UL1558 Switchgear

Installer/User Guide

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Technical Support Site

If you encounter any installation or operational issues with your product, check the pertinent section of this manual to see if the issue can be resolved by following outlined procedures.

Visit https://www.vertiv.com/en-us/support/ for additional assistance.

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1 Important Safety Instructions

The information provided in this Installer/User Guide and additional referenced documentation should be reviewed and acknowledged by all personnel responsible for the use of the equipment. All models represented in this manual are for illustrative purposes only, due to the individual specifications associated with each customer. Vertiv will not assume responsibility for actual use establish by the models.

Proper installation, operation, and maintenance are critical to the performance of the equipment.

Correct operating conditions in terms of input voltage, current and the fault capacities must be ensured at the time of installing switchgear.

Refer ANSI C37.20.1 for abnormal operation conditions.

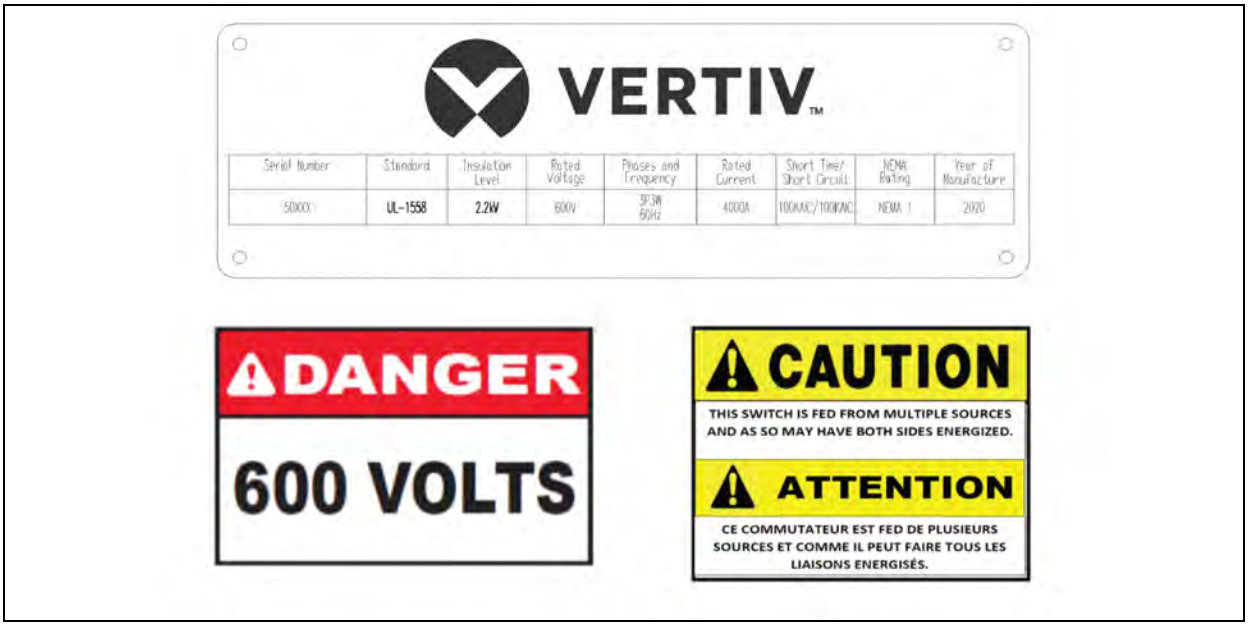
General Instructions

- Read all the instructions included in this Installer/User Guide (IUG) before working with the equipment.
- Store and keep this IUG to ensure proper commissioning and maintenance to ensure the prolong use of the equipment.
- Install the switchgear based on the design limitations as given in this IUG. The design limitations are presented on the main nameplate and should never be installed in applications that exceed the limits presented by the nameplate.
- Always follow standard safety protocols set forth by your company.
- Turn off all the power sources and de-energized the equipment before removing the covers and opening of doors of the equipment. All components should be locked out and tagged in line with standard protocol and ANSI Standard Z244.1 Control of Hazardous Energy – Lockout/Tagout.
- Wear PPEs while working on the switchgear.
- Only Vertiv qualified personnel should work on the switchgear.
- If additional information is needed, contact your Vertiv representative.

1.1 Labels and Markings

The switchgear comes standard with a master nameplate, on the main incoming section, as well as several other labels. All nameplates and labels provide information related to the switchgear including and not limited to the switchgear's electrical data, cautions and warnings to help provide the personnel of important information and safety precautions. An example of some labels that may be found on the switchgear are shown in Figure 1.1 on the next page .

Figure 1.1 Typical Labels



2 Introduction

2.1 General Information

Vertiv™ switchgear low voltage assemblies with Emax 2, Magnum, and Masterpact low voltage air circuit breakers, power circuits up to 600 volts AC, with interrupting capacities up to and including 100kA. The switchgear assembly is composed of vertical sections having three isolated compartments: Device, Bus, and Cable, that are arranged to meet customer specifications explained in detail in Standard Layout on page 7 .

- Vertiv low voltage switchgear assemblies are constructed with a 4 cell high maximum arrangement, and allows for numerous combinations of Emax 2, Magnum, and Masterpact cells or instrument cells within the device compartment.
- The device compartment within all sections have a top and bottom horizontal cableway for control wiring as well as hinged front doors that are held closed by a minimum of 1 latch.
- The bus and cable compartments are accessible from the rear. The bus compartment consists of a continuous main horizontal bus rated up to 4000 amps, that provides incoming power to all sections. The horizontal bus may be located at the top or the bottom of each bus compartment and attached to a system of vertical bus rated up to 4000 amps.
- The cable compartment provides space for terminations and maintenance and comes standard with rear covers, with the option of hinged doors upon request.

WARNING! This equipment operates at maximum 600 V phase. Improper use may result in death or serious injury.

2.2 Technical Information

Table 2.1 Technical Information

Standards		
UL 1558	Metal-enclosed Low-voltage Power Circuit Breaker Switchgear	Tested Switchgear Sections (TSS)* **NOTE: * TSS: Switchgear sections corresponding to the original system that was tested in accordance with the standards above.**
CSA C22.2	Switchgear Assemblies	
IEEE C37.20.1	IEEE Standard for Metal-Enclosed Low- Voltage (1000 Vac and Below, 3200 Vdc and Below) Power Circuit Breaker Switchgear	
Test Certificate:		
ETL File: 104406595DAL-001		Switchgear is designed, tested, and constructed based on the standard above
Electrical Data		
Rated Voltages	Rated insulation voltage, Vi	2.2 kV
	Rated operating voltage, Ve	Up to 600 VAC
	System types	3 phase-3 wire, 3 phase-4 wire
	Rated frequency	60 Hz

Table 2.1 Technical Information (continued)

Rated Ampacities	Rated current	Up to 4000 A
	Rated short circuit current	Up to 100 kA at 600 V
Mechanical Data		
Dimensions	Height in (mm)	94.8 (2407) (without OHLD rails)
	Width in (mm)	22.7(576), 30.2(768), 37.8(960)
	Depth in (mm)	53(1344), 60.5(1536), 68(1728)
Surface Protection	Frame	Paint finish
	Enclosure	Paint finish
Enclosure Type	NEMA 1	
Plastic Components	Self-extinguishing, flame retardant	
Busbars	Standard - Tin plated (silver plated available)	
	Bus bracing	Up to 100 kA at 600 V
Paint finish	Enclosure	Standard - RAL 7035 (Special Colors are available)

3 Packaging and Handling

The switchgear lineup is shipped in single sections or shipping splits. Separation of lineups are deemed by the project engineer and their communication with the customer. Unless otherwise requested, the single sections or splits will be wrapped and shipped on a pallet. The pallets are designed for the specific section or split. But the standard size of the pallet is the width of the section or split by the depth of the section plus twelve (12) inches, (approximately six (6) inches in the front and rear of the gear when centered on the pallet).

NOTE: Each section is unique to the job thus, the section weights vary. For actual weights and dimensions consult equipment shipping documentation.

Figure 3.1 Packaging

3.1 Receiving and Inspection

Ensure all sections and splits are present when switchgear arrives on site. Notify your Vertiv representative, if any anomalies are found.

- A thorough inspection should be performed to make sure no damages occurred during shipment. If damages did occur a qualified technician needs to investigate the gear for proper diagnosis.
- Damages from improper handling are to be reported to both the carrier and your Vertiv representative.
- All sections are inspected and marked before they leave the facility. It will be clearly marked with what side is the front as well as the section or split number.
- All packaging material should be saved until the gear is ready to be installed, especially if there is a delay in the installation, so that it can be stored safely. See Storage on the next page if a delay occurs.

3.2 Unloading of Switchgear

The switchgear should be unloaded close to the installation site. This will help minimize any additional transportation and alleviate possible damage and safety incidents.

- All sections and splits should always be kept vertical and where possible kept secured to the pallet until in the final position.
- Make sure the pallet is balanced when moving and use safety straps as needed to secure the equipment.
- Properly trained personnel should move and unload all equipment to prevent damage to the equipment or serious injury or death.
- Ensure that the forklift is in use is capable of lifting the load.
- When removing the equipment from the pallet, the section and splits have lifting brackets and holes in the plinth for lifting skates.
- The lifting brackets should be used to move the sections and splits by crane or lifting straps. Each section and split will come standard with four brackets attached to the frame.
- If a crane is used for transportation, then it must comply with the ASME B30 Safety Standards. Lifting brackets must be removed, before site re-connection can take place.

3.3 Storage

Below are the storage requirements to be followed, if there is a delay in the installation of the switchgear:

- Store properly to avoid any type of damage.
- Unpack and examine before storage (see Receiving and Inspection on the previous page).
- All cell doors within the device compartment should be opened to allow the unit to adjust to the room temperature and humidity.
- It should be stored in a location that has less than 50 % humidity and a stable temperature between 32-104°F (0-40°C).
- Space heaters should be temporarily disconnected from internal connections and powered externally to reduce condensation.
- If the unit is going to be stored for an extended period, then the sections and splits should be re-covered in the packaging material to help protect them.

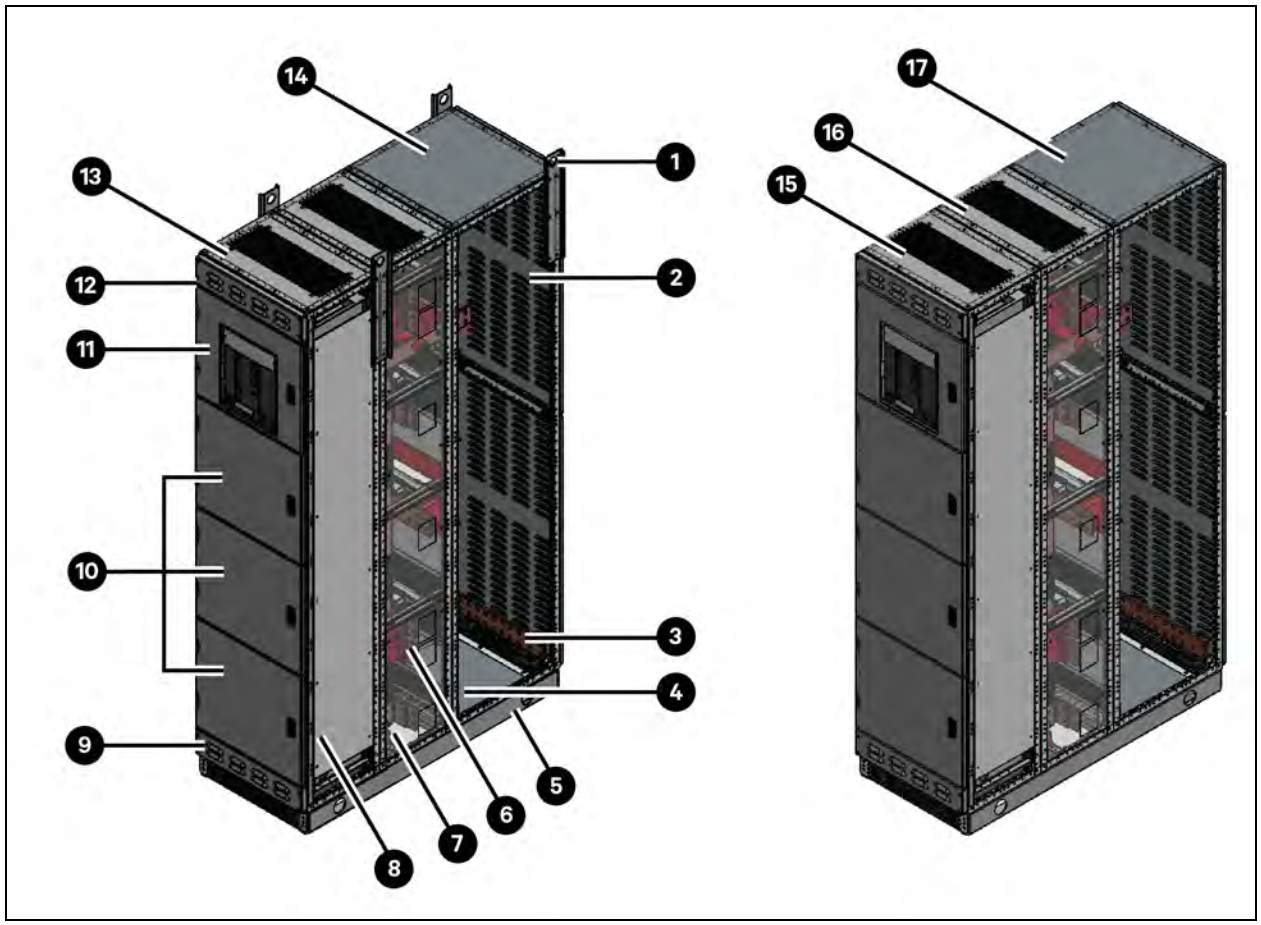
4 Installation

4.1 Standard Layout

The switchgear assembly comes standard with one or more vertical sections. Each vertical section is divided into three compartments. Those three compartments are the device, bus, and cable. The device compartment is in the front of the section, the bus compartment is in the middle and the cable compartment for terminating, is in the rear.

Each section comes standard with a continuous horizontal ground bus that is located at the bottom or top of all sections within the cable compartment. The cable compartment also accepts top or bottom cable entry, as well as bus duct or closed coupled connections on request. All vertical sections are modular, which allows extendibility for future sections.

Figure 4.1 Vertical Section Overview



Item	Description
1	Lifting brackets
2	Rear doors/covers
3	Ground bus
4	Removable bottom gland plate

Item	Description
5	Plinth
6	Horizontal bus
7	Bus compartment segregation between sections
8	Device compartment segregation between sections
9	Bottom wireway
10	Instrument/empty cell
11	Breaker cell
12	Top wireway
13	Vented roof
14	Removable top gland plate
15	Device compartment
16	Bus compartment
17	Cable compartment

4.1.1 Device Compartment

The purpose for the compartment is to provide a four cell stack that can accommodate any requested low-voltage power circuit breakers or requested devices.

- Each cell is isolated from each other and from the bus compartment using metal barriers.
- Cells A, B, C, and D can accommodate any feeders, blank or control units as shown in Figure 4.2 on the facing page .
- Cells B and C can also accommodate main and tie units.
- Any breaker door can include instruments, such as pilot lights, push buttons, control switches, and maintenance switches.
- Control units can house, either within the cell or on the cell door, different instruments such as high resistance grounds, potential transformers, relays.

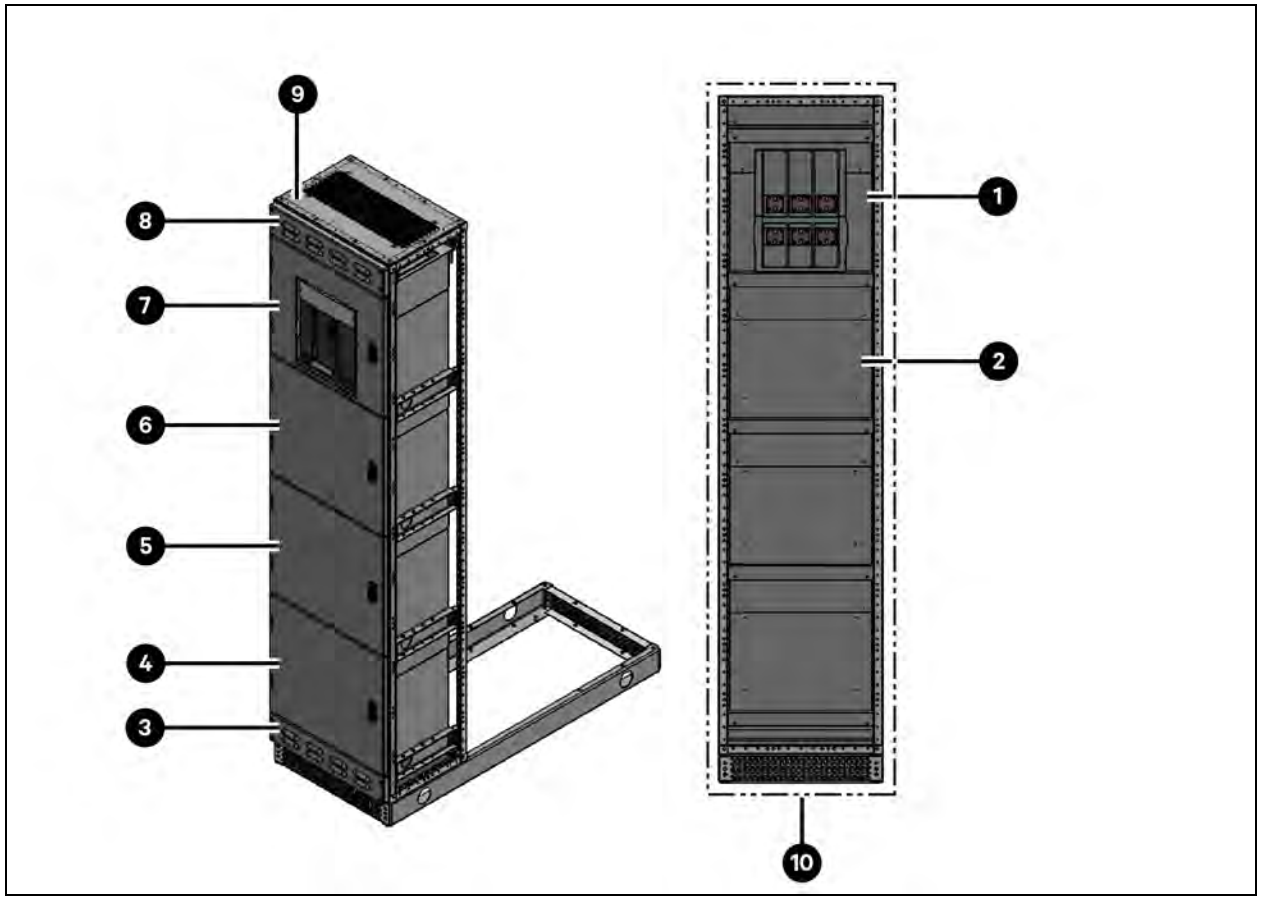
When looking at the front of the gear, each cell number is determined based on its location within the lineup and vertical section. The extreme left vertical section is always 1 and ascends until the last section is counted. This also helps with installation, because it allows for a quick reference when putting the vertical sections together.

Once the vertical sections are established, each cell then correlates with the section such as A1, which is the top cell within vertical section 1. Also, within the device compartment are the top and bottom wireways used for control wiring. This helps to route the control wiring to go through each cell.

- The top wireway is approximately 4 in. (102 mm) high and 14 in. (356 mm) deep.
- The bottom wireway is approximately 5 in. (102 mm) high and 14 in. (356 mm) deep as well.

Both come standard with a cover to protect the cables within them. A vertical wireway is also present within each cell, irrespective of number of units is in that cell. This allows for wiring between each functional unit as well as a passage from one horizontal wireway to another.

Figure 4.2 Device Compartment Overview



Item	Description
1	Breaker segregation
2	Device compartment segregation between bus compartment
3	Bottom wireway
4	D cell
5	C cell
6	B cell
7	A cell
8	Top wireway
9	Device compartment
10	Rear view

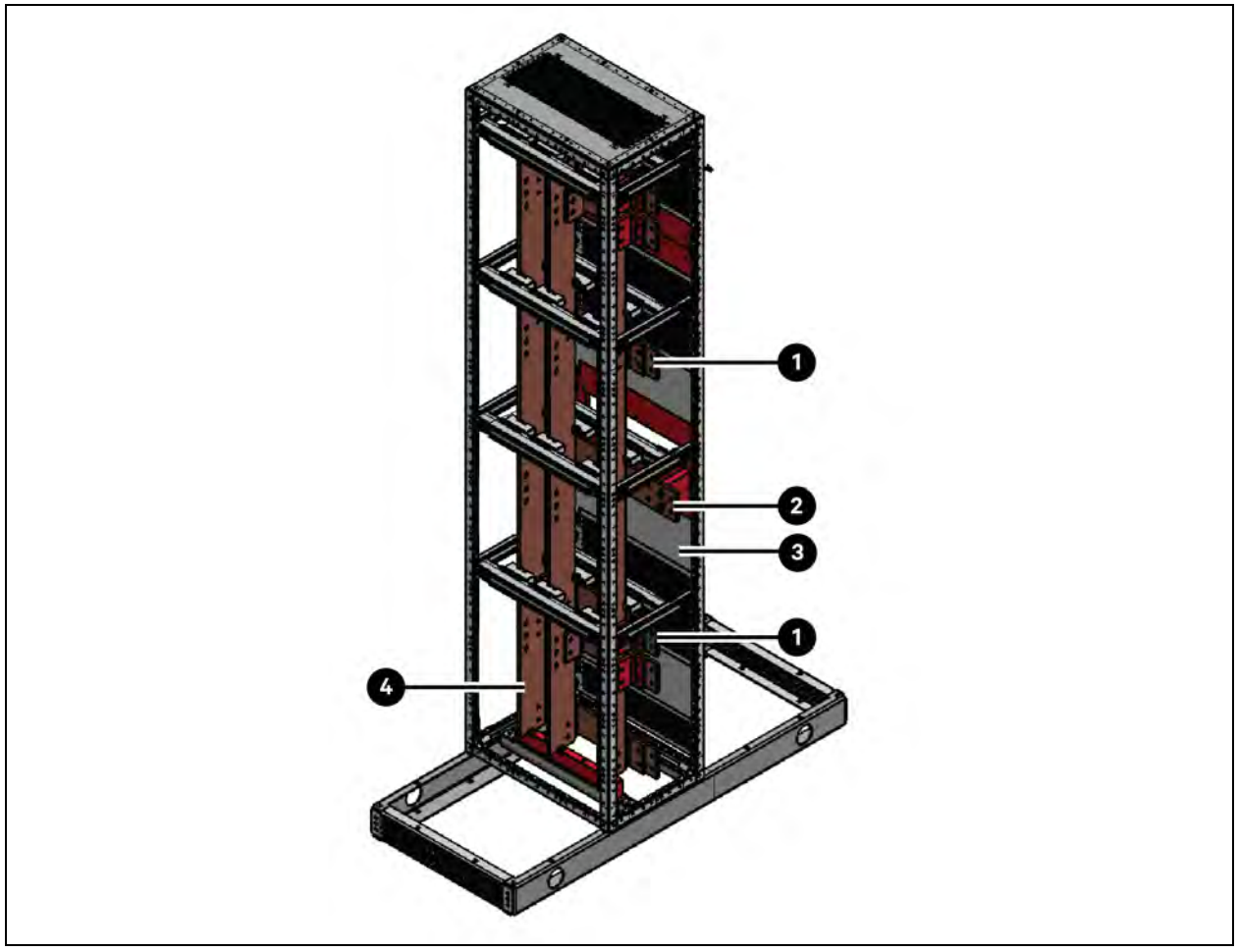
4.1.2 Bus Compartment

The bus compartment houses the complete bus system and is the middle compartment within any section. The bus system is compiled of vertical distribution bar and the main horizontal bus.

- The vertical bar provides power to each cell within a section, where the main horizontal bus provides power from section to section throughout the lineup.
- The vertical bus is arranged from left to right based on the front of the gear, with phase arrangement A-B-C.
- The horizontal busbar can be located at the top or bottom of the bus compartment. The location of the horizontal bus is arranged from top to bottom based on the front of the gear, which correlates to a phase arrangement of A-B-C.
- The busbar consist of one to four laminations per phase depending on the amperage of the modular configuration.
- All sections are available in 3-phase 3-wire or 3-phase 4-wire systems.
- The neutral phase is optional, if a neutral is requested, it follows the same number of laminations as in the horizontal bus.

Sections that are within the same shipping split will be connected at the factory, but lineups consisting of multiple shipping splits will need to be connected and installed onsite with the provided splice kits. The splice kit bolts will need to be torqued based on the specified torque value provided in this manual. All buses are available in tin plated or silver flashed sheets.

Figure 4.3 Bus Compartment Overview



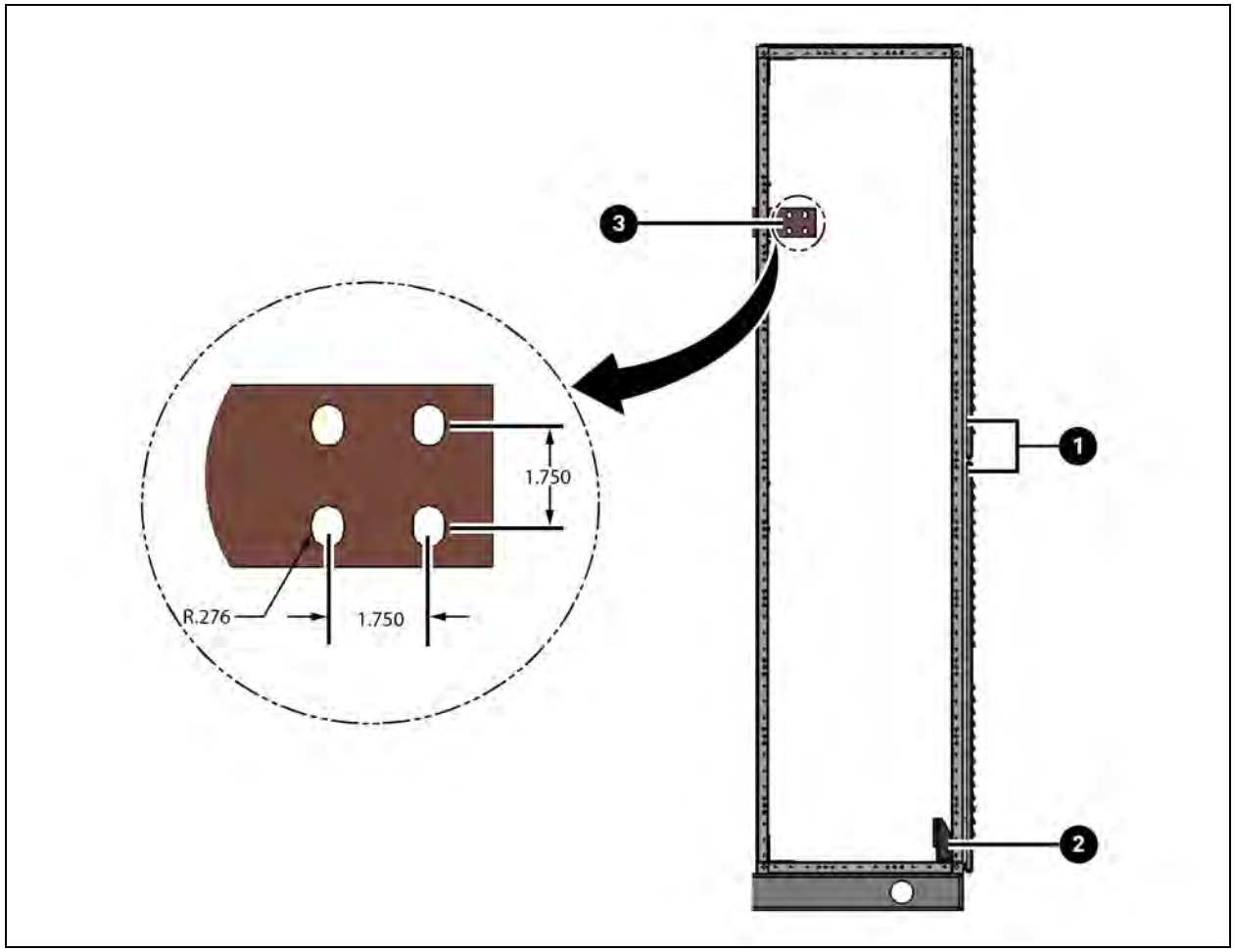
Item	Description
1	Horizontal main bus
2	Neutral busbar (Optional)
3	Segregation between bus and cable compartment
4	Vertical bus

4.1.3 Cable Compartment

The cable compartment is where all the terminations for main and feeder breakers are performed and is the rear compartment in all the sections. The depth of the compartment changes depending on the amperages and number of cables entering the equipment.

The standard depths of the cable compartment are 22.7 in. (576 mm), 30.2 in. (768 mm), and 37.8 in. (960 mm). It allows for top or bottom entry/exit. Two steel covers or doors can be installed on the cable compartment as an option. The continuous ground busbar is also located in the cable compartment at the bottom or top of the gear. It is connected to the fame and is connected together when it runs from one vertical section to the next within the lineup.

Figure 4.4 Cable Compartment Overview



Item	Description
1	Rear covers/doors
2	Ground busbar
3	Landing pad of terminations

4.2 Installation of Switchgear

Following are the steps to follow for the installation of the switchgear.

1. Verify that all sections and connecting hardware are handy.
2. Review all supplied documentation and project drawings to understand the layout.
3. Mark the floor for all drill holes needed to fasten the gear to the floor based on supplied drawings.
4. Install all possible conduits before the switchgear arrives to the site.

NOTE: Conduit installation should conform to local codes and adhere to the NEMA rating of the gear.

5. Switchgear must be installed in an indoor location with limited humidity and temperature changes.

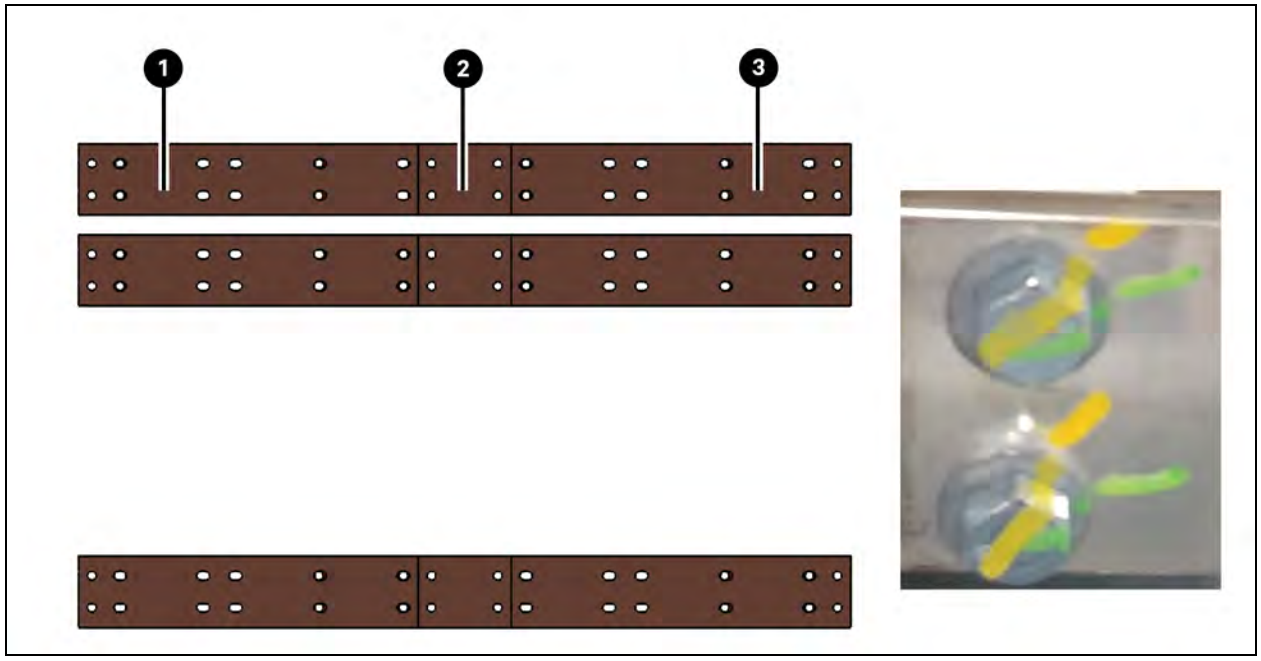
The humidity should not exceed 95% over a 24hr period or exceed 90% over a period of 1 month. Temperature limits are -5 degree Celsius to 40 degree Celsius.

6. Floor must be leveled and free from slop for optimum performance.
7. Ensure proper clearances will be available upon installation.
    - Minimum of 2.5 ft (750 mm) from the highest part of the section to the ceiling.
    - Minimum of 3.0 ft (920 mm) between the left and right end sections and the closest obstruction.
    - Minimum of 3.5 ft (1066 mm) between the front and rear of the lineup and the closest obstruction.
8. Remove all sections and splits from pallets and position in the final sequence and location.
9. Use the provided M8 fasteners to connect the frames of the sections and shipping splits from left to right.

Figure 4.5 Connection of Frame

10. Once sections and shipping splits are connected, the lineup can be attached to the floor. The four corners of the switchgear should at a minimum be attached using M12 anchoring bolts. (Review supplied documentation for locations).
11. Connect the main horizontal bus splice plates using the links and M10 hardware supplied. Torque bolts based on the Table 5.1 on page 19 . Use a paint marker to draw a line across the bolt head, to provide a visual check. Repeat for other phases.

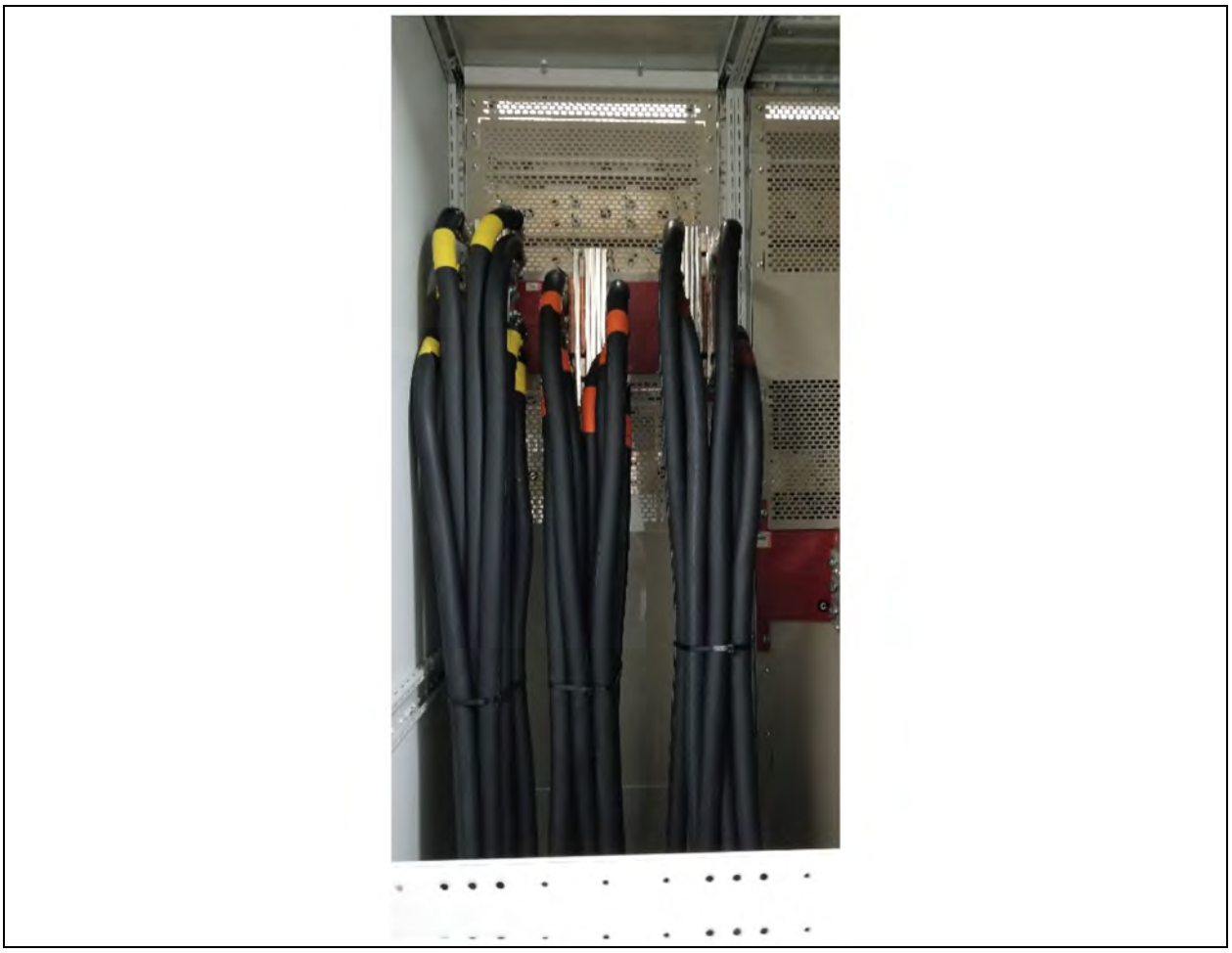
Figure 4.6 Main Bus and Torqued with Visual



Item	Description
1	Section horizontal bus
2	Splice plate
3	Section horizontal bus

12. Install all appropriate compression lugs on the appropriate cables using the correct crimping tool (rated for 90°C).
13. Once the correct lugs have been fitted to the field cable, it can then be terminated on to the lug landing pad. Depending on the width and amperage of the section, external cable compartment covers and/or internal cable compartment segregation may need to be removed for connecting to the landing pads and reinstalled once all terminations are complete.
14. Ensure that the gland/conduit plates are removed from the switchgear before drilling for conduit locations.

Figure 4.7 Terminated Cables



15. Ensure all field terminations are torqued using the torque values outlined in Torque Table on page 19 .
16. Control wire should be routed from one of the sides of the switchgear into the top or bottom wireways, and from there can be pulled to any compartment within the switchgear.

4.3 OHLD Installation

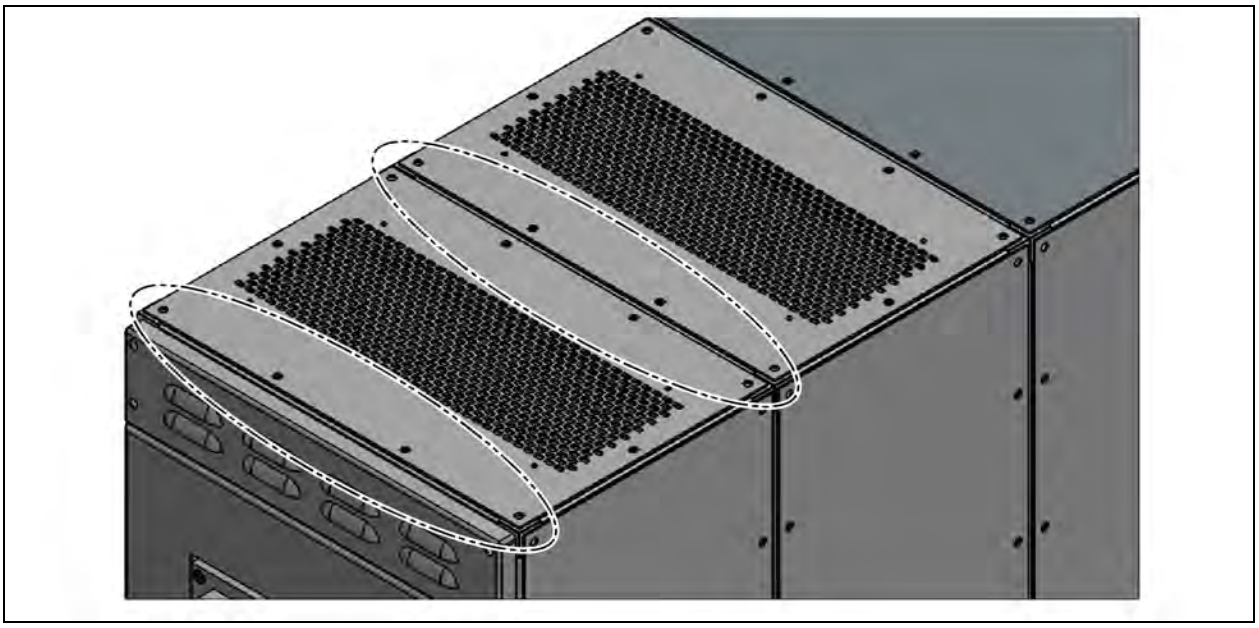
The OHLD is shipped separately and is attached to the lineup once the lineup is installed. Follow the below guidelines for the installation of the device.

1. Remove the OHLD and rails from the shipment and unpack them.

Figure 4.8 Packaged OHLD Accessories

2. Remove the bolts from the front vent and the front row of the second vent. These hole locations are used to mount the OHLD rails onto the lineup.

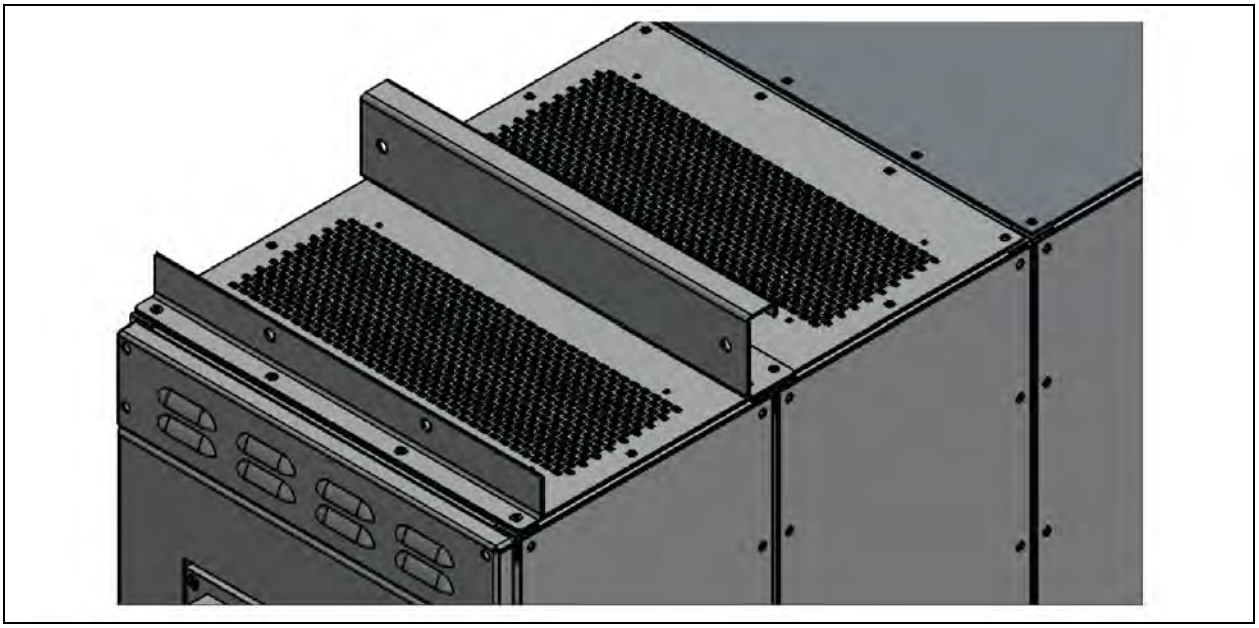
Figure 4.9 Location for OHLD Installation



3. Mount the front and rear rail onto the top of the unit using the supplied hardware.

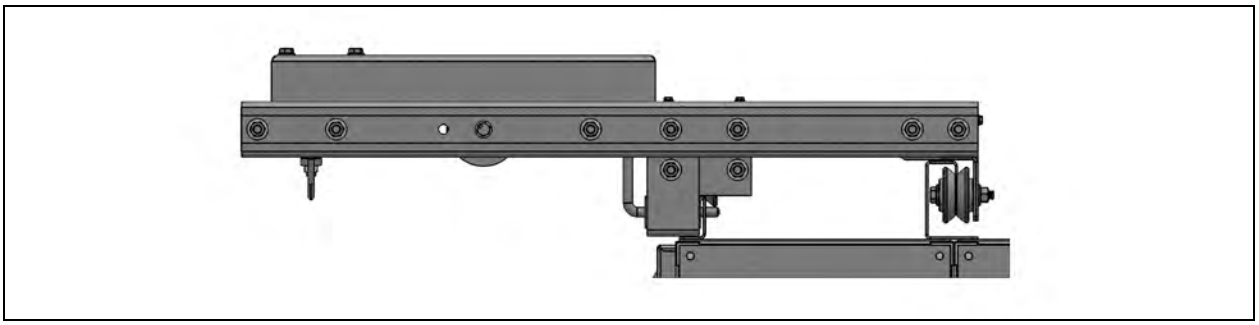
NOTE: Countersunk M8 bolts are used to fix the front rail, to allow for the OHLD to glide across.

Figure 4.10 OHLD Rails



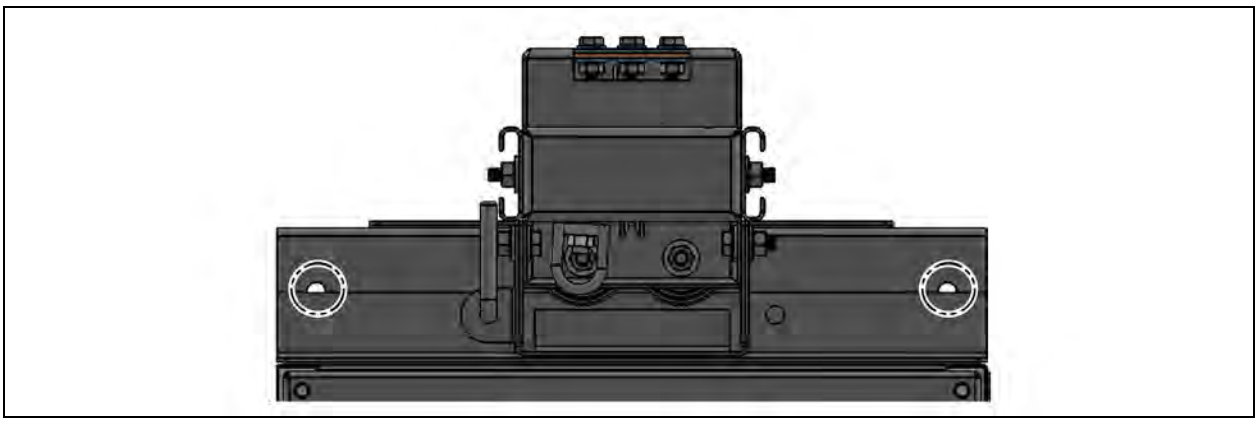
4. Position the OHLD onto the prongs of a forklift and raise up to the position of the rails.
5. Align the grooves of the wheels with the front rail and behind the rear rail and slide it on.

Figure 4.11 Side View of OHLD on Rails



6. Install stoppage bolts in the rear rail, at the far left and right of the end sections if the movement of the OHLD is correct.

Figure 4.12 Stoppage Locations



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4.4 Torque Table

All mechanical parts within the equipment are assigned a torque value. The Table 5.1 below specifies the required torque values for each size of bolt. All mechanical parts come pre-marked and torque to the values below. If the hardware is not marked or specified below, then it is understood that hand tight capacity, which on an average is 2 ft/lbs (3 Nm), is acceptable.

Table 5.1 Torque Values

Bolt Size	Torque Values	
	Standard (ft/lbs)	Metric (Nm)
M6	6	8
M8	16	22
0.375 in.	16	22
M10	29	39
M12	40.5	55
0.5 in.	40.5	55

4.5 Pre-Energization Tests

Before energization, the following checks should be carried out:

a. Check that all the shipping splits are connected and secured to the floor.
b. Check that all splice plates are installed and torqued.
c. Check that the switchgear is clean and free from any dust, dirt or contaminates.
d. Check that all gland/conduit plates are installed and secured to the switchgear.
e. Check that the switchgear is grounded appropriately.
f. Check that all withdrawable air circuit breakers are installed.
g. Check that all covers and doors are closed and locked.

The following test must be carried out on the Switchgear before energization with all the breakers installed and closed and all control fuses/circuit breakers removed or open.

- Perform a continuity check on the main power circuit using a high resolution resistance tester. Record the results and compare them during service intervals to identify any anomalies.
- Conduct insulation resistance test.
- Conduct 2.2 kV Hipot test.

NOTE: Once these tests are complete the switchgear can be returned to its normal state with all control fuses/circuit breakers installed or closed. The switchgear is now ready for energization.

4.6 Energization of Switchgear

Energization of the switchgear should only be carried out after all pre-energisation tests have been complete. All work should be carried out by a Vertiv authorized person and in line with all local and federal health and safety rules.

- With all circuit breakers including the incoming breaker open, the switchgear can then be energized.

- Before closing the main incoming breaker, checks should be made to ensure that the supply feeding the switchgear is of the correct voltage and phase sequence.
- Once the supply has been verified as correct, the main incomer breaker can be closed. This operation will energize the main busbar and live side of all feeder breakers.
- It is advised that each feeder breaker energize separately to ensure there is not a large inrush of power.
- Once all feeder breakers have been energized the switchgear is now fully operational.

5 Maintenance

Maintenance is very important to the service life of the equipment and should be performed regularly to ensure trouble free operation resulting in the longest possible service life of the switchgear. It is essential that all maintenance and repairs are carried out by a Vertiv authorized personnel with the proper PPE. Local authority having jurisdiction and/or individual facility procedures should be followed to properly lock out/tag out the equipment during performed maintenance.

5.1 Setting up a Maintenance Schedule

- It is highly recommended to set a maintenance schedule for the switchgear.

NOTE: The usage of the equipment will help to determine how often maintenance should be performed.

- Before performing any maintenance make sure the power is turned off to the unit and everything is de-energized.
- Ensure that OSHA approved solvents comply with local regulations are used for cleaning.
- The solvent should be non-flammable, with a threshold limit of 300 PPM or higher.

5.2 Maintenance Inspections

Maintenance inspections should be performed on the switchboard and accessories periodically, depending on the maintenance schedule established by the end user. Perform visual and physical inspections to ensure the working conditions of the equipment.

1. Visual – Proper operation of all indicators, meters, and instruments.
2. Physical – All bolted covers are properly secured.
3. Visual – Proper operation of heaters and thermostats, if available.
4. Physical – Check all bolt connections, to ensure they are still torqued. If discoloration or corrosion exist, then there may be an overheated connection.
5. Physical/Visual – Make sure all cables are tightly secured and supported.
6. Visual – Look for signs of wear and tear on control wiring. Wire should be replaced, if uncertain.
7. Physical – Clean the equipment by wiping all the areas with a clean cloth or the use of compressed dry air.
8. Physical/Visual – If an overhead lifting device is present and used, make sure the gear mechanism and rope are in tack and performing properly before lifting.

NOTE: Other than stated above, all individual devices and instruments should have maintenance performed on them based on the individual maintenance requirements set fourth by the manufacturer. This includes and is not limited to the low voltage circuit breakers, instruments, indicators, meters, and any other possible components that are installed within the equipment.

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6 Accessories

The main accessory offered by Vertiv is an Over Head Lifting Device (OHLD).

- The OHLD is used to lift breakers from the floor or from a completely drawn out cradle.
- An internal winch with wire rope is used to provide the power for lifting.
- The OHLD can travel the complete width of the switchgear lineup.
- Rails come with the OHLD and are mounted on the top of the switchgear and these rails have holes that allows for the OHLD to lock into place in the center of the section.
- The rails mount on the top of the device compartment to provide support to the whole lifting system.

Figure 7.1 Over Head Lifting Device

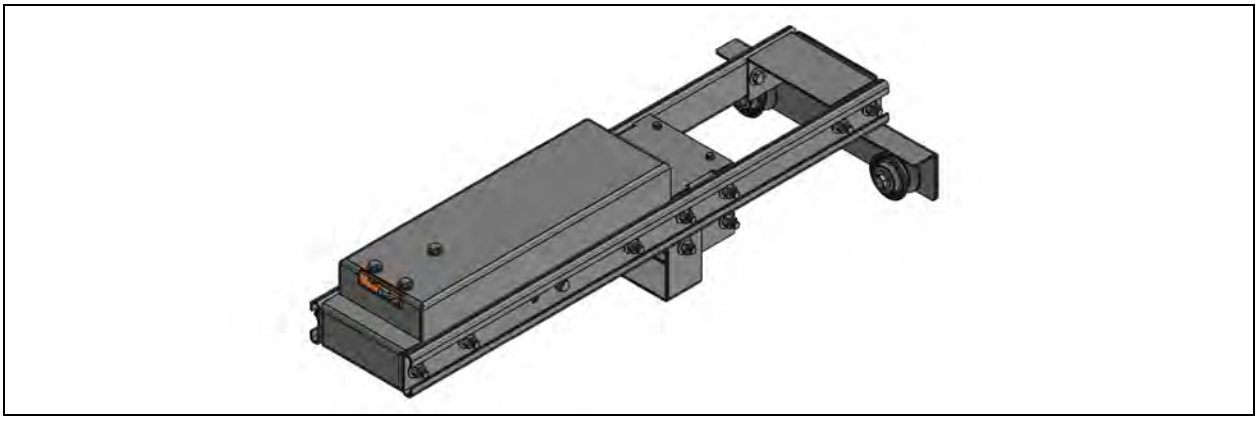
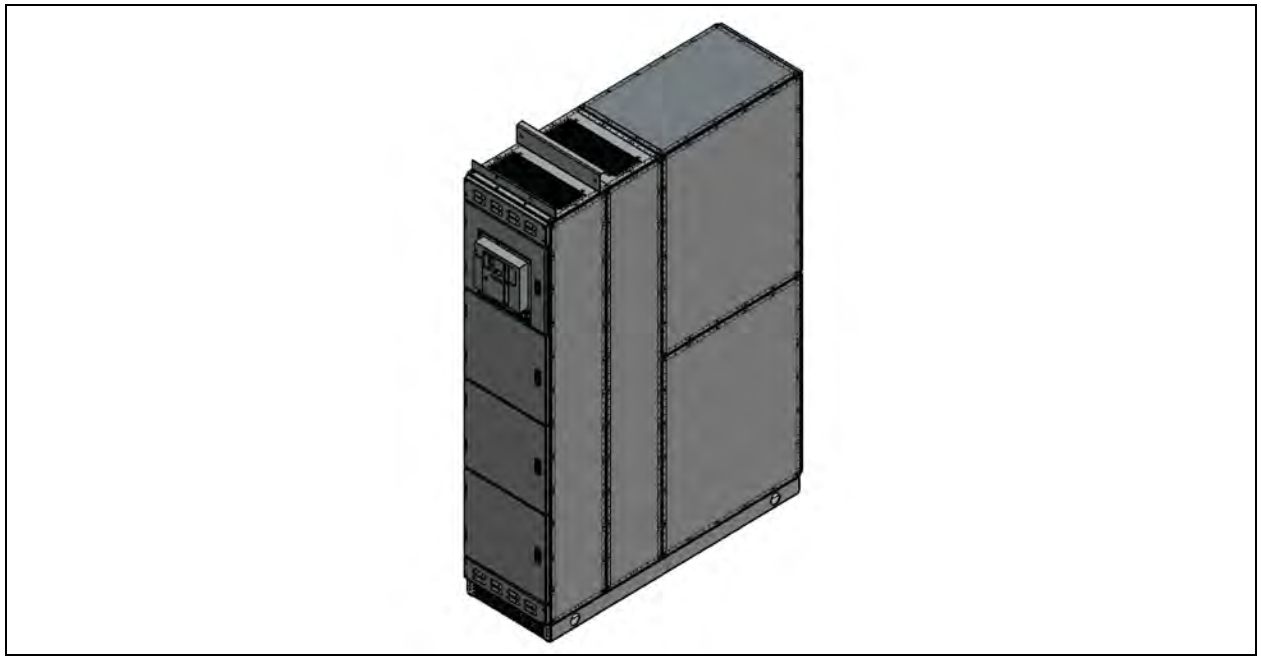


Figure 7.2 Vertical Section with OHLD Rails



6.1 OHLD Operation

1. While operating the OHLD, specific details should be observed and performed to make sure it will work and operate as intended.
2. Before using the OHLD make sure it is set correctly on the track and is level.
3. Make sure at least four to five wraps of the wire rope are around the drum before lifting and that the wire rope is free of any knots or kinks.
4. The OHLD should only be used to lift breakers. For safety purposes make sure to never walk or stand under the OHLD device while lifting or holding a circuit breaker.

Appendices

Appendix A: Technical Support and Contacts

A.1 Technical Support/Service in the United States

Vertiv Group Corporation

24x7 dispatch of technicians for all products.

1-800-543-2378

Vertiv™ Powerbar Products

Europe - +44(0) 2835 3030

USA - +1 864 375 1757

UAE - +971 488 64062

A.2 Locations

United States

Vertiv Headquarters

505 N Cleveland Ave

Westerville, OH 43082

Europe

Via Leonardo Da Vinci 8 Zona Industriale Tognana

35028 Piove Di Sacco (PD) Italy

Asia

7/F, Dah Sing Financial Centre

3108 Gloucester Road, Wanchai

Hong Kong

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