helps to make sure that the space between the contact surfaces is filled after the screws are fastened.

Material of contact surfaces	Pre-treatment
Silver plated	Clean ⁽¹⁾
Nickel plated	Remove passivation layer ⁽⁴⁾
Copper or copper alloy	Clean ⁽¹⁾ , expose metallic surface ⁽²⁾
Aluminum	Clean ⁽¹⁾ , expose metallic surface ⁽²⁾
Steel	Clean ⁽¹⁾ , expose metallic surface ⁽²⁾
Zinc plated steel	Remove passivation, not, however, the zinc layer ⁽³⁾
Hot galvanized sheet metal	Clean ⁽¹⁾ , passivation do not need to be removed

(1) Clean using lint-free cloth, use cleaning agent in case of serious contamination.
(2) Expose metallic surface:

- By treating the entire surface with emery cloth or a rotating grinding tool (grain size 100 or 80) or
- Using a wire brush which is clearly marked for use exclusively for aluminum or exclusively for copper

(3) using a brass brush, steel brush
(4) Rub slightly by hand using scotchbrite abrasive agent (Nickel layer must not be reduced)

Specifications for Screw Connections

Overview

NOTE:

- The thread of screws and bolts must not be pretreated
- Maximum tolerance for the effective tightening torques: $\pm 15\%$
- The nut must correspond in strength to the grade of the screw/bolt used or be of better quality

General Screw Connections

Screw or bolt	Plastics	Grade or material	
		$\geq 8.8 \leq 10.9$	Self-locking screw ≤ 8.8
Thread ?	Tightening torques (Nm)		
M4	0.25	2.6	-
M5	0.5	5.0	7.0
M6	0.8	8.8	12.3
M8	1.8	21.0	30.0
M10	3.5	42.0	59.0
M12	6.0	70.0	97
M 16	12	170	-

Screw Fastening for Power Transmission

Screws and bolts: Grade ≥ 8.8

Conductor material: copper	
Thread ?	Tightening torques (Nm)
M6	6.5
M8	17
M10	35
M12	68
M 16	135
M20	200

Screw Connection for Terminal Strips

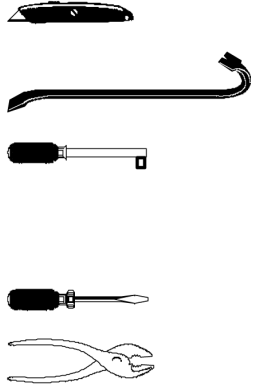
Thread ?	Tightening torques (Nm)
M2.5, 2.6	0.5
M3	0.7
M3.5	1.0
M4	1.5
M 5	2.5

Required Tools

Required Tools

The following are the required tools not included in the scope of supplies:

- Cutter
- Nail puller
- Approved torque wrenches with different bits for hexagon socket screws and socket head screws and nuts; bits for screw and nut grades M5, M6, M8, M10, M12, M16, M20
- Screw driver and Philips screwdriver
- Cutting pliers
- Four crane straps/chains of L \geq 2000 mm each, capacity \geq 1500 kg
- Lint-free, clean rags



Appendix B

Busbar Connections

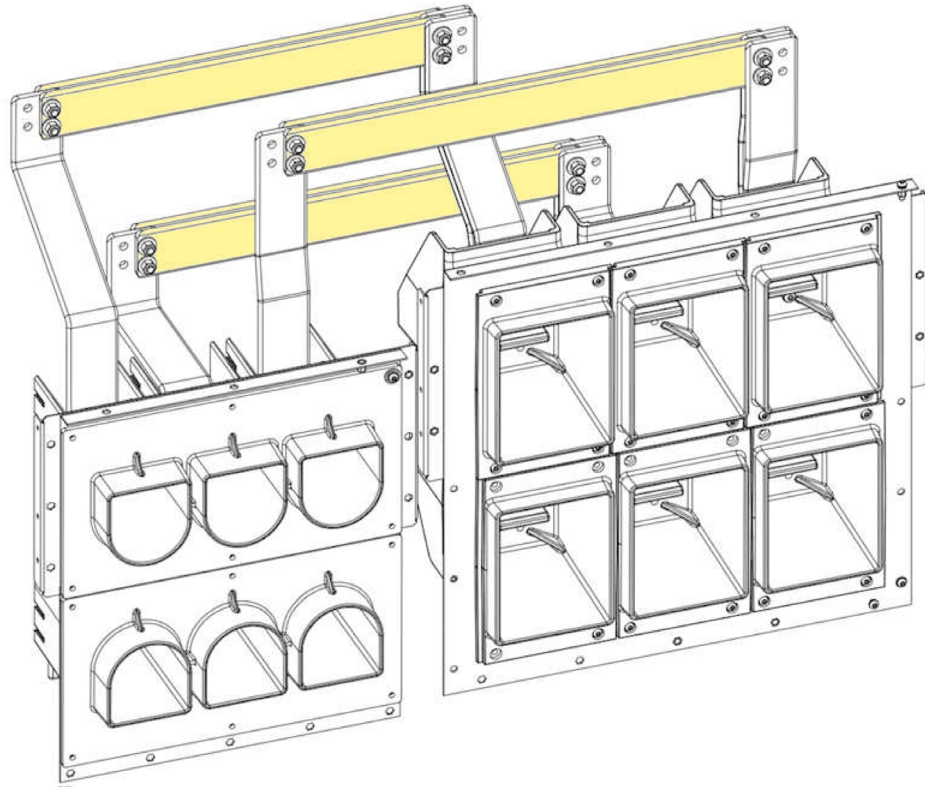
What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Arrangement of Copper Main Busbars Between PIX RoF Cubicles	102
Arrangement of Aluminium Main Busbars Between PIX RoF Cubicles	106

Arrangement of Copper Main Busbars Between PIX RoF Cubicles



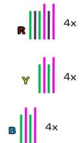




Configuration of Busbars Between PIX RoF Cubicles



Cubicle type and rated current		Main busbar rated current (Copper)			
		1250 A	2000 A	2500 A	3150 A
Feeder	1250 A				
	2000 A	Not Applicable			
	2500 A	Not Applicable	Not Applicable		
	3150 A	Not Applicable	Not Applicable	Not Applicable	
Bus PT	600 mm				
	800 mm	Not Applicable			

— Upper Risers
— Main Busbar
— Packers
 Numerical beside indicates number of fixing holes

Cubicle type and rated current		Main busbar rated current (Copper)			
		1250 A	2000 A	2500 A	3150 A
Bus coupler	1250 A		Not Applicable	Not Applicable	Not Applicable
	2000 A	Not Applicable		Not Applicable	Not Applicable
	2500 A	Not Applicable	Not Applicable		Not Applicable
	3150 A	Not Applicable	Not Applicable	Not Applicable	


Cubicle type and rated current		Main busbar rated current (Copper)			
		1250 A	2000 A	2500 A	3150 A
Bus riser	1250 A		Not Applicable	Not Applicable	Not Applicable
	2000 A	Not Applicable		Not Applicable	Not Applicable
	2500 A	Not Applicable	Not Applicable		Not Applicable
	3150 A	Not Applicable	Not Applicable	Not Applicable	
<p>  Upper Risers  Main Busbar  Packers Numerical beside indicates number of fixing holes </p>					

Arrangement of Aluminium Main Busbars Between PIX RoF Cubicles

Configuration of Busbars Between PIX RoF Cubicles

Cubicle type and rated current		Main busbar rated current (Aluminium)			
		1250 A	2000 A	2500 A	3150 A
Feeder	1250 A				
	2000 A	Not Applicable			
	2500 A	Not Applicable	Not Applicable		
	3150 A	Not Applicable	Not Applicable	Not Applicable	


— Upper Risers
— Main Busbar
— Packers
 Numerical beside indicates number of fixing holes




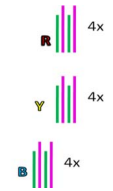
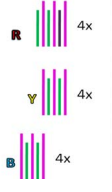
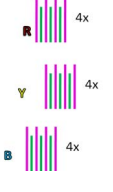
NOTE: A sheet metal plate on both sides of fixing is a part of hardware. It should be used without fail in case of Aluminium busbars only.

Cubicle type and rated current		Main busbar rated current (Aluminium)			
		1250 A	2000 A	2500 A	3150 A
Bus PT	600 mm				
	800 mm	Not Applicable			
Bus coupler	1250 A		Not Applicable	Not Applicable	Not Applicable
	2000 A	Not Applicable		Not Applicable	Not Applicable
	2500 A	Not Applicable	Not Applicable		Not Applicable
	3150 A	Not Applicable	Not Applicable	Not Applicable	

— Upper Risers
— Main Busbar
— Packers
 Numerical beside indicates number of fixing holes



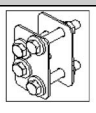
NOTE: A sheet metal plate on both sides of fixing is a part of hardware.
 It should be used without fail in case of Aluminium busbars only.

Cubicle type and rated current		Main busbar rated current (Aluminium)			
		1250 A	2000 A	2500 A	3150 A
Bus riser	1250 A		Not Applicable	Not Applicable	Not Applicable
	2000 A	Not Applicable		Not Applicable	Not Applicable
	2500 A	Not Applicable	Not Applicable		Not Applicable
	3150 A	Not Applicable	Not Applicable	Not Applicable	

- Upper Risers
- Main Busbar
- Packers

Numerical beside indicates number of fixing holes

NOTE: A sheet metal plate on both sides of fixing is a part of hardware. It should be used without fail in case of Aluminium busbars only.



Appendix C

Deflector Assembly Procedures

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Deflector Assembly Procedure for PIX Cubicles	110
Assembly Procedures for Rear Deflectors	112
Assembly Procedure for End Deflectors	113

Deflector Assembly Procedure for PIX Cubicles

Overview

Deflectors are necessary to ensure personal safety in case of internal faults detected in accordance with IEC 62271-200

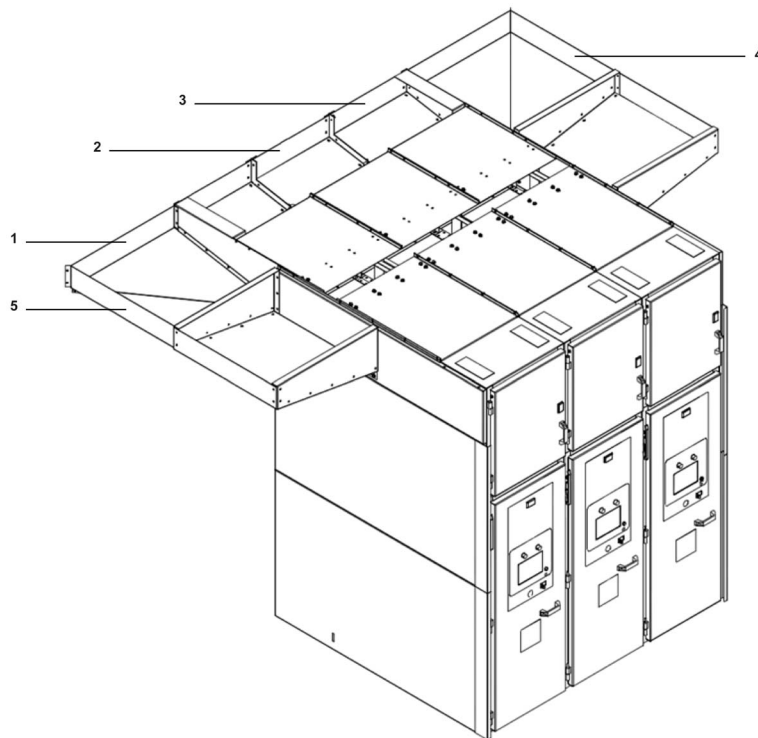
IAC: Internal Arc Classification: AFLR:

Accessibility type A: Restricted to authorized personnel only.

F for Front side accessibility

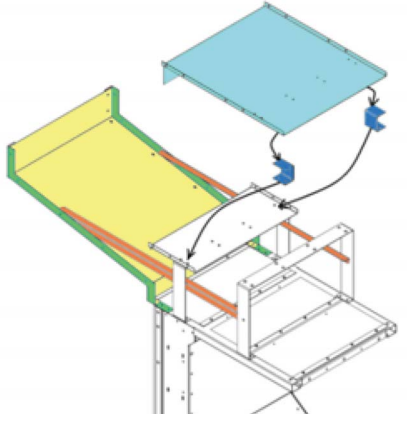
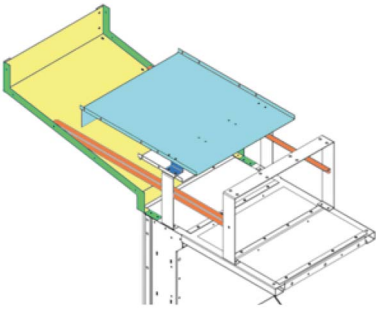
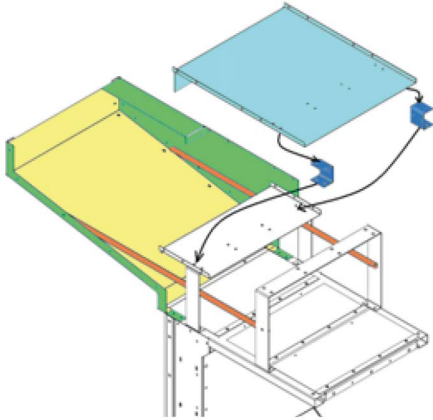
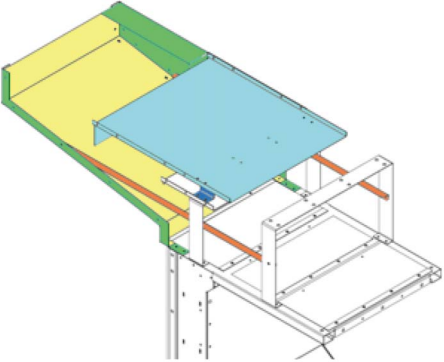
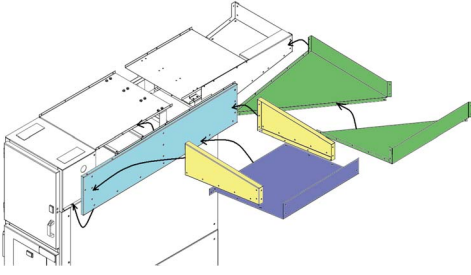
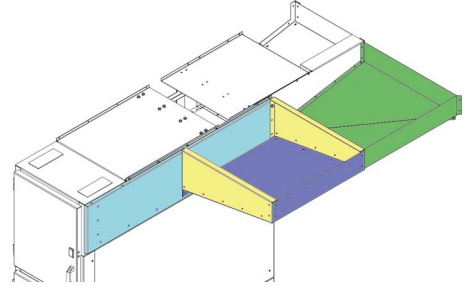
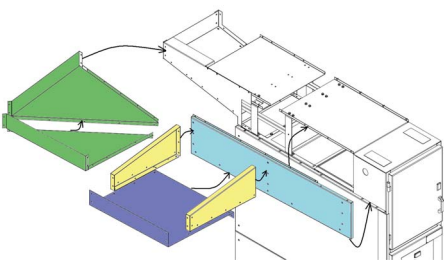
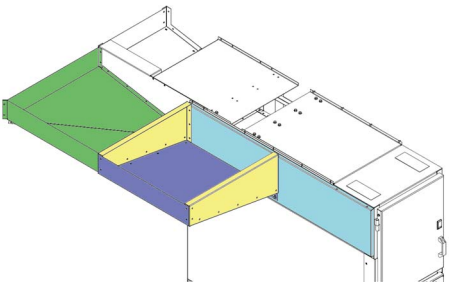
L for Lateral side accessibility

R for Rear side accessibility



The following table shows the assembly drawings for mounting the deflectors:

	Deflectors	Assembly Drawings	
1	Rear Deflector for AFLR for Left End Cubicle		

	Deflectors	Assembly Drawings	
2	Rear Deflector for AFLR for Middle Cubicle		
3	Rear Deflector for AFLR for Right End Cubicle		
4	End Deflector for AFLR for Right End Cubicle		
5	End Deflector for AFLR for Left End Cubicle		

Assembly Procedures for Rear Deflectors

Assembly Procedure for Rear Deflectors

Step	Action	Assembly Drawing
1	Part 1 and 2 to be assembled with the Rear Unit Top Cover. Part 1 also to be bolted with the End Cover.	
2	Part 3 to be placed and bolted over the bends of parts 1 and 2 and also to be bolted with the Rear Unit Back Cover.	
3	Step 1 and 2 to be followed for adjacent Deflectors. The two connecting Rods (Part 4) to be assembled as shown in the assembly drawing only after completing the assembly work of the adjacent Rear Deflectors.	
4	Lastly the two brackets (Part 5) to be assembled over the Rear Unit Top Cover Upper Plate and Part 6 to be bolted over the two brackets.	

Assembly Procedure for End Deflectors

Assembly Procedure for End Deflectors

Step	Action	Assembly Drawing
1	Part 1 to be assembled with the End Cover as shown in the assembly drawing.	
2	Part 3 to be assembled with the End Cover and with Part 1. It should be placed over the lower bend of Part 1.	
3	Part 2 to be assembled with the end Cover and with Part 3. Part 3 should be over the lower bend of Part 2.	
4	Part 4 to be bolted with the Rear Deflector and Part 5 to be assembled with Part 1 and 4.	



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