
Installation, Operation and Maintenance Manual

SecoGear 5kV-15kV IEEE Metal-Clad Switchgear

GE legacy product
documentation



In 2018 ABB acquired GE Industrial Solutions. SecoGear is now serviced and maintained by ABB. If you need spare parts or your installed equipment has aged and requires modernization or replacement – ABB is your first point of contact (look for contact details on the last page).

ABB provides comprehensive maintenance, diagnostics, and repair services for medium voltage and low voltage electrical apparatus.

The ABB Electrification Service offering is comprised of services that will help you to take care of the equipment, modernize it, and recommend the most appropriate business decisions to guarantee the availability, reliability and sustainability of critical assets and meet your evolving needs.

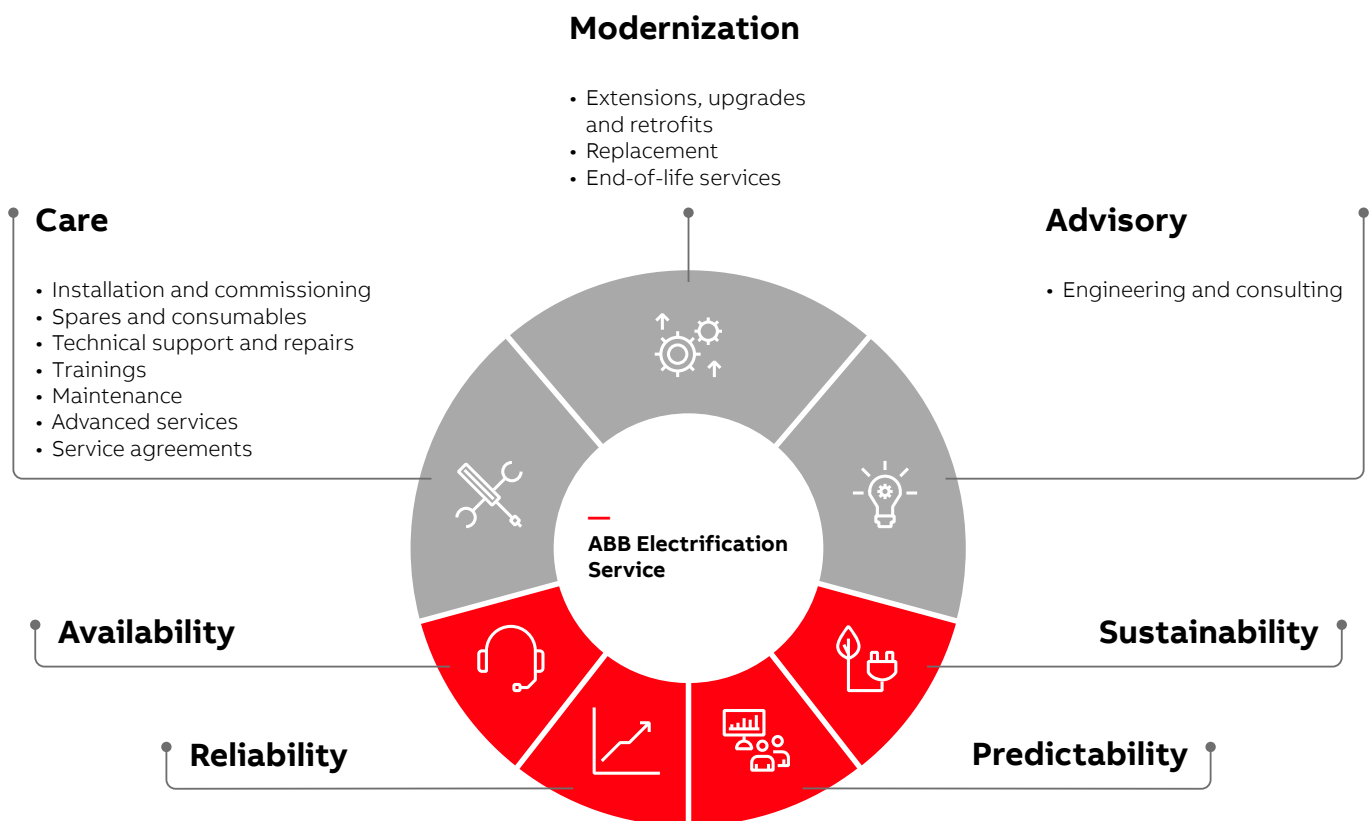


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Hazard Classifications

The following important highlighted information appears throughout this document to warn of potential hazards or to call attention to information that clarifies a procedure. Carefully read all instructions and become familiar with the devices before trying to install, operate, service or maintain this equipment.

DANGER

Indicates a hazardous situation that, if not avoided, will result in death or serious injury.

WARNING

Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION

Indicates that if the hazard is not avoided could result in minor or moderate injury.

NOTICE

It is used to notify of practices not related to personal injury.

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This document is based on information available at the time of its publication. While efforts have been made to ensure accuracy, the information contained herein does not cover all details or variations in hardware and software, nor does it provide for every possible contingency in connection with installation, operation, and maintenance. Features may be described herein that are not present in all hardware and software systems.

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No warranties of merchantability or fitness for purpose shall apply.

Contact your local ABB sales office if further information is required concerning any aspect of SecoGear switchgear operation or maintenance.

1. Introduction

This manual provides complete installation instructions and operation and maintenance information for SecoGear Metal-clad Switchgear.

SecoGear switchgear is designed for the protection, instrumentation, and control of various types of medium voltage electrical apparatus and power circuits.

The switchgear consists of modules containing circuit breakers and auxiliary equipment, which are stacked two high to form vertical sections. Sections may be arranged side by side and connected mechanically and electrically to form complete switchgear assemblies.

SecoVac vacuum circuit breakers (VCB) are easily removable to provide maximum accessibility for maintenance with minimum interruption of services. The switchgear is designed to provide a high degree of safety to the operator. All equipment is enclosed in grounded metal compartments and all primary conductors are insulated.

The equipment is available in the ratings listed in the following table 1-1. The maximum ratings of the equipment and devices are based on usual service conditions as covered in ANSI standards, using $K=1$, and not $K>1$. Operation at currents above the equipment rating will result in temperature rises in excess of these standards and is not recommended.

For outdoor installations, a weather proof power equipment center would be required to house the indoor equipment.

CAUTION

This equipment is not designed for exposure to dripping liquids, as this condition is not a usual ANSI service condition. Dripping liquids can destroy the integrity of the insulation system and must be avoided.

Table 1-1: Rated Electrical Characteristics (maximum ratings for kA based on $K=1$, and not $K>1$)

CIRCUIT BREAKER	MAXIMUM VOLTAGE	CONTINUOUS CURRENT	INTERRUPTING RATING	MOMENTARY WITHSTAND
SecoVac VCB	4.76 kV – 15 kV	1200 A	31.5 kA	82 kA
SecoVac VCB	4.76 kV – 15 kV	1200 A	40 kA	104 kA
SecoVac VCB	4.76 kV – 15 kV	2000 A	40 kA	104 kA
SecoVac VCB	4.76 kV – 15 kV	3000 A	40 kA	104 kA

Safety

Each site must maintain a safety program for the protection of personnel, as well as other equipment, from the potential hazards associated with electrical equipment. The following requirements are intended to augment your company's safety program, but they do NOT supplant your responsibility for devising a complete safety program. The following basic safety requirements are applicable to all major electrical equipment, such as switchgear or switchboards. Neither condones nor assumes any responsibility for practices that deviate from the following:

1. ALL CONDUCTORS MUST BE ASSUMED TO BE ENERGIZED UNLESS THEIR POTENTIAL HAS BEEN MEASURED AS GROUND AND ADEQUATE CAPACITY GROUNDING ASSEMBLIES HAVE BEEN APPLIED TO PREVENT ENERGIZING. Many accidents have been caused by unplanned energization from nonrecognized back feeds, equipment malfunctions, and from a wide variety of sources.

2. It is strongly recommended that all equipment be completely de-energized, verified to be "dead," and then grounded with adequate capacity grounding assemblies prior to any maintenance. The grounding cable assemblies must be able to withstand energizing fault levels so that protective equipment may clear the circuit safely. This concept is covered in depth in Chapter 20 of ANSI/NFPA 70B, Electrical Equipment Maintenance.

The logic for this precaution is that maintenance of energized equipment could precipitate a dielectric failure from such diverse causes as dislodging a tiny piece wire missed during a construction cleanup, startling an animal inside the gear, or deflecting a conducting part. A dielectric failure generally initiates a power flashover, which presents an extreme risk of injury or death to people or damage to equipment in close proximity.

3. Although the provided interlocks reduce some of the risks, the individual's actions while performing service or maintenance are essential to prevent accidents. Each person's knowledge, mental awareness, and planned and executed actions often determine if an accident will occur. The most important method of avoiding accidents is for all associated personnel to carefully apply a thorough understanding of the specific equipment – from the viewpoints of its purpose, its construction, its operation – and the situations that could be hazardous.

All personnel associated with installation, operation, and maintenance of electrical equipment, such as power circuit breakers and other power handling equipment, must be thoroughly trained, with periodic retraining, regarding power equipment in general, as well as the particular model of equipment with which they are working.

Instruction books, actual devices, and appropriate safety and maintenance practices such as OSHA publications, National Electric Safety Code (ANSI C2), National Electric Code, and National Fire Protection Association (NFPA) 70B Electrical Equipment Maintenance must be closely studied and followed. During actual work, a supervisor should audit practices to assure conformance.

Maintenance

Excellent maintenance is essential for the reliability and safety of any electrical equipment:

- Maintenance programs must be designed for the specific application, well planned and carried out consistent with both industry experience and manufacturer recommendations.
- The *local environment* must always be considered, including such variables as ambient temperatures, extreme moisture, number of operations, corrosive atmosphere, major insect problems, and any other unusual condition or abuse of the application.

One of the critical service activities, sometimes neglected, involves the calibration of various control devices. A proper calibration monitors conditions in the primary and secondary circuits, sometimes initiating emergency corrective action, such as opening or closing circuit breakers.

In view of the vital role of these devices, it is important that a periodic test program be followed. We recommend checking all significant calibrations at an interval of one to two years, until you have accumulated enough

experience to select a test interval better suited to the individual requirements. The interval between periodic checks will vary depending upon the local environment, the type of device, and the user's experience.

Some devices can be adequately tested using test sets. Specific calibration instructions on particular devices are typically provided in the vendors' documentation. However, these manuals cannot include every possible part that could require attention, particularly over a very long service period or under adverse environments. Maintenance personnel must be alert to deterioration of any part of the supplied switchgear, taking actions as necessary to restore it to serviceable status.

Industry publications of recommended maintenance practices such as ANSI/NFPA 70B, Electrical Equipment Maintenance, should be carefully studied and applied in each site's formation of planned maintenance. Visit geindustrial.com for the latest publications.

Some customers may require additional assistance in the planning and performance of maintenance. ABB offers onsite services to perform maintenance or provide technical assistance.

The performance and safety of all equipment may be compromised by the modification of supplied parts or their replacement by non-identical substitutes. All such design changes must be qualified to ANSI/IEEE Standard C37.59.

Maintenance personnel should methodically keep written maintenance records as an aid in future service planning and equipment reliability improvement. Promptly report any unusual experiences.

2. Receiving, Handling and Storage

Receiving

Every shipping section leaving the factory is plainly marked with the case number, requisition number, and customer order number. If the equipment has been split for shipment, the section numbers of the equipment enclosed in each shipping package are identified. To avoid the loss of any parts when unpacking, carefully check the contents of each container against the packing list before discarding the packing material.

The contents of each shipping package are listed on the Master Packing List. In addition, this list includes the number of the shipping crate that contains miscellaneous parts needed to install and operate the equipment (such as hardware, contact lubricant, touch-up paint, circuit breaker closing devices). Normally, such devices are packed in a cardboard carton secured in an empty section compartment. Large items, such as the lift truck and dollies, are always shipped in separate crates or cartons.

Inspecting for Damage

All equipment leaving the factory is carefully inspected and packed by personnel experienced in the proper handling and packing of electrical equipment. Upon receipt of any equipment, immediately perform a visual inspection to ascertain if any damage has been sustained in shipping or if there are any loose parts.

Circuit breakers will be shipped separately in individual containers and should be unpacked to visually inspect them for damage or loose parts as soon as possible after they have been received. Be sure to inspect all devices mounted or packed inside compartments of each section to see if any have been dislodged or damaged.

Filing a Claim

If any damage is evident, or indication of rough handling is visible, file a claim for damage at once with the transportation company immediately. Include any information on damaged parts, part number, case number, requisition number, etc.

Handling

It is preferable to leave the shipping skids in place under the switchgear until it reaches its final location. The equipment should be installed in its final location prior to installing the circuit breakers.

Enclosure Lifting

The switchgear sections are best handled by lifting with a crane as shown in Figure 2-1. Removable lifting plates are provided as standard equipment, on the top of each switchgear section. Utilize four equal length cables and an overhead crane, each with a minimum load rating of twice the weight of the shipping section to be lifted. Estimated weights for shipping splits are displayed on the drawings in the accompanying bill of materials.

EXAMPLE

Switchgear section weight = 5,000 lbs.

The crane and the four lift cables must have a minimum load lifting capacity of 10,000 pounds.

The angle between the cables and the top of the equipment must be at least 45°. If this is not possible because of lack of headspace, spreader bars must be used. Also, lift cables with greater load capability may be necessary, depending upon the angle between the cables and the crane hook.

Connect a cable from the crane to the four lifting plates located on the top-front and rear of the switchgear (Figure 2-1 and Figure 2-2).

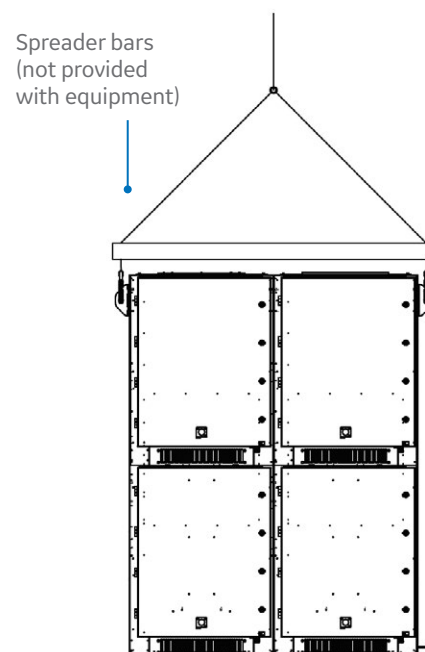


Figure 2-1: Recommended Lifting Method (Front View)

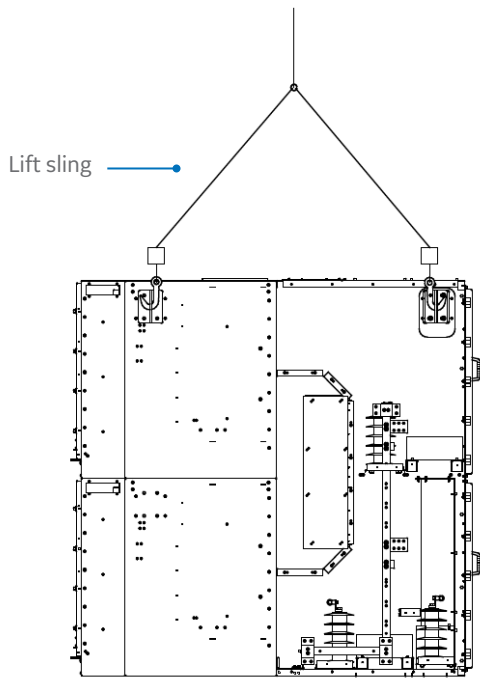


Figure 2-2: Recommended Lifting Method (Side View)

Forklifts

When using a forklift to raise the lineup, proceed as follows:

1. Expand forklift tines to their maximum (widest) extension.
2. Carefully insert tines of forklift below one side of the enclosure at the approximate center of the panel as shown in Figure 2-4.
3. Raise equipment and proceed to transport the enclosure.
4. Carefully lower the enclosure until it rests stable at its final destination.

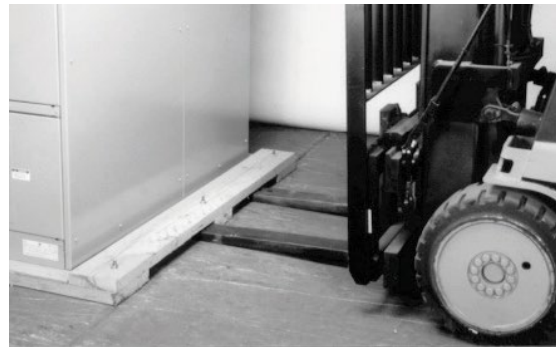


Figure 2-4: Placing Forklift Tines under Equipment Shipping Skid

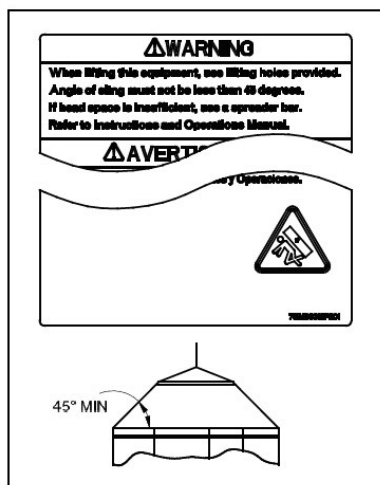


Figure 2-3: Corner Warning Label

Using Rollers

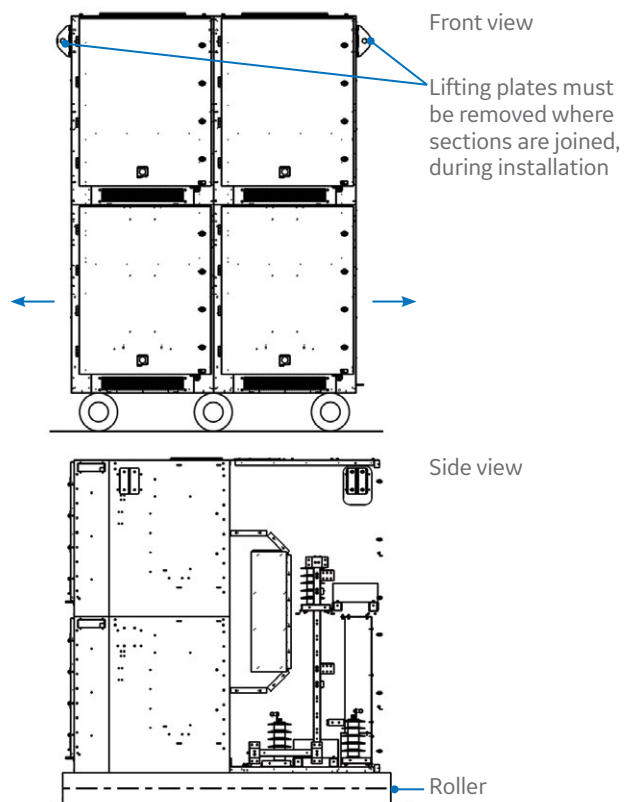


Figure 2-5: Method of Moving

After shipping skids are removed, roller may be used to roll equipment parallel to front only.

Storage

Switchgear

If it is necessary to store the switchgear for any length of time, the following precautions should prevent corrosion or deterioration:

1. Remove factory-installed protective covering.
2. Check thoroughly for damage.
3. Store in a clean, dry, rodent-free location between -30 °C and 40 °C.

WARNING

Remove all cartons, containers, and miscellaneous packaging and packing material from inside the switchgear sections before energizing any internal heaters. To prevent fire, remove any plastic or polyethylene shrouding from the switchgear sections before energizing any internal heaters.

4. Provide protective coverings to prevent dirt, water, or other foreign substances from entering the switchgear.
5. If dampness or condensation may be encountered in the storage location, heaters must be placed inside the switchgear sections to prevent moisture damage. Approximately 300 W of heat in each section is required.

CAUTION

If the space heaters are to be temporarily energized from an external source, it is important to remove the fuses on the secondary side of the control power transformer. This precaution is to prevent a feedback of higher voltage to other portions of the equipment through the CPT primary.

SecoVac Vacuum Circuit Breakers

If circuit breakers are not to be placed into service at once, remove them from their shipping cartons and thoroughly inspect them for damage. If the circuit breakers are in satisfactory condition, replace them in their shipping cartons for storage. Do not remove the circuit breaker shipping supports at this time.



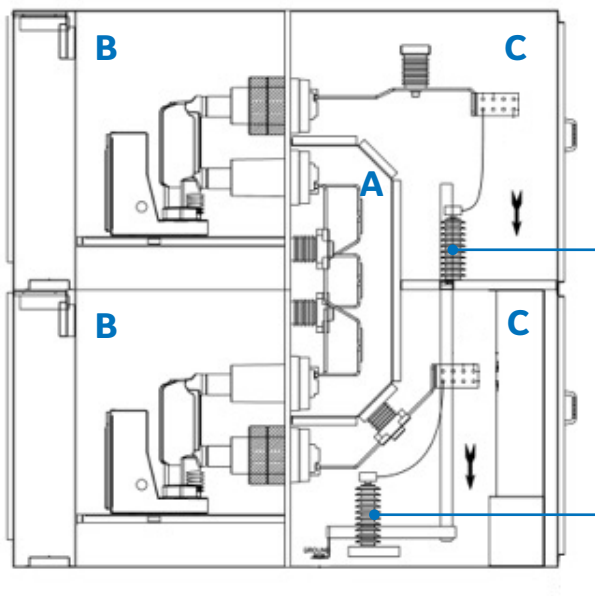
Figure 2-6: SecoVac Vacuum Circuit Breakers

Store the circuit breakers in a clean, dry location in an upright position. They must be properly supported to prevent bending of the studs or damage to any of the circuit breaker parts. Do not remove any protective grease until the circuit breakers are ready to be installed. A plastic or canvas-type cover should be provided to reduce the possibility of damage to the circuit breakers due to dust and water.

3. SecoGear Construction

This section describes SecoGear Medium Voltage Switchgear, along with the functions of the electrical and mechanical systems. Figure 3-1 contains a typical side view of dual feeder section, showing the major isolated compartments as well as circuit breakers, CTs, and optional Surge Arrestors.

The switchgear consists of modules containing circuit breakers and auxiliary equipment, which are stacked two high to form vertical sections. Sections are arranged side by side and connected mechanically and electrically to form complete switchgear assemblies.



A = Main Busbar Compartment Optional Surge Arrestors
B = Circuit Breaker Compartment
C = Cable Compartment

Figure 3-1: Section Contents

Circuit Breaker Compartment

The circuit breaker compartment is designed to house SecoVac vacuum circuit breakers. These compartments can be stacked for two-high switchgear configurations. Each circuit breaker compartment has two physical positions, CONNECTED and DISCONNECTED/TEST.

All of the protective devices, metering devices, secondary control, and control fuses are located in the front area of the circuit breaker compartment or they are located on the front compartment door.

The compartment includes guide rails, stationary primary contacts, automatic shutters, interlocks, MOC and TOC switches and necessary control and indicating devices.

Window-type current transformers for protection and metering circuits are mounted on the insulated bushings containing the fixed primary contacts.

Closed-door Drawout

Closed-door drawout is a standard construction feature on all circuit breaker compartments (Figure 3-2). The circuit breaker compartment doors remain closed and latched while the circuit breaker is racked to or from the CONNECTED and DISCONNECTED/TEST positions.

The circuit breaker should always be OPEN when it is moved into or out of the CONNECTED position.



Figure 3-2: Circuit Breaker Manual Rack in/out

There are two tools available to rack-in and rack-out the circuit breakers.

The standard is the manual racking device (Figure 3-2) which allows the operator to manually engage the circuit breaker mechanism to change it's position.

The optional remote racking device (Figure 3-3) allows the operator to engage the circuit breaker mechanism to change it's position while remaining outside the arc-flash boundary.



Figure 3-3: Circuit Breaker Automatic Rack in/out

CAUTION

Although the circuit breaker compartment door may be opened in any position, it is recommended that the door be opened only when the circuit breaker is in the DISCONNECTED/TEST position.

Fixed Primary Disconnect Contacts

Tubular fixed primary disconnect contacts are recessed inside the insulated primary bushings (spouts), which are mounted on the back plane of the circuit breaker compartment (Figure 3-4).

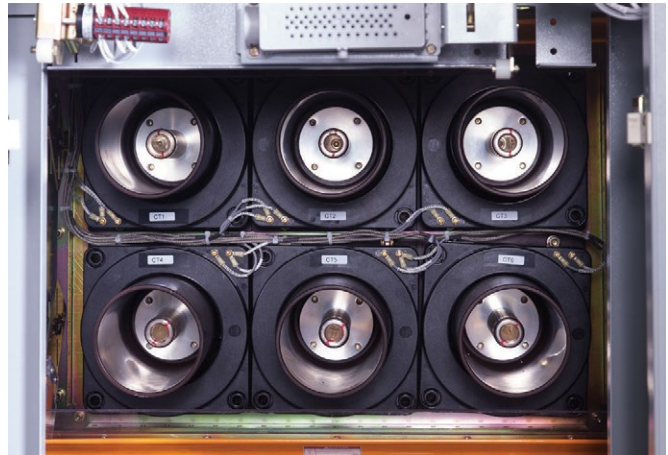


Figure 3-4: SecoGear Primary/Secondary Disconnects

Note: Figure 3-4 above is shown without the automatic shutters in their normal DISCONNECT/TEST position to clearly view the Primary/Secondary Disconnects.

The primary finger clusters on the circuit breaker will engage these contacts when the circuit breaker is racked into the CONNECTED position.

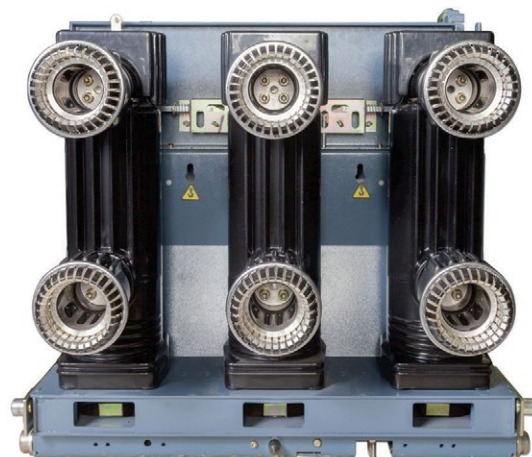


Figure 3-5: Circuit Breaker Primary/Secondary Cluster

Automatic Shutters

Standard automatic shutters (Figure 3-6) are constructed from glass-reinforced polyester and help provide protection against contact with the energized stationary primary disconnects when the circuit breaker is removed from its compartment. The shutters can be manually operated for maintenance and padlocked in the closed position for safety.

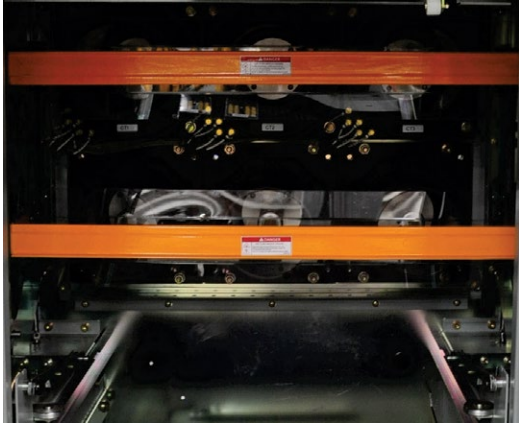


Figure 3-6: Automatic Shutters

DANGER

Hazard of electric shock or burn. Turn off power to this equipment before working inside.

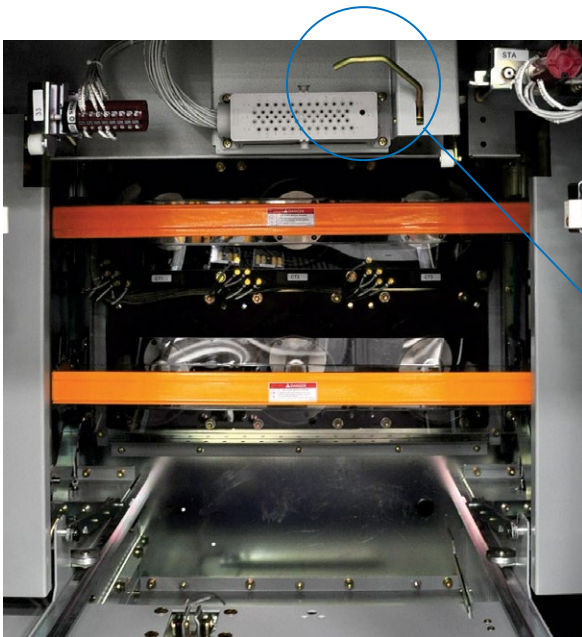


Figure 3-7: Interlock for Secondary Disconnect Plug Removal

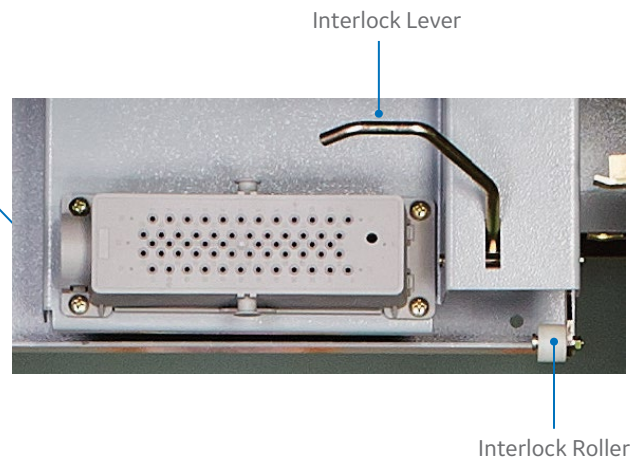
The shutters are closed when the circuit breaker is in the DISCONNECTED/TEST position. As the circuit breaker is racked from the DISCONNECTED/TEST position to the CONNECTED position, the shutters open allowing the circuit breaker to connect to the primary disconnects.

Interlocks

The circuit breaker compartment is equipped with the following IEEE C37.20.2 required interlocks to block incorrect operations that could put the operator at risk and compromise the efficiency and reliability of equipment:

- Interlocks to prevent closing the primary contacts while the circuit breaker is being racked to or from the CONNECTED position, by blocking the operating mechanism mechanically and electrically
- Mechanical Interlocks preventing racking of a closed circuit breaker
- Mechanical Interlock to discharge mechanism spring energy prior to withdrawal of the circuit breaker from the compartment
- Rejection interlocks to prevent insertion of improperly rated circuit breaker
- The secondary disconnect plug (Figure 3-7) must be connected prior to racking the circuit breaker to the CONNECTED position and cannot be removed while the circuit breaker remains in the CONNECTED position.
- The Open - Close- Open automatically opens the circuit breaker when leaving or entering the compartment, and that springs are discharged, Figure 3-8.

Other safety interlocking features include compartment door and racking screw access padlocking (Figure 3-9). For more information, see SECTION 9: Maintenance, “SecoGear Padlocks and Keylocks.”



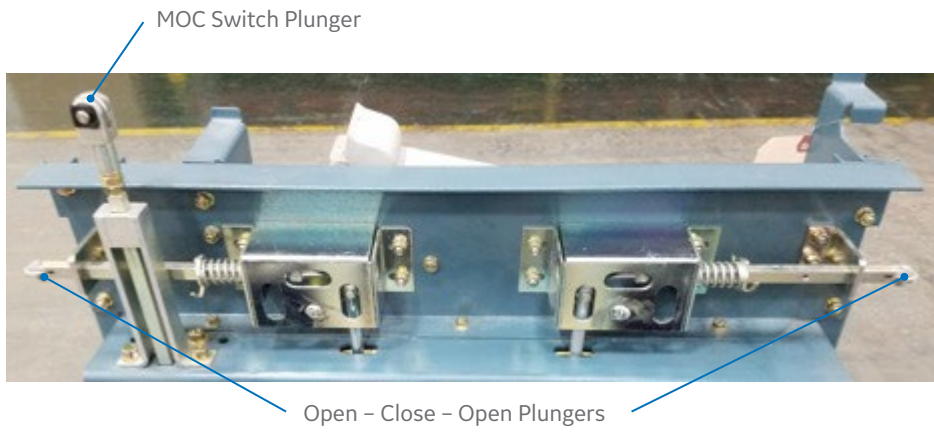


Figure 3-8: Open-Close-Open Safety Interlock Plungers

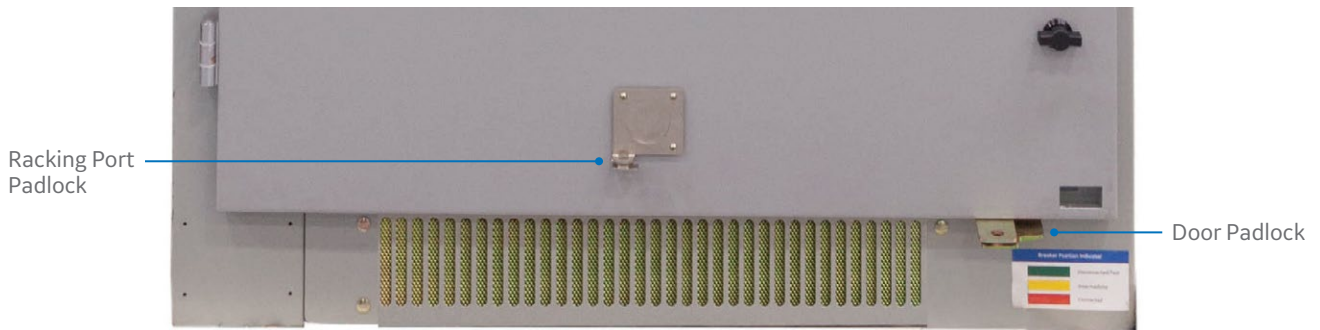


Figure 3-9: Padlock for Door and Breaker Rack in/out

Current Transformers

Window-type current transformers are mounted over the primary bushings in the rear of the circuit breaker compartment and are isolated from the circuit breaker by the shutters. They are front-accessible by removing the personnel barrier and manually opening the shutters.

⚠ DANGER

Hazard of electric shock or burn. Turn off power to this equipment before working inside.



Figure 3-10: Current Transformers

Auxiliary Compartments

Voltage Transformers

Voltage transformers are located in an auxiliary compartment. Up to three transformers can be mounted on a movable tray equipped with primary and secondary disconnecting devices. When the voltage transformers are disconnected, they are at a safe strike distance from all live parts of the switchgear.

In addition, a grounding device is provided, which contacts the fuses when the voltage transformers are disconnected, effectively discharging the transformers, reference IS Field Engineer's Manual EM9370, appendix section 25 & 26 for proper discharge of static charges prior to removal. Once properly discharged, the transformer fuses may be safely removed and replaced. An auxiliary compartment shutter will isolate the primary disconnect when the rollout is fully withdrawn from the cell. An insulated barrier mounted at the rear of the carriage moves with the carriage to a position in front of the stationary part of the primary disconnect device, providing a safe striking distance from all live parts.



Figure 3-11: Voltage Transformers

Control Power Transformers and Fuse Trays

Current-limiting fuses with high interrupting ratings are sometimes used in metal-clad switchgear to protect small transformers or circuits where circuit breakers cannot be economically or functionally justified. The fuses are mounted in a movable tray equipped with primary and secondary disconnecting devices.

Single phase control power transformers up to 15 kVA and their secondary circuit breaker are mounted on the tray with the primary fuses (Figure 3-13). Larger control power transformers, up to 75 kVA (single phase) or 45 kVA (three phase), are located in the cable compartment behind their associated fuse tray, and their secondary circuit breaker is located behind a cover on the upper cable compartment. When the fuses are disconnected, they are at a safe strike distance from all live parts of the switchgear. The fuse only tray is shown in Figure 3-12.



Figure 3-12: Fuses-only Tray



Figure 3-13: CPT with Fuses Tray

In addition, a grounding device is provided, which contacts the fuses after they are disconnected, effectively removing any static charge from the fuses, reference IS Field Engineer's Manual EM9370, appendix section 25 & 26 for proper discharge of static charges prior to removal. Once properly discharged, the fuses may be safely removed and replaced. The disconnecting devices are capable of interrupting transformer magnetizing current, but should not be used to interrupt load current.

Mechanical or key interlocks are applied to prevent operating the disconnect device and withdrawing the tray while the load is connected. This is generally accomplished by interlocking so that the transformer secondary circuit breaker must be locked in the open position before the disconnecting device can be connected or disconnected. Current-limiting fuse and control power transformer rollouts are located in auxiliary compartments.

Manually Operated Ground and Test Device

The type SVGTXX Manual Ground and Test Device is an auxiliary removable device for use in SecoGear metal-clad switchgear equipment during initial installation and at normal maintenance periods. The Ground and Test device does not contain interrupters or a mechanism; therefore, it has no interrupting or close-making capability. The device is provided with primary finger connections to match the circuit breaker compartments (1200 A or 2000 A) and has a momentary withstand capability equal to the switchgear (104 kA peak). For more detailed information refer to Publication#DEH-50007 SecoVac Ground and Test Device Installation Manual.

The function of this device is to solidly ground the equipment manually as well as permit various types of tests. It provides a convenient means of grounding a system bus or cable connections to safeguard personnel who may be working on the equipment. Exposed Ground and Test Device terminals can also be used for applying a high potential test, measuring insulation resistance to ground and phasing cables. Refer to the Ground and Test Device manual for a detailed description of the design and operating principles before using.



Figure 3-14: Manual Ground and Test Device

NOTICE

Use of the motor-operated remote racking device to connect or withdraw any ground and test device is strongly recommended.

Circuit Breaker

This section contains an overview of the SecoVac vacuum circuit breaker, along with the functions of the electrical and mechanical systems. For complete operation and maintenance instructions refer to Publication#DEH-50001 SecoVac Vacuum Circuit Breaker Installation Manual.

NOTICE

The performance and safety of all equipment may be compromised by the modification of supplied parts or their replacement by non-identical substitutes. All such design changes must be qualified to the original manufacturer's specifications.

Maintenance personnel should keep constant, accurate written records as an aid in future service planning and equipment reliability improvement. Promptly report any unusual experiences.

The closing and opening mechanisms are of the stored energy type and use a gear motor to charge a closing spring. During a closing operation, the energy stored in the closing spring is used to close the vacuum interrupter contacts; compress the wipe springs, which load the contacts; charge the opening spring; and overcome bearing and other friction forces. The energy then stored in the wipe springs and opening spring will open the contacts during an opening operation.

Closing and opening operations are controlled electrically by the switchgear or remote relaying. Mechanical control is provided by manual close and trip buttons on the circuit breaker.

The closing spring may be manually charged. The mechanism will operate at the AC or DC voltage indicated on the circuit breaker nameplate.

Circuit breakers are provided with a MOC switch plunger and a TOC switch actuator when needed. These will work with the MOC and TOC switches to indicate whether a circuit breaker is open or closed, and whether it is in the connected position.



Figure 3-15: SecoVac Vacuum Circuit Breaker

This removable element of the SecoVac vacuum circuit breaker consists of an operating mechanism, interlocks, and primary and secondary disconnecting devices. All SecoVac vacuum circuit breakers are equipped with wheels for easy movement.

The fingers are held in contact with the circuit breaker stud by a garter spring, providing contact pressure when the finger assembly is connected to the tube in the SecoGear circuit breaker compartment.

SecoVac vacuum circuit breakers of the same rating are interchangeable in their corresponding circuit breaker compartments; for detailed description and operation instructions, refer to Publication#DEH-50001 SecoVac Vacuum Circuit Breaker Installation Manual.

Primary Disconnects

Primary disconnects utilize silver-plated copper fingers positioned in a circular configuration and are supported by a non-magnetic spider. This spider spaces the fingers equally around the circuit breaker stud and fastens them to the end of the stud.



Figure 3-15: Disconnect Finger Cluster

Lift Truck

For ease of the circuit breaker handling during installation and removal, a lift truck is provided (Figure 3-17). This accessory device elevates the circuit breaker, the VT/CPT tray, or the Ground and Test Device from the floor to the level of the tracks in the SecoGear circuit breaker compartment.



Figure 3-17: Lift Truck Ready for Use

For a detailed description and operating instructions, see SECTION 5. Installing and Removing SecoVac Vacuum Circuit Breaker.

Racking Mechanism

When installed in the circuit breaker compartment, the circuit breaker is supported by two steel tracks, one on each side of the enclosure. Once the circuit breaker is locked into the DISCONNECTED/TEST position within the cell, the racking mechanism is used to move the circuit breaker between the DISCONNECTED/TEST and CONNECTED positions. This mechanism is contained in the undercarriage of the circuit breaker. The racking mechanism is manually operated, utilizing the racking handle furnished with the switchgear.

The circuit breaker cannot be moved between the CONNECTED and DISCONNECTED/TEST positions unless it has been opened. The circuit breaker cannot be closed unless it is in the CONNECTED or DISCONNECTED/TEST position.

For detailed explanation of the racking mechanism refer to SECTION 7: "Circuit Breaker Operation."

Remote Racking System (Optional)

The optional electrically operated remote racking device (see Figure 3-18) provides a convenient means for racking a circuit breaker between the CONNECTED and DISCONNECTED positions from a remote location. It is easily mounted on the SecoGear circuit breaker compartment door and is designed for quick transfer between units.

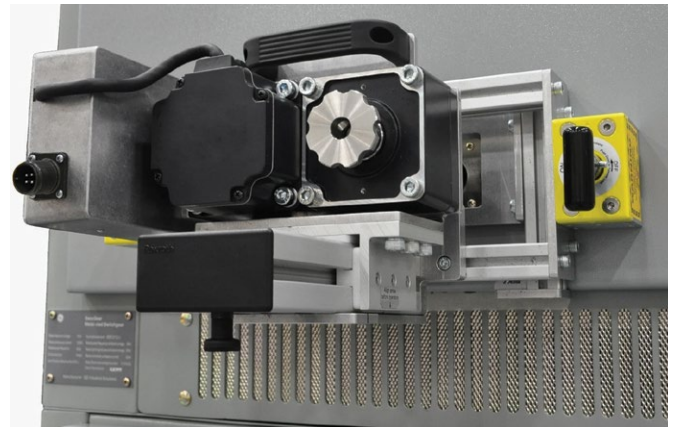


Figure 3-18: Remote Racking Operator



Figure 3-19: Remote Switch Operator

The remote racking operator is furnished with a Remote Switch Operator. Please allow the Remote Switch Operator to fully charge before operating.

The Remote Switch Operator includes a Wireless Control Operator with a range of 300 ft. For more details, refer to Publication#DEH-50008 Remote Racking Device Installation Manual.

4. Installation

This section contains complete instructions for installing SecoGear metal-clad switchgear for 5kV – 15kV IEEE medium voltage applications.

CAUTION

Personnel installing this equipment must be thoroughly familiar with this instruction manual and all articles of the National Electrical Code applicable to the installation of this switchgear. In addition, all installation drawings, both mechanical and electrical, must be understood and strictly followed to prevent damage to the switchgear or equipment being protected by the switchgear.

NOTICE

Before installation work is started, it is important to review all of the drawings provided, including the equipment arrangement drawings, site installation drawings, elementary and remote connection drawings, mechanical connection drawings, and the summary of equipment list.

Site Location

In general, the location of the switchgear equipment is determined during the equipment's specification or procurement. Indoor locations within buildings impose certain requirements that must be met so that the switchgear may operate efficiently with a minimum of maintenance.

In locating the switchgear, adequate aisle space must be provided at the front and rear of the equipment to ensure proper ventilation of the equipment and to allow service and

maintenance of the equipment with the front and rear doors open. The recommended aisle space is shown on the floor plan supplied with the equipment drawings.

The switchgear equipment should be placed in an area where clean, dry air is free to circulate around and above it. Since air is taken into the equipment at the bottom of each section and exhausted at the top, a location with good airflow must be provided for efficient operation. A minimum of 30 in. of clear space above the equipment is recommended.

Foundation Requirements

Recessed steel channels for supporting the equipment are recommended. However, mounting the indoor switchgear directly on a smooth, level floor is allowable. The foundation must be flat and level in all planes, perpendicular on both axes within 0.25 in. (6.35 mm) over a 10 ft. (3048 mm) span.

The embedded floor channel requirements are as follows:

1. Each floor channel shall be level over its entire length, and floor channels shall be level with each other. This is critical to prevent distortion of the equipment and to ensure proper mechanical and electrical connections between shipping splits and close-coupled equipment.
2. The finished floor shall be slightly pitched away from the mounting channels. Ensure that the pitch does not exceed flat and level requirements.
3. The finished floor shall not be higher than the channels.
4. When bolting to floor channels, floor channels must be drilled and tapped. (Weld nuts may be welded inside of the channels.)
5. Conduit penetrations shall not be greater than 1 in. above the finished floor. See drawing 8PVA005501 (summarized in Figure 4-1) for anchoring details.

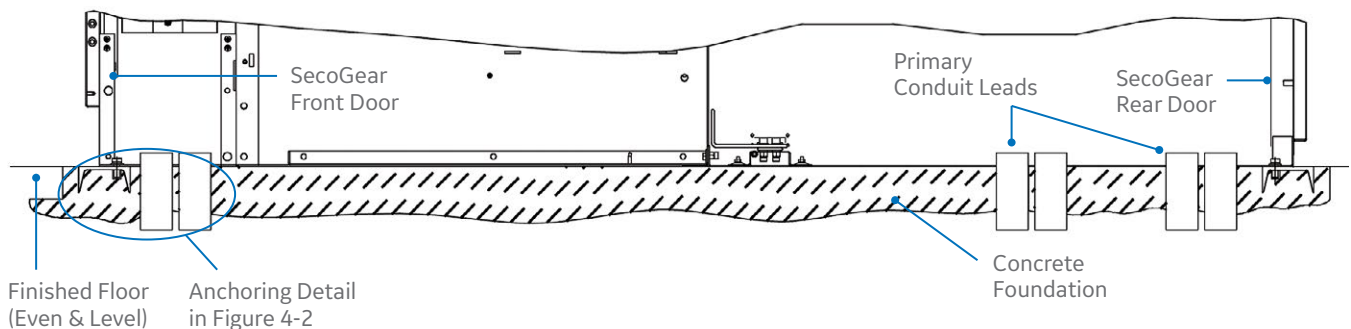


Figure 4-1: SecoGear Installation Drawing – Indoor Anchoring Method

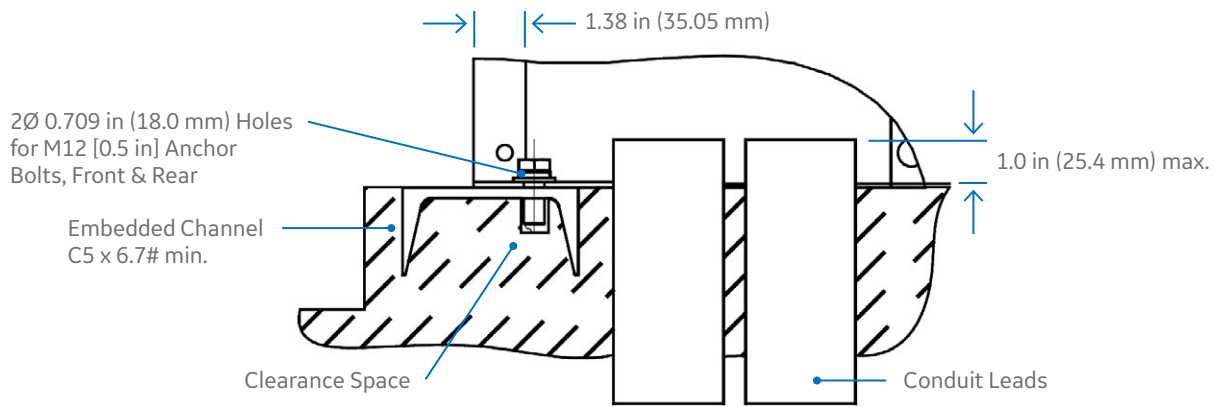


Figure 4-2: SecoGear Primary Indoor Anchoring Method

Assembling Shipping Sections

Before assembling SecoGear shipping sections, all components should be available at the site location. This will facilitate component identification as well as installation. The foundation should be prepared in accordance with the instructions in “Foundation Requirements” and all embedded conduits installed and capped.

For each lineup, the assembly procedure involves

1. Bolting side-by-side sections together.
2. Inserting main bus and bus ties, and bolting them between sections.
3. Installing the left and right end trim covers.
4. Interconnecting the wires between the shipping splits.
5. Taping special bus joints, and taping or booting cable terminations to insulate them.



Figure 4-3: Lineup Shown Assembled

Bolting Sections Together

Once the sections have been moved to the foundation, first remove the lift plugs from the sides (two per stack per side), as shown in Figure 4-4.



Figure 4-4: Lift Plugs in Position

Next, tuck the interconnect wire (Figure 4-5) into the module prior to pushing stacks together.

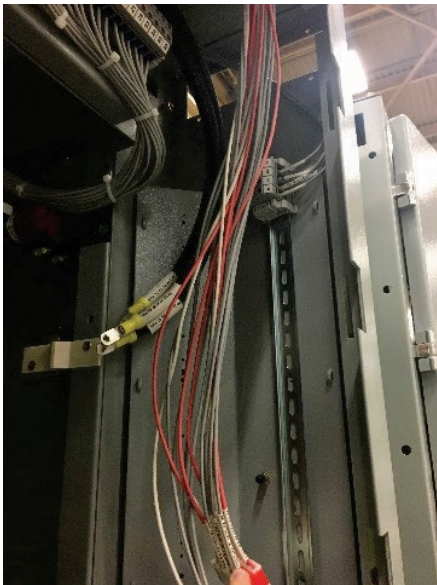


Figure 4-5: Position Wires for Clearance

Now, the sections can be pushed to their final positions.

All switchgear sections are bolted together through removable weld-nut plates located inside the front and rear doors (see Figure 4-6). Only one nut plate is required per joining section, so the middle section may have none attached from the factory.

In the front of the modules (Figure 4-5), insert bolts from the right stack into the nut strip on the left stack. Install five M10 x 25 bolts per module, 10 bolts per stack (torque to 19.2 ft.-lbs. [26 Nm]).

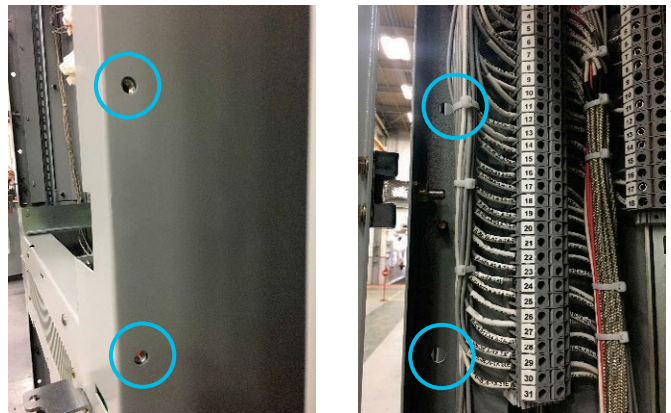


Figure 4-6: Front Bolt Locations (left and right)

Finally, in the rear compartment (Figure 4-7) insert bolts from the left stack into the clinch nuts on the right stack. Install six bolts per stack (torque to 19.2 ft.-lbs. [26 Nm]).

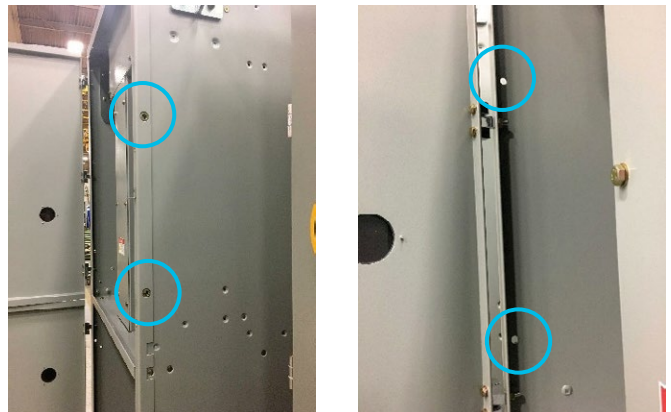


Figure 4-7: Rear Bolt Locations (left and right)

Attach Trim Covers

Where not connected to other switchgear, the welding nut plates are designed to receive bolts for the left or right end covers.

Always bolt from the outside of the switchgear. First, assemble and bolt the front trim cover, and then assemble and bolt the rear trim. Finally, bolt them together in the middle of the gear.



Figure 4-8: Front Left Trim Covers Installed

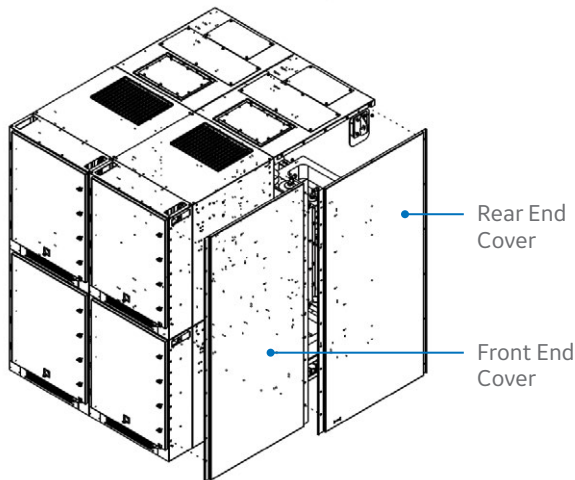


Figure 4-9: Side Sheet Assembly

Wiring

Control wires (up to #10 gauge wire) that cross shipping splits have color coded ends and are labeled as plug connectors at each split. Ensure all plugs are properly reconnected.

WARNING

Plugs may contain CT circuit wiring. Do not disconnect plugs when the equipment is energized, since opening energized CT circuits can create hazardous high voltages.

Taped Insulation

SecoGear is provided with main bus joint and cable lug boots to provide insulation protection over connection points. In special cases you may need to use taped insulation or another method to protect the connections. This work would not be performed at the factory, but we are providing some basic reference information in this section.

With the new and improved insulating material available on the market, we highly recommend going to the vendors' website to review current product offerings and installation methods that will best work for your situation. Products may include tapes, putties, and heat-shrinkable options. The following examples illustrate some of the key concerns and issues when installing tape or other non-boot style insulation. Carefully follow the material vendors' installation instruction to assure proper coverage and adhesion.

The following insulation system involves the use of high voltage insulating tape and electrical-grade rubber-based putty. Electrical grade putty will be used only when required to grade voids and smooth out sharp edges of joints, terminator, or entrance bushing connections. The high-voltage tape will be used both as filler and also as the final insulation covering for these examples. Overlap any expired roll by one-half turn.

PART 1: BUS BARS, 5 KV OR 15 KV

Apply the appropriate number of layers of high-voltage tape 4 or 5 (2" or 4" wide), mastic side down, at medium tension, to bus bars per Figure 4-10.

NOTICE

Medium tension thins a 0.030" x 2" tape to approx. 0.024" x 1.75". A 0.030" x 4" tape thins to approx. 0.024" x 3.5".

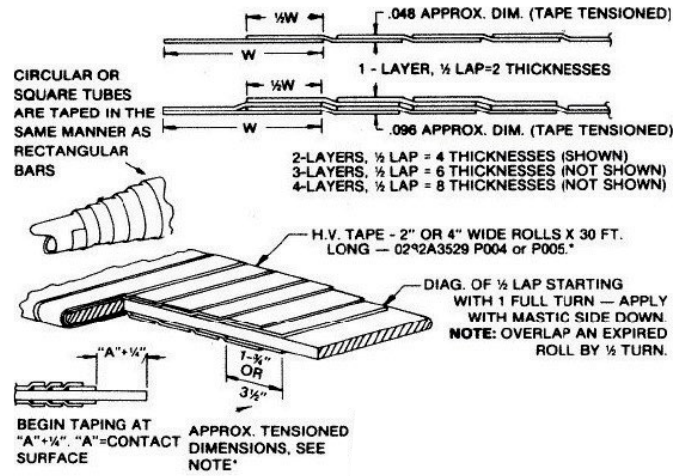


Figure 4-10: Tape Bus Bars

Table 4-1: Tape Bus Bars

		BAR SIZES							
INSULATION RANGE	NUMBER OF LAYERS	TAPE WIDTH	3/8 X 2	1/4 X 3	1/2 X 3	1/4 X 4	1/2 X 4	1/4 X 6	1/2 X 6
			1/4 X 2	1/8 X 3	3/8 X 3	3/8 X 4	5/8 X 4	3/8 X 6	5/8 X 6
600 to 5,000V	1 Layer	2"	4'	5'	6'	8'	9'	11'	12'
	1/2 Lap*	4"	2'	3'	3'	4'	5'	5'	6'
5,001 to 15,000V	2 Layers	2"	9'	11'	12"	18'	19'	23'	24'
	1/2 Lap*	4"	5'	6'	6'	9'	10'	11'	12'

*Note: Apply 3 layers - 1/2 Lap for conductors passing through C.T's

PART 2: TAPED JOINTS, 5 KV OR 15 KV

Step A: Filler, 5 kV or 15 kV

Apply three (3) layers – one-half lap of high-voltage tape (2" or 4" wide), mastic side-down at medium tension over all bolt heads, nuts, bars, or splice plates to form a smooth surface for taping. Any bars with sharp burrs and edges must be deburred and smooth before applying tape.

Step B: Outer Wrap, 5 kV or 15 kV

Apply two (2) layers – one-half lap of high voltage tape (2" wide), mastic side-down, maintaining a medium tension on the tape while wrapping. Begin the wrap away from the joints, overlapping the adjacent insulation, (epoxy fluid, dip, thermoplastic sleeving, cable, or tape) by 3" minimum. When completing the wrapping of the joint, do not keep tension on the last 2" or 3" of tape. These last few inches should be laid in place without tension to prevent the tape end from lifting. No other taping or paint is required.

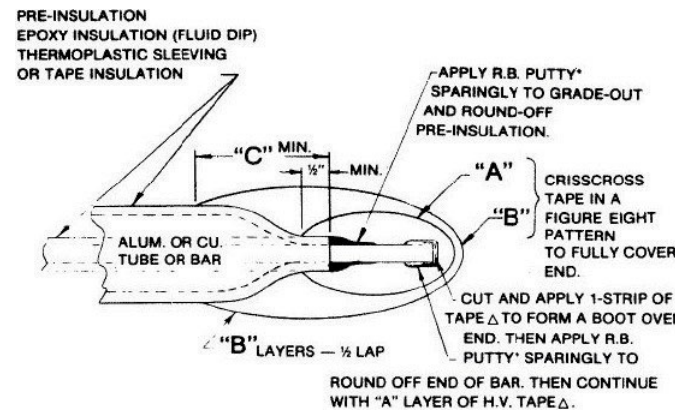


Figure 4-11: Tape Dead-end Bus Joint

Table 4-2: Tape Dead-end Bus Joint

INSULATION LEVEL	INNER FILLER "A"	OUTER WRAP "B"	"C"	APPROX. NO. ROLLS PER JOINT OF H.V. TAPE Δ	
				2" OR 3" BARS OR TUBES	4" OR 6" BARS
5 or 15KV	R.B. Putty* & 3-Layers Tape	3-Layers Tape Δ	3"	1/4 Roll Putty* 1/2 Roll Tape Δ	1/2 Roll Putty* 1 Roll Tape Δ

* Electrical grade rubber-based putty 0282A3529 P008 in roll form will be used to grade voids and smooth out sharp edges of joints. This putty has no insulation value. 1-Roll is 1/8" x 1 1/2" x 5ft. LG.

Δ High voltage insulating tape 0282A3529 p004 roll is .030" x 2" x 30' LG. Apply with mastic side down.

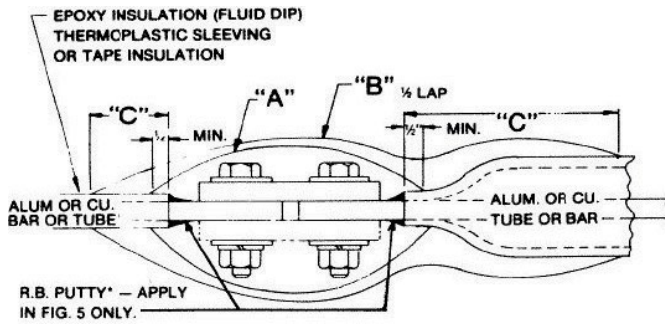


Figure 4-12: Tape Bus Connection Joint

Table 4-3: Tape Bus Connection Joint

INSULATION LEVEL	INNER FILLER "A"	OUTER WRAP "B"	"C"	APPROX. NO. ROLLS PER JOINT OF H.V. TAPE Δ	
				2" OR 3" BARS	4" OR 6" BARS
5 or 15KV	3-Layers H.V. Tape Δ	2-Layers H.V. Tape Δ	3"	1 Roll H.V. Tape Δ	2 Roll H.V. Tape Δ

* Electrical grade rubber-based putty 0282A3529 P008 in roll form will be used to grade voids and smooth out sharp edges of joints. This putty has no insulation value. 1-Roll is 1/8" x 1 1/2" x 5ft. LG.

Δ High voltage insulating tape 0282A3529 p004 roll is .030" x 2" x 30' LG. Apply with mastic side down.

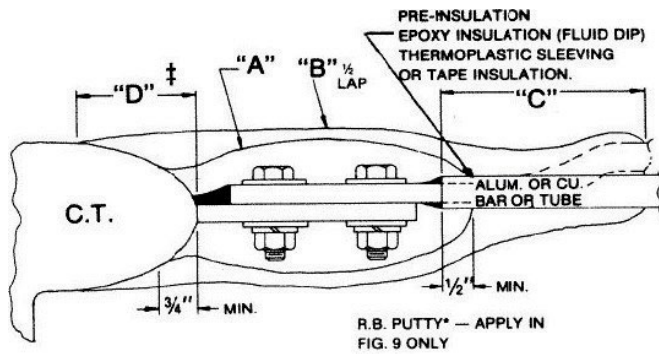


Figure 4-13: Tape Current Transformer Joint

Table 4-4: Tape Current Transformer Joint

INSULATION LEVEL	INNER FILLER "A"	OUTER WRAP "B"	"C"	"D"	APPROX. NO. ROLLS PER JOINT OF H.V. TAPE Δ	
					2" OR 3" BARS OR TUBES	4" OR 6" BARS
5 or 15KV	3-Layers H.V. Tape Δ	2-Layers H.V. Tape Δ	3"	3" ‡	1/2 Roll H.V. Tape Δ	1 1/2 Roll H.V. Tape Δ

* Electrical grade rubber-based putty 0282A3529 P008 in roll form will be used to grade voids and smooth out sharp edges of joints. This putty has no insulation value. 1-Roll is 1/8" x 1 1/2" x 5ft. LG.

‡ Insulate as far as possible – Do not cover polarity marks

Δ High voltage insulating tape 0282A3529 p004 roll is .030" x 2" x 30' LG. Apply with mastic side down.

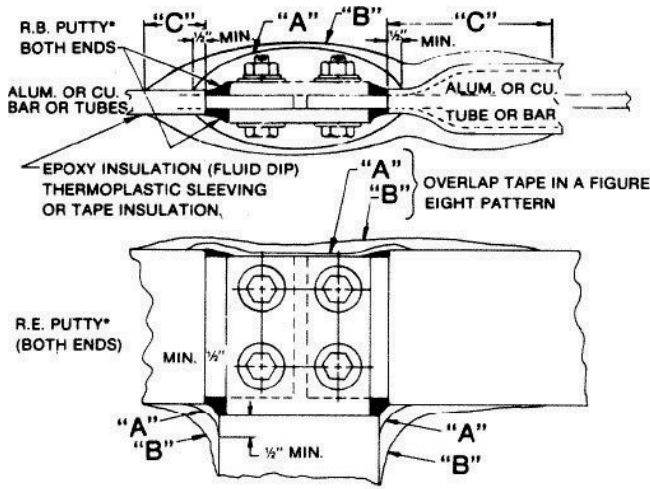


Figure 4-14: Tape Tee Connection Joint

Table 4-5: Tape Tee Connection Joint

				APPROX. NO. ROLLS PER JOINT OF H.V. TAPE Δ	
INSULATION LEVEL	INNER FILLER "A"	OUTER WRAP "B"	"C"	2" OR 3" BARS	4" OR 6" BARS
5 or 15KV	R.B. Putty* 3-Layers H.V. Tape Δ	2-Layers H.V. Tape Δ	3"	1/2 Roll Putty* 1 Roll H.V. Tape Δ	1 Roll Putty* 2 Roll H.V. Tape Δ

* Electrical grade rubber-based putty 0282A3529 P008 in roll form will be used to grade voids and smooth out sharp edges of joints. This putty has no insulation value. 1-Roll is 1/8" x 1 1/2" x 5ft. LG.

Δ High voltage insulating tape 0282A3529 p004 roll is .030" x 2" x 30' LG. Apply with mastic side down.

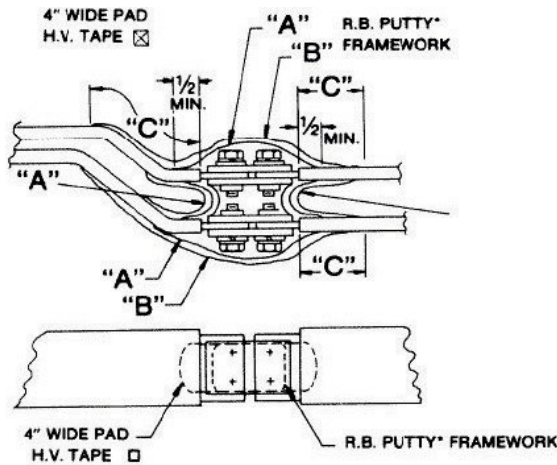


Figure 4-15: Tape Double Bus Bar Joint

Table 4-6: Tape Double Bus Bar Joint

				APPROX. NO. ROLLS PER JOINT OF H.V. TAPE Δ	
INSULATION LEVEL	INNER FILLER "A"	OUTER WRAP "B"	"C"	2" OR 3" BARS	4" OR 6" BARS
5 or 15kv	R.B. Putty* 3-Layers H.V. Tape \boxtimes 3-Layers H.V. Tape Δ	2-Layers H.V. Tape Δ	3"	1/2 Roll Putty* 1 Roll H.V. Tape \boxtimes 1 Roll H.V. Tape Δ	1 Roll Putty* 2 Roll H.V. Tape \boxtimes 2 Rolls H.V. Tape Δ

* Electrical grade rubber-based putty 0282A3529 P008 in roll form will be used to grade voids and smooth out sharp edges of joints. This putty has no insulation value. 1-Roll is 1/8" x 1 1/2" x 5ft. LG.

Δ High voltage insulating tape 0282A3529 p004 roll is .030" x 2" x 30' LG. Apply with mastic side down.

\boxtimes H.V. Tape 0282A3529 p005 – Roll is .030" x 4" x 30' LG.

Bus Bar Installation

Before installing the main bus, you must remove the items in Figure 4-16 for access.

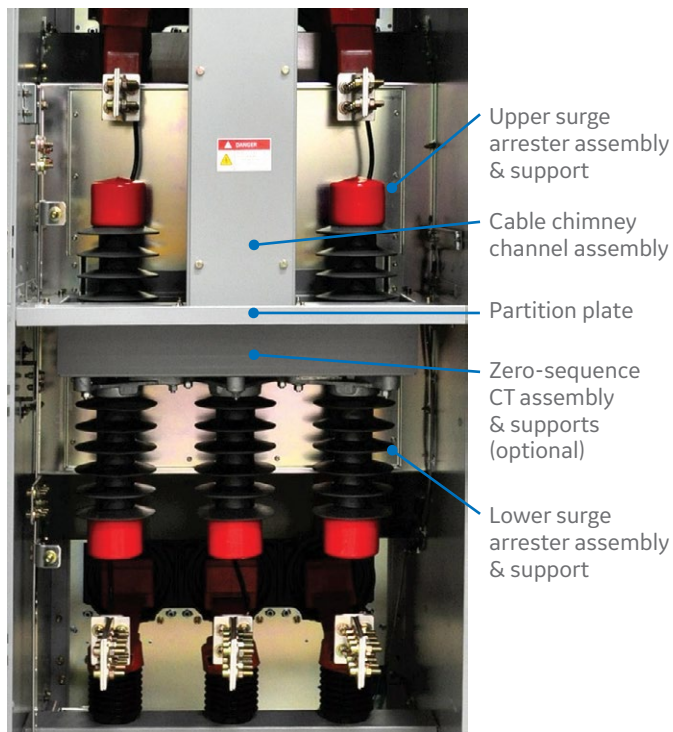


Figure 4-16: Bus Access via Rear Cover Plates

The order in which these components are removed will depend on whether the cables exit from above or below. Figure 4-16 shows a configuration for cables exiting above.

Once these items are removed, you now have clear access to the main bus panels. The upper and lower access panels are each divided into two pieces as seen in Figure 4-17.

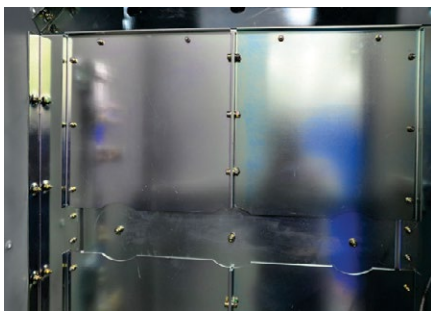


Figure 4-17: Bus Access Panels

Once these panels are removed (Figure 4-18), the main bus can be installed, as described below. Main bus bars across shipping splits are packaged and shipped separately. Each bar is marked with phase and section designation.

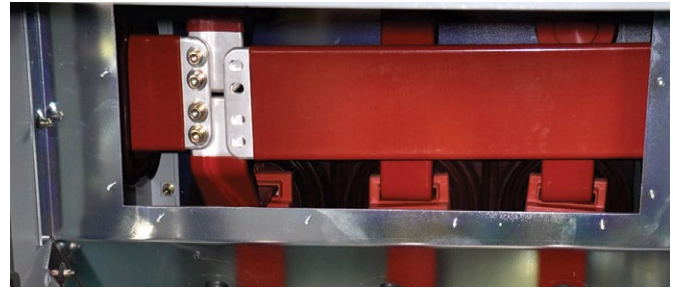


Figure 4-18: Bus Accessible

1. Feed bus through the side shrouds shown in Figure 4-19.



Figure 4-19: Side Bus Shrouds

2. Torque bus to 36.9 ft.-lbs. [50 Nm]. Use M12 x 50 to bolt down bus.
3. Install bus boot.
4. Re-install rear barrier assembly cover plates.

Table 4-7: Main Bus Sizes

CURRENT	MATERIAL	PIECES	SIZE
1200 A / 2000 A	Copper	1	.3937 in x 5.9055 in (10 mm x 150 mm)
3000 A	Copper	2	.3937 in x 5.9055 in (10 mm x 150 mm)

Table 4-8: Riser/Runback Bus Size

CURRENT	MATERIAL	PIECES	SIZE
1200 A	Copper	1	.3937 in x 3.1496 in (10 mm x 80 mm)
2000 A	Copper	2	.3937 in x 3.1496 in (10 mm x 80 mm)

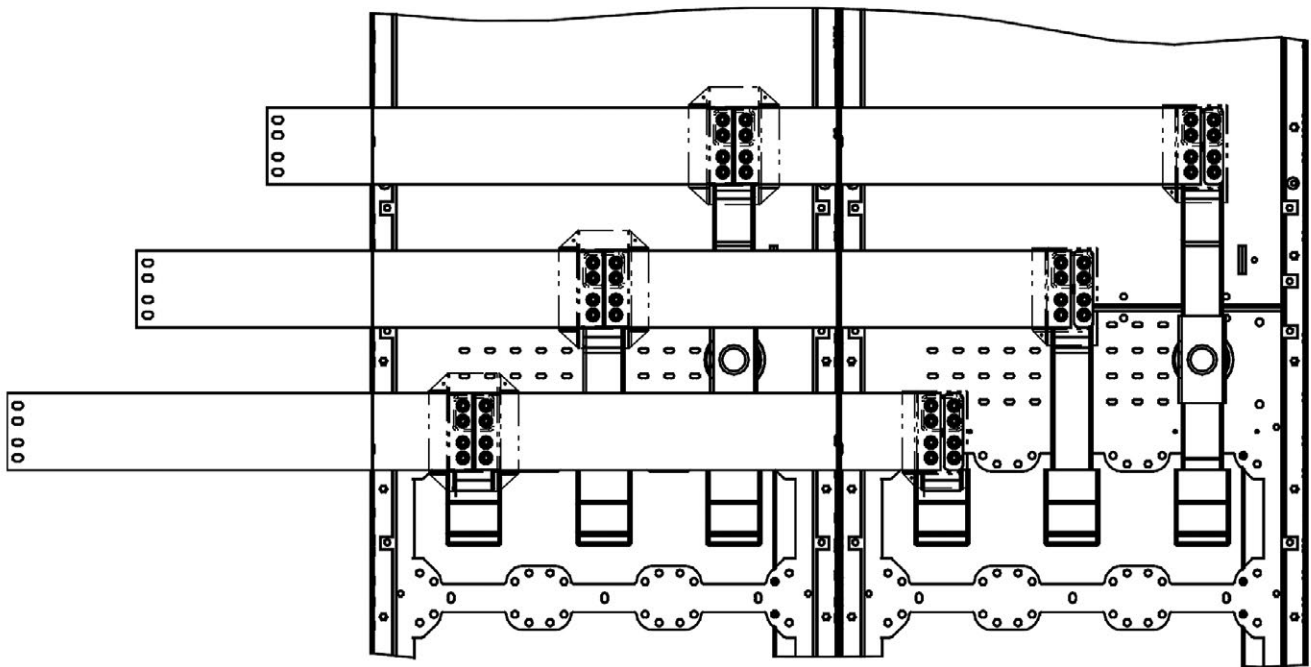


Figure 4-20: Main Bus Connection – Rear View

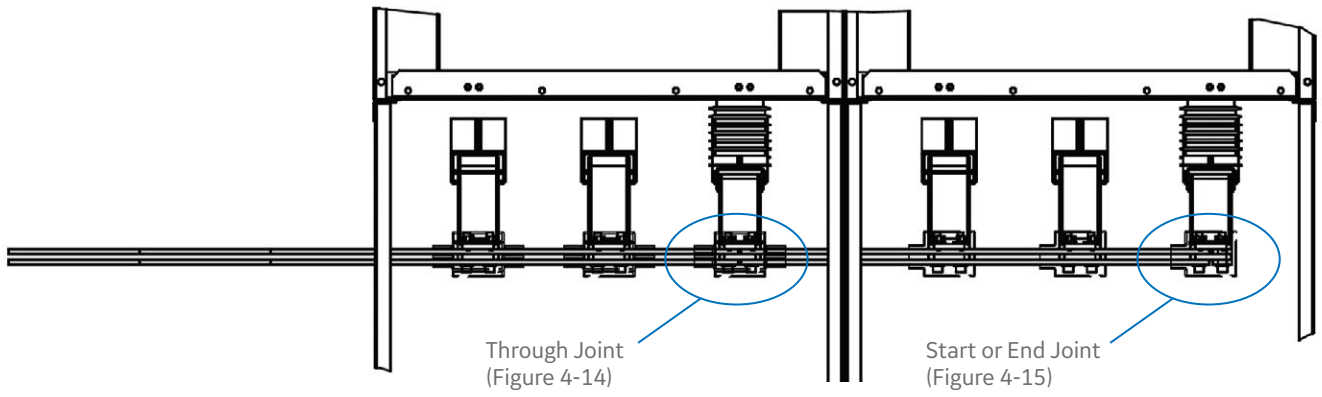


Figure 4-21: Main Bus Connection – Plan (Top) View

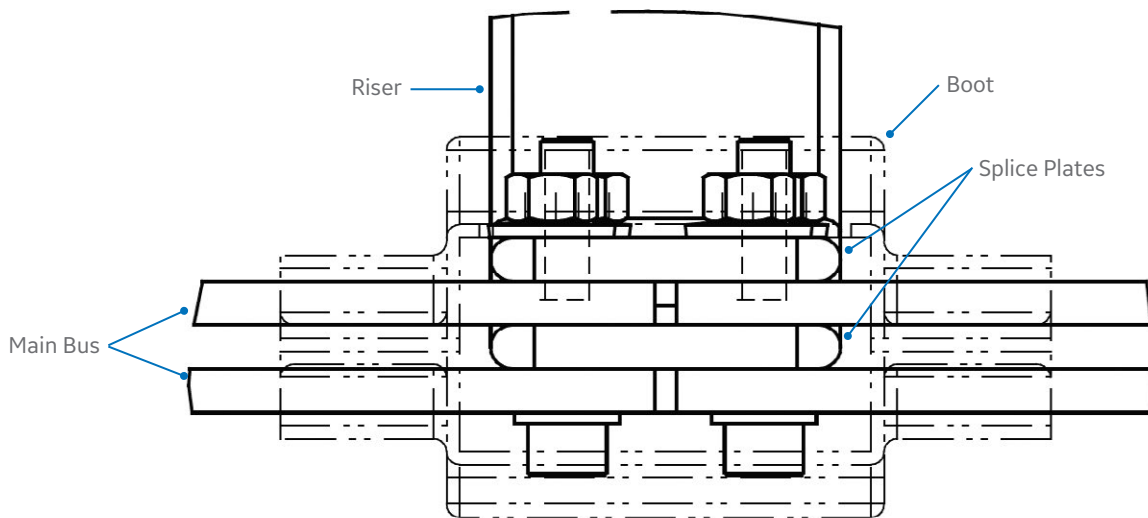


Figure 4-22: Main Bus Connection – Through Joint

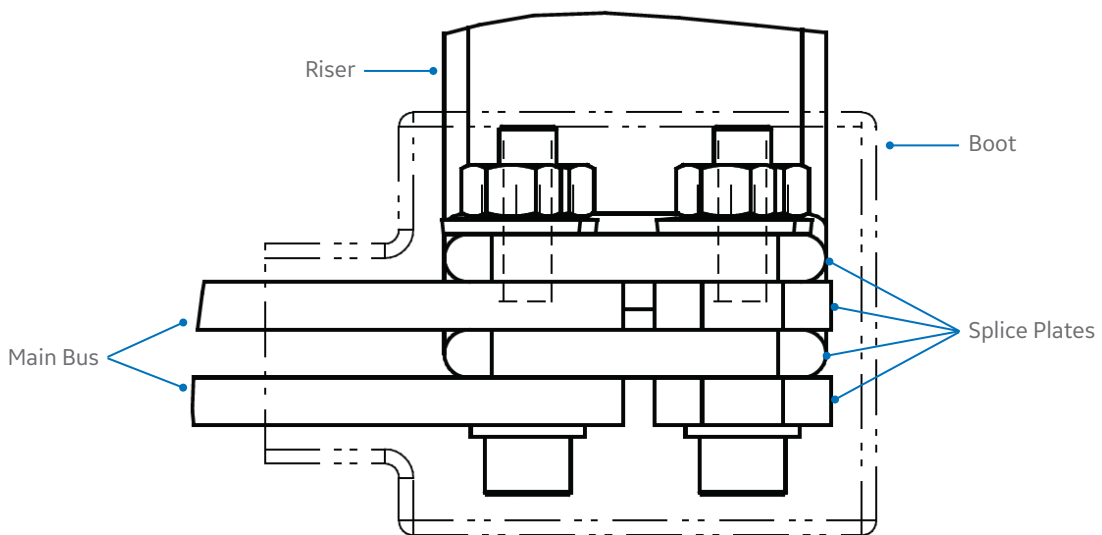


Figure 4-23: Main Bus Connection – Start or End Joint

Recommended Torque Values

Table 4-9 indicates torque values to be used for tightening the fasteners indicated in these documents.

Table 4-9: Recommended Torque Limits

BOLT SIZE	BOLT TORQUE (N-M)	BOLT TORQUE (FT-LBS)
M4	3	2.2
M5	5.9	4.4
M6	10	7.4
M8	26	19.2
M10	50	36.9
M12	86	63.4
M16	200	147.5
M20	300	221.3

Ground Bus Installation

Ground bus splice and hardware are typically shipped assembled at both sides of adjacent shipping packages.

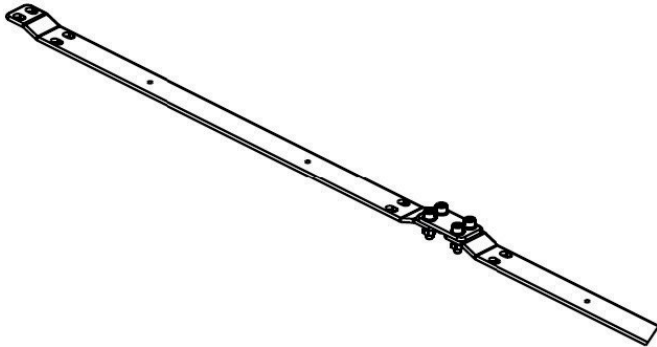


Figure 4-24: Typical Ground Bus

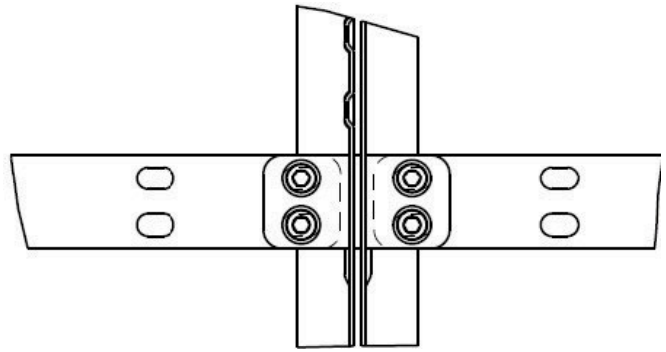


Figure 4-25: Ground Bus - Plan View

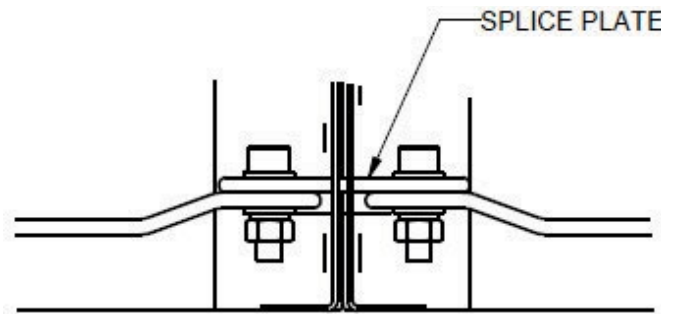


Figure 4-26: Ground Bus - Rear View

Cable Access Panels

Cable plates are provided on top of the equipment and as part of the rear floor plate. Two cutouts are provided in each area for use in cable exiting from above or below. Both are fastened with 6 mm hardware that requires a 10 mm socket or wrench.

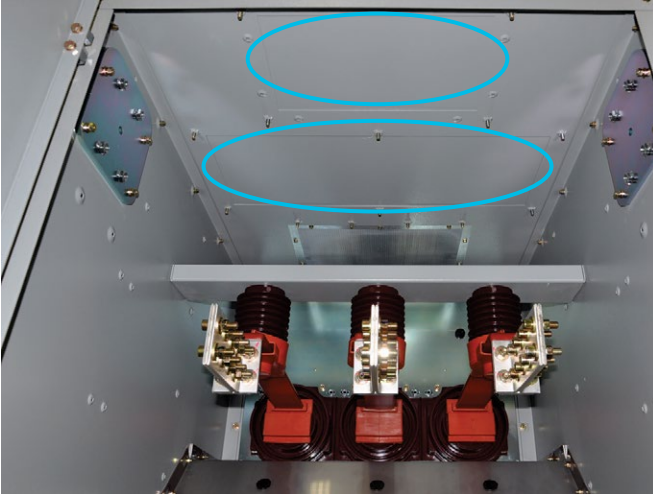


Figure 4-27: Upper Cable Plates

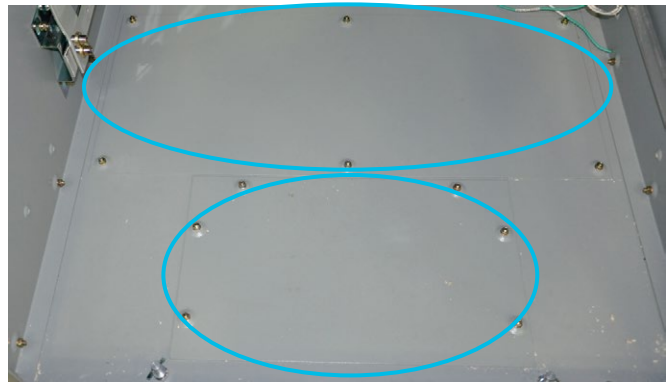


Figure 4-28: Lower Cable Plates

Final Inspection

Make a final inspection to see that no tools, construction materials, or other foreign matter have been left in the switchgear equipment.

5. Circuit Breaker Installation/Removal

Inspection and Preparation

Before installing, operating, or removing a circuit breaker, refer to Publication#DEH-50001 SecoVac Vacuum Circuit Breaker Installation Manual for preparation, inspection, and testing. Check thoroughly for damaged or loose parts and for any dirt or foreign matter.

Be sure that a thin film of lubricating grease (D6A15A2) is present on primary disconnects of the switchgear before installing the circuit breaker.

Ensure there are no unnecessary materials or tools inside of the circuit breaker compartment and proceed to clean the compartment body and the insulation parts with a soft cloth.

Racking

The racking operation features two positions, CONNECTED and DISCONNECTED/TEST.

- **CONNECTED** – In the CONNECTED position, the primary and secondary contacts are fully engaged. The circuit breaker must be open before it can be racked out of this position.
- **DISCONNECTED/TEST** – When in the DISCONNECT/TEST position, the primary contacts are disconnected, but the secondary contacts remain engaged. This allows complete circuit breaker operation without energizing the primary circuit.

Circuit breakers may be racked between these two positions with the compartment door closed and latched.

All circuit breakers are supported on the drawout rails mounted on the side walls of the SecoGear circuit breaker compartment. On SecoVac vacuum circuit breakers, two wheels on each side of the circuit breaker rest on each drawout rail.



Figure 5-1: Two-High Breaker Section

Circuit breaker movement is provided by a racking mechanism mounted in the bottom of the cassette. This mechanism utilizes a center-mounted drive screw. When the screw is rotated clockwise by the racking handle, the circuit breaker assembly mounted on top of the cassette is pulled into the connected position.

The racking handle is inserted through an opening in the front of the compartment door as shown in Figure 3-2.

Installing SecoVac Vacuum Circuit Breaker into Switchgear Compartment

A. Place Circuit Breaker onto the Lift Truck

NOTICE

Maximum recommended lifting capacity for the lift truck is 700 lbs.

Before loading the SecoVac VCB onto the lift truck, assure that it is in the open position and with the springs discharged by checking the status of the indicators on the front cover.

1. Check the lifting and interlocking mechanisms of the lift truck for smooth operation, and inspect the cables in the hand winch system for any signs of damage, fatigue, or wear before operation.
2. To pick up a VCB from the floor level, first lower the lifting platform to the lowest position, Figure 5-2.



Figure 5-2. Lowered Lifting Platform

3. Adjust the rails on the hoist before loading the VCB. The rails are adjustable and have 3 sets of slots on each side of the hoist platform. These rails must be latched into the center most slots of the platform for proper operation to pick up the VCB, Figure 5-3.

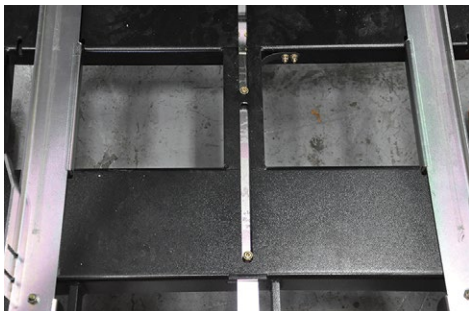


Figure 5-3. The Hoist Rail Slots

4. Move the lift truck in front of the VCB and lock truck in place using the floor lock shown in Figure 5-4. Now roll the VCB onto the rails of the lift truck. The wheels on the VCB should follow the rail guides.



Figure 5-4. Press the Front Pedal to Lock Lift Truck

5. The VCB should be pushed onto the rails until the locking tabs on the side lock into the slots on the hoist rails. Check that the locking tabs on both sides are engaged and locked into position on the lift truck rails, Figure 5-5. Once both tabs are locked into the slots, the VCB is ready to be lifted to the correct position for installation. Figure 5-6 shows properly loaded VCB locked in position, and compartment interlock in the retracted position.



Figure 5-5. SecoVac VCB Tab Locked in Lift Truck Slot



Figure 5-6. SecoVac VCB Properly Mounted on Lift Truck

- Release the floor lock by depressing the lever on the right or left-hand side of the floor lock and move the lift truck away, Figure 5-7.



Figure 5-7. Release Floor Lock

B. Insert Circuit Breaker into Switchgear Compartment

- Check the lifting and interlocking mechanisms of the lift truck for smooth operation, and inspect the cables in the hand winch system for any signs of damage, fatigue, or wear before proceeding.
- Open the SecoGear compartment door, and position the lift truck in front of the switchgear compartment.
- Turn the hand winch clockwise to raise, or counterclockwise to lower, the VCB into position, Figure 5-8. Adjust the height of the VCB to align with the guide slots located in the switchgear compartment, Figure 5-11.



Figure 5-8. Lift Truck Crank Handle



Figure 5-9. Cable Winch Spool



Figure 5-10. Cable Secured to Hoist



Figure 5-11. Lift Truck Arm (Left) Aligned with Switchgear Guide Slot (Right)

- Push the lift truck forward so that the rail guide arms fully engage the switchgear, Figure 5-12.



Figure 5-12. Lift Truck Guide Arm Stops

- Lock the lift truck in position by pressing down on the floor lock lever, Figure 5-13.



Figure 5-13. Press the Front Lever to Lock Lift Truck

6. Engage the compartment interlock onto the switchgear compartment. This operation requires a combination of steps shown on Figures 5-14 through Figure 5-16.

a. Push the operation handle until it is fully engaged in the switchgear compartment slot.

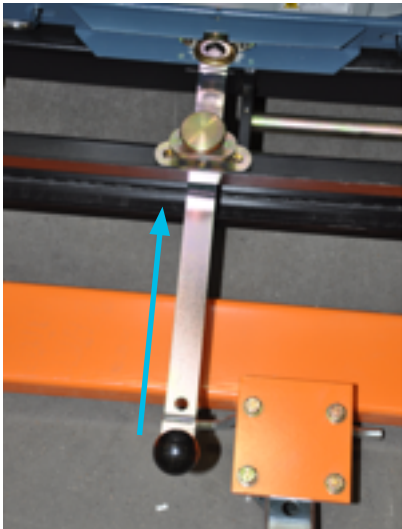


Figure 5-14. Operation Handle



Figure 5-15. Operation Handle Fully Engaged into Switchgear Compartment

b. Lock the operation handle into place by pressing down and rotating the interlock pin clockwise until it is fully engaged.



Figure 5-16. Press Down on the Interlock Pin and Rotate Clockwise to Lock the Latch Handle

7. To insert the VCB into the switchgear compartment, push the two locking handles on the front of the VCB inward (toward the center) to release from the lift truck and push the VCB onto the rails and into the switchgear compartment, Figure 5-17.



Figure 5-17. Unlock VCB from Lift Truck

8. Lock the VCB in the DISCONNECTED/TEST position using the spring-loaded locking handles, Figure 5-18. The tabs on the VCB will engage slots in the switchgear compartment rails



Figure 5-18. Lock VCB into Switchgear

1. Once the VCB is in the switchgear compartment, disengage the lift truck compartment interlock by rotating the interlock pin counterclockwise, Figure 5-19, then move the handle to the left and pull the latch handle toward you and from the switchgear compartment until it is fully retracted, Figure 5-20.



Figure 5-19. Rotate Interlock Pin Counterclockwise to Unlock the Latch Handle



Figure 5-20. Interlock Latch Handle

CAUTION

Verify that the VCB safety stop in the switchgear compartment has returned to the normal extended position.

2. Verify that the VCB safety stop has returned to the extended position, Figure 5-21. If necessary, release by inserting a screw driver into the slot to dislodge, Figure 5-22.



Figure 5-21. Stop in Proper Position

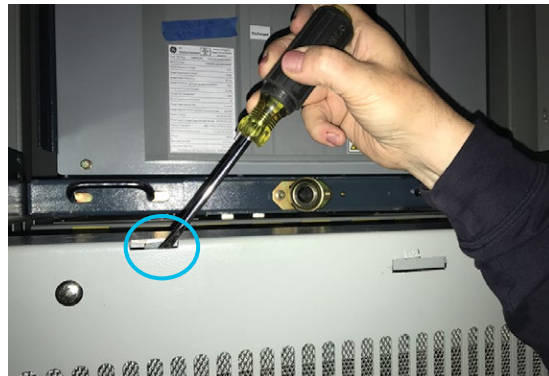


Figure 5-22. Eliminating Stop Interference

3. Release the lift truck floor lock by depressing the lever on the right or left-hand side of the floor lock and move the lift truck away from the switchgear, Figure 5-23.



Figure 5-23. Release Floor Lock

Removing the Circuit Breaker

The VCB must be open and in the DISCONNECTED/TEST position before proceeding.

1. Check that the position indicator flag in lower right front corner of compartment shows DISCONNECTED/TEST.
2. Ensure that the spring energy is discharged. Check that indicators on the VCB front cover show DISCHARGED and OPEN.
3. Disconnect secondary control power plug.
4. Position the lift truck in front of the switchgear compartment, and rotate the lift truck crank handle to adjust the height of the lifting platform such that the ends of the lift arms align with the guide slots just below the VCB rails in the switchgear compartment. (Turn clockwise to raise, counterclockwise to lower.)
5. Push the truck forward so that the transfer truck arms fully engage in the switchgear rail guide slots and the rail stops engage the switchgear. Lock the lift truck in position by pressing down on the truck locking pedal, Figure 5-13.
- 6. Engage the lift truck compartment interlock to secure the truck to the switchgear compartment.**
7. Push the two locking handles on the front of the VCB inward to unlock the VCB from the switchgear compartment, Figure 5-17.
8. Pull the VCB forward onto the lift truck rails and lock in position on the lift truck using the locking tabs on both sides of the VCB. Ensure they engage and lock into position, 5-5.
- 9. Release the lift truck compartment interlock.**
10. Release the floor lock of the lift truck, Figure 5-7, and move the lift truck away from the switchgear.
11. Lower the VCB to the ground.

Racking the Circuit Breaker to Connected Position

CAUTION

When racking the VCB from CONNECT to DISCONNECT, or DISCONNECT to CONNECT, do not stop or pause at any intermediate position. Failure to engage in either CONNECT or DISCONNECT position will render the VCB inoperable.

1. Connect the secondary plug of the VCB into the socket at the top of the switchgear compartment and lock it, Figure 5-24 and Figure 5-25.



Figure 5-24. Release Secondary Plug from VCB



Figure 5-25. Insert Secondary Plug and Lock into Switchgear Compartment Socket

2. Make sure the VCB is in open position. If it is closed, press the manual open pushbutton.
3. Close the door and insert the racking handle into the racking access hole located at the bottom of the door, Figure 5-26 and Figure 5-27, until the racking socket is engaged with the racking drive screw.
4. Turn the handle clockwise (approximately 20 turns) until it cannot be rotated any further.

CAUTION

Do not over torque the racking handle, applied force should not exceed 22.12 ft lb (30 N/m)

When it makes a clicking sound, the VCB is now in the Connected position. The VCB position indicator will change the status from "TEST" to "CONNECTED", Figure 5-29 through Figure 5-31.

Racking the Circuit Breaker to Disconnected/Test Position

CAUTION

When racking the VCB from CONNECT to DISCONNECT, or DISCONNECT to CONNECT, do not stop or pause at any intermediate position. Failure to engage in either CONNECT or DISCONNECT position will render the VCB inoperable.

1. With the VCB in the CONNECTED position and open, close the door and insert the racking handle, Figure 5-26, into the racking access hole located at the bottom of the door, Figure 5-27, until the racking socket is engaged with the racking drive screw.



Figure 5-26. Racking Handle

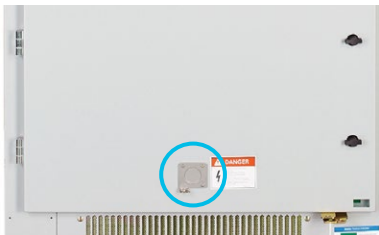


Figure 5-27. Racking Handle Insertion on Door



Figure 5-28. Access Hole Open

2. Turn the handle counterclockwise to drive the VCB out of the CONNECTED position. Do not stop turning until the indicator flag clearly shows DISCONNECTED.

As the VCB moves, the position indicator will change to reflect current position, Figure 5-29 through Figure 5-31, in the lower right front of the switchgear compartment.

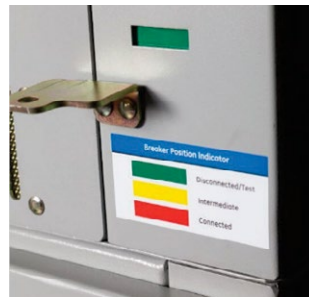


Figure 5-29. Disconnected/Test Position (Green)



Figure 5-30. Intermediate Position (Yellow)



Figure 5-31. Connected Position (Red)

For more information please refer to Publication#DEH-50001 SecoVac Vacuum Circuit Breaker Installation Manual.

6. Testing and Inspection

After equipment has been installed and all connections made, it should be tested and inspected before energizing. Although the devices have been tested at the factory, a final field test should confirm that the equipment has been properly installed and all connections are correct.

WARNING

The primary equipment should be completely de-energized while the tests are in progress.

Directions for testing relays, instruments, and meters are given in the instruction book furnished for each device. The proper settings of the protective relays and circuit breaker are normally determined from a complete power system coordination study performed by the purchasers or their consultant; therefore, the settings of these devices must be made by the purchaser.

The extent of the tests on the equipment as a whole will depend on the type and function of the equipment. Tests which should be performed, however, include circuit breaker operation, and switchgear meggering, phasing, and grounding checks.

High-potential tests to check the integrity of the insulation are not necessary if the installation instructions are carefully followed. If local codes demand this test or the purchaser wishes to make high-potential tests, the test voltage should not exceed

- 14 kV alternating current for 4.16 kV equipment
- 27 kV alternating current for 13.8 kV equipment

These voltages are 75% of factory test voltages, in accordance with IEEE standards.

WARNING

Voltage transformers, control power transformers and surge arresters must be disconnected during high-voltage testing.

Circuit Breaker Operation Test

All SecoGear circuit breaker compartments have a TEST position in which the circuit breaker primary contacts are disconnected while the secondary contacts are still engaged. This TEST position permits complete testing of the electrical control circuit without energizing the primary power circuit.

When the circuit breaker is first put into service, its control circuit must be thoroughly tested while in this position to make sure that all closing and tripping circuits are complete and functioning properly.

The TEST position is not suitable for inspection and maintenance of the circuit breaker and should therefore be used only for testing circuit breaker operation.

Refer to Publication#DEH-50001 SecoVac Vacuum Circuit Breaker Installation Manual for other preoperational checks on the breakers.

Circuit Breaker Test Jumper (Optional)

An optional test jumper catalog number BMBJ1 can be ordered, that will allow a breaker placed on the floor outside the cubicle to be tested utilizing the lineup control circuit and the breaker control switch on the compartment door. This jumper will connect the secondary disconnect plug on the breaker to the secondary disconnect coupler in the breaker compartment. Normal open and close operation can be verified by use of the control switch.

Circuit Breaker Test Box (Optional)

The test box (Figure 6-1) is used to operate a SecoVac VCB that has been removed from the switchgear compartment. It should be installed at a location where maintenance and testing of the circuit breaker can be conveniently done.

The customer must provide and install cables to supply control power for the test box. Make certain that the green ground conductor is connected to the electrical ground.

For more information on the use and operation of the Circuit Breaker Test Box, see publication DEH-500011.



Figure 6-1: SecoVac Test Box

7. Circuit Breaker Operation

Included below are abbreviated operating instructions for SecoVac vacuum circuit breakers. Before activation of the circuit breakers or operation of the switchgear equipment, thoroughly read and be familiar with the Publication#DEH-50001 SecoVac Vacuum Circuit Breaker Installation Manual.

Closing Operation

SecoVac vacuum circuit breakers are equipped with an integral charging handle and a “CLOSE” pushbutton on the front. The spring must be charged before the circuit breaker can be closed.

A complete charge is accomplished by manually pulling the handle down about 90° (until it stops) ten times to fully charge the closing springs. The closing spring will be charged automatically if the circuit breaker is in the TEST position (secondary plug connected) and control power is present.

The charge indicator will show CHARGED on a yellow background. The circuit breaker can be closed by pressing the manual CLOSE pushbutton on the front cover.

Opening Operation

A manually operated OPEN pushbutton mounted on the circuit breaker front cover, operates the trip shaft to open the circuit breaker.

8. Energizing The Switchgear

Before Energizing

Before energizing the switchgear, perform a thorough final check using the following checklist:

1. Circuit breakers and other operating mechanisms exercised.
2. Electrical insulation resistance tested phase-to- phase and phase-to-ground.
3. Relays, meters and instruments properly connected.
4. Electrically operated circuit breakers and operating mechanisms exercised.
5. Ground fault protection system tested.
6. Adjustable trips properly set.
7. Field wiring secured and free of live bus.
8. Grounding connections made.
9. All debris, scrap wire, etc., removed.
10. All covers installed, doors closed and latched.

CAUTION

Energizing switchgear for the first time is potentially dangerous. Therefore, qualified electrical personnel should be present when the equipment is energized. If problems caused by damage or poor installation practices have not been detected in the above checklist, serious damage can result when power is turned on.

9. Maintenance

Before Energizing

A periodic maintenance schedule must be established to obtain the best service from the switchgear. At minimum, you must perform an annual check of the switchgear devices and all connections. Equipment subject to highly repetitive operation may require more frequent maintenance.

Keep a permanent record of all maintenance work, including

- A list of periodic checks and tests made, along with the date
- The condition of the equipment
- Any repairs or adjustments

Maintenance employees must follow all recognized safety practices, such as those contained in NFPA 70B: Electrical Equipment Maintenance, and NFPA 70E: Standard for Electrical Safety in the Workplace and in company or other safety regulations.

WARNING

Solid insulation surrounding an energized conductor and power apparatus must never be relied upon to provide protection to personnel.

For specific information regarding the maintenance of devices such as circuit breakers, relays, and meters, refer to the manual provided with each device, or download the instructions from the manufacturer's website.

Circuit Breaker And Instrument Compartments

A circuit breaker inspection is recommended at least once a year. More frequent inspections are recommended where severe load conditions, dust, moisture, or other unfavorable conditions exist, or if the vital nature of the load warrants it.

Always inspect the circuit breaker after a short-circuit current has been interrupted.

Circuit Breaker Test for Proper Operation

Test and inspect all circuit breakers for proper operation as follows:

1. Operate each circuit breaker while in the TEST position and check all functions. This is particularly important for circuit breakers that normally remain in either the opened or closed positions for long periods of time.

WARNING

Primary equipment must be completely de-energized while conducting tests of control circuits. Be sure to disconnect all areas of backfeed from secondary circuits, as well as external sources.

2. Remove the circuit breakers from their compartments to a clean maintenance area.

Checks After the Circuit Breaker Is De-energized

WARNING

De-energize equipment completely before doing maintenance work on any devices, connections, bus work, circuit breaker, or feeder cable compartments. This includes de-energizing any connections to outside primary or secondary sources, such as transformers, tie lines, etc.

At the time of inspection after de-energizing the circuit breaker check each of the following items:

1. Manually operate the circuit breaker several times, checking for obstructions or excessive friction. Manual closing of an electrically operated circuit breaker may be performed by the following two steps:
 - a. To charge the mechanism springs, pull the operating handle down until it stops (about 90°) ten times. The charge indicator will show CHARGED on a yellow background.
 - b. Depress the CLOSE button on the front of the circuit breaker. The springs should discharge and, if the latch is properly reset, the circuit breaker will close.
 - c. Depress the OPEN button on the front of the circuit breaker.

2. Electrically operate the circuit breaker several times to check performance of the electrical accessories.
3. Visually check for loose hardware on the circuit breaker; also, check the bottom of the compartment for any hardware that has fallen from the circuit breaker.
4. Check insulating parts for evidence of overheating and for cracks that indicate excessive thermal aging.

Refer to Publication#DEH-50001 SecoVac Vacuum Circuit Breaker Installation Manual for detailed maintenance instructions and replacement of parts.

Lubrication

In general, the circuit breaker requires moderate lubrication. Bearing points and sliding surfaces should be lubricated at the regular inspection periods with a thin film of lubricant D6A15A2. Before lubricating, remove any hardened grease and dirt from latch and bearing surfaces with mineral spirits, then wipe with a clean rag.

CAUTION

Remove all excess lubricant with a clean cloth to avoid accumulation of dirt or dust.

The contact surface of the disconnect fingers should be cleaned and greased with lubricant D6A15A2.

Instruments, Components and Relays

1. Check and inspect all devices to see that they are functioning properly.
2. Check that all electrical connections are tight.
3. Check mounting of the device.

Under normal conditions, the protective relays do not operate; therefore, it is important to check the operation of these devices regularly. Refer to the Relay manual for detailed instructions.

Switchgear Interior

⚠ WARNING

De-energize equipment completely before doing maintenance work in compartments. This includes de-energizing any connections to outside primary or secondary sources, such as transformers, tie lines, etc.

1. Thoroughly clean the interior of the circuit breaker and instrument compartments. Use a vacuum cleaner and clean rags only. Do not use steel wool or oxide papers. Blowing with compressed air is not recommended.
2. Check indicating devices, mechanical and key interlocks.
3. Check primary disconnecting device contacts for signs of abnormal wear or overheating. Discoloration of the silvered surfaces is not ordinarily harmful. These contacts should be cleaned only by wiping with a lint-free cloth.
4. Clean the racking mechanism and lubricate with lubricant D6A15A2.

Before replacing the circuit breaker, wipe off the primary disconnecting device contacts. Apply a thin coat of lubricant D6A15A2 to the stationary studs and to the primary disconnects on the circuit breaker.

Main Bus Compartment

WARNING

De-energize equipment completely before doing maintenance work in compartments. This includes de-energizing any connections to outside primary or secondary sources, such as transformers, tie lines, etc.

The following instructions apply to SecoGear model number 3PVA0040020003, with two circuit breaker compartments. They are for reference only and may vary slightly for other configurations.

1. Remove the zero-sequence current transformer (CT) assembly and the arrester assembly, located in the middle of the rear panel.
2. Next, remove the partition plate.
3. With the partition plate removed, you now have access to take the chimney channel assembly out of the compartment.
4. Finally, remove the support plate and two cover plates to expose the main bus compartment.

Now, you have direct access to the main-bus compartment for maintaining and combining main busbars. When you have completed the maintenance, reverse these steps to reassemble the compartment.

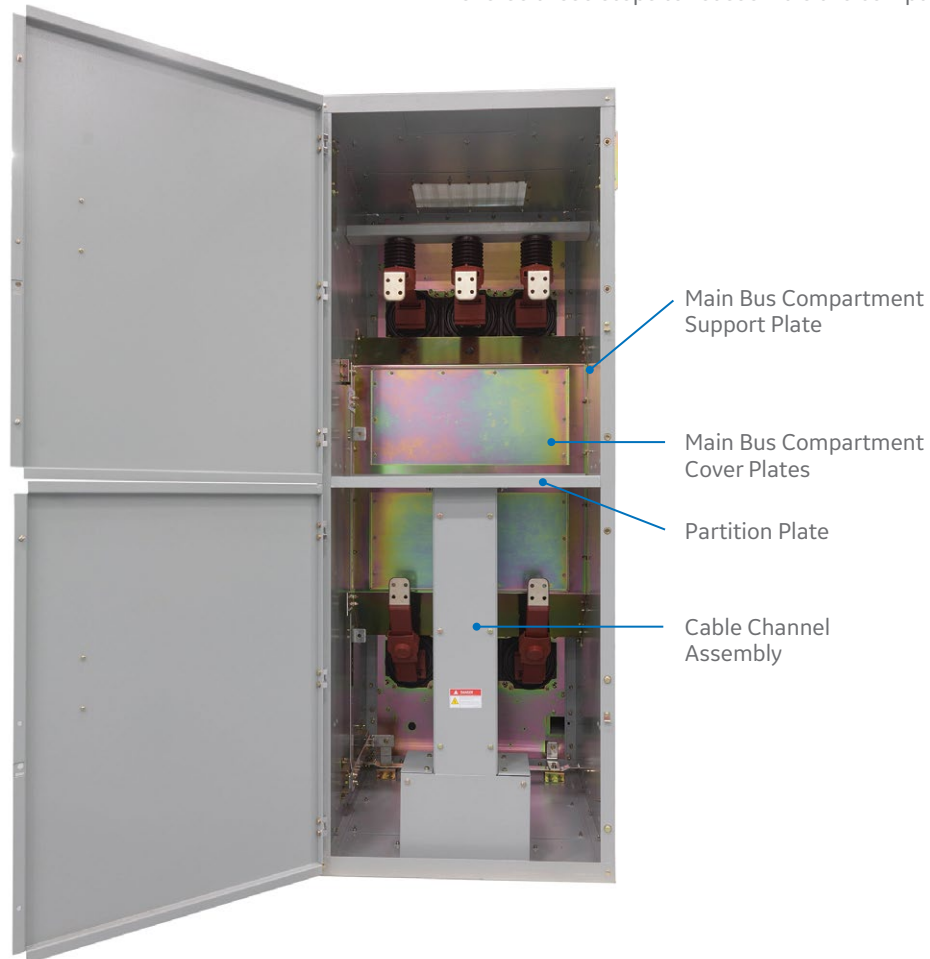


Figure 9-1: Rear Compartment Assembly Illustration

Replacing Current Transformers (CTS)

WARNING

Equipment must be de-energized before beginning any maintenance work to prevent electrical shock.

The CTs are mounted in the circuit breaker compartment. To access the CT assembly, de-energize SecoGear, open the front door, and remove the SecoVac VCB.

1. Prepare the CT for mounting by verifying the following items before proceeding:
 - Ratio
 - Polarity
 - Category number
 - Orientation per line diagram
2. Carefully raise and position the CT into the circuit breaker compartment.
3. Push the CT onto the spout until it is flush with the rear of the assembly (Figure 9-2). Repeat for any additional CTs.



Figure 9-2: CTs Mounted in Compartment

4. Install spacers behind CTs (Figure 9-4). Apply 7/8" spacers to single CT modules; apply 7/8" and 2" spacers (Figure 9-3) to piggyback CT modules.



Figure 9-3: CT Spacers, 7/8" (left) and 2" (right)

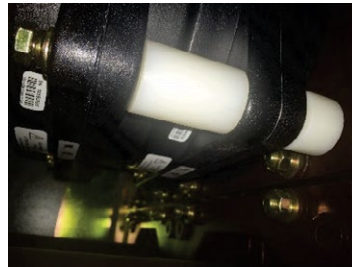


Figure 9-4: CT Spacers Installed

5. Secure CTs by installing bolts from the front, torque to 8 ft.-lbs [10.85 Nm].

Wire the CTs

1. Remove the wire ties from the CT wire harness, tape the harness edging, and route the wires through the upper wire channel/trough. Install the CT wire harness (Figure 9-5) to each CT individually.



Figure 9-5: CT Wire Harness in Compartment

2. Route and retain CT wires through the upper channels of the front of gear and connect to the Short Circuiting Terminal Blocks (Figure 9-6).



Figure 9-6: Shorting Terminal Blocks

3. Verify that the shutter operation (Figure 9-7) does not interfere with CTs or wire routings. Finally, tie the wire to the vertical support.

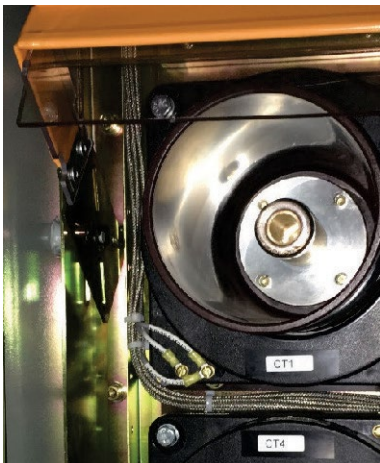


Figure 9-7: CT Installed, Shutters in Open Position

Overall Switchgear

Make the following checks on the complete switchgear equipment.

1. Clean and inspect all painted surfaces, and retouch where necessary.
2. Check to see that all anchor bolts and other structural bolts are tight.
3. Check that all circuit breaker and instrument compartment door latches operate properly.
4. If the switchgear is equipped with heaters, check to see that all heaters are energized and operating.
5. For exterior vent openings in equipment furnished with air filters, the foam filter elements should be removed and washed in warm soapy water, rinsed, and reassembled at least annually. Elements should be inspected before re-assembly and replaced if any signs of deterioration are evident.

Padlocks and Keylocks

SecoGear offers various padlocking features and optional keylock operation. In some cases, it is necessary to use more than one padlocking feature for proper lockout/tagout protection.

Circuit Breaker Racking Port Padlock Provision

The racking access port padlocking provision is located at the bottom and in the middle of the door (Figure 9-8).



Figure 9-8: SecoGear Manual Racking Port Padlocked

This lock prevents racking in a circuit breaker whenever the door is closed. The door padlocking provision, described below, must also be used to make sure the circuit breaker cannot be racked in by unauthorized personnel.

Door Padlock Provision

The compartment door has a padlock provision located in the lower right corner (Figure 9-9) to prevent opening the door to access the cubicle or install a circuit breaker.



Figure 9-9: Compartment Door Padlock

If a circuit breaker is already in the compartment, it can still be tracked into the connected position through the closed door unless the racking access port is locked out, as shown in Figure 9-8.

Shutter Padlock Provision

Shutter padlocking is available if you need to work in the cubicle but want to prevent the shutters from opening, and thus prevent racking a circuit breaker in.

There are two brackets to install padlocks (one on the left [Figure 9-10] side and one on the right) just beyond the barrier in the “high voltage” compartment of the cubicle.

In order for the shutters to open, both sides need to actuate, so you need to lock out only one side.

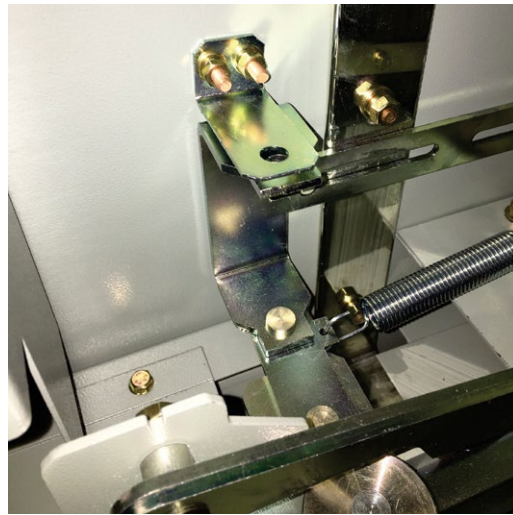


Figure 9-10: Shutter Padlock



Figure 9-11: Kirk Lock Location in SecoGear

Key Interlocks (Optional)

After initial installation of the switchgear equipment, insert all necessary interlock keys into the appropriate locks. Store all spare keys in accordance with the owner's established procedures.

Kirk Lock

Figure 9-11 shows the position of the Kirk lock. Turning the key 90° clockwise moves the Stopper Rod up (Figure 9-12 through Figure 9-13) and prevents the undercarriage from rolling.

By default, a Kirk lock having an Auxiliary switch turns NO to NC.



Figure 9-12: Initial Stopper Rod Position

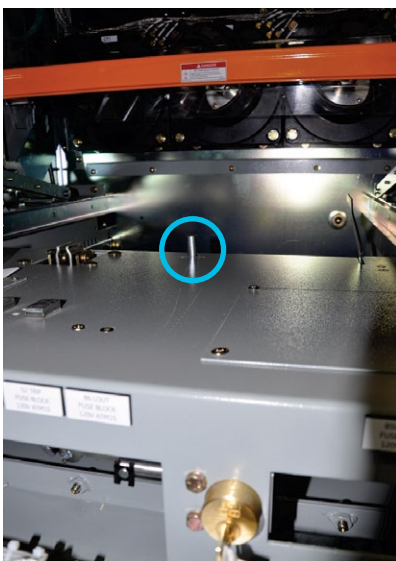


Figure 9-13: Locked Stopper Rod Position

CAUTION

Refer to the key interlock schematic included in the summary furnished with the equipment to determine the sequence of operation and the correct number of operating keys required. Improper use of spare keys will defeat the interlocking scheme.

Preferred Lock Out Tag Out Procedure (LOTO)

There are two basic methods to LOTO a circuit breaker from service. Option A below would be followed when the main bus is energized and only one circuit breaker is impacted. Option B below is to be used when the main bus and incoming source are not energized, and the substation is without power.

Option A)

Rack the selected circuit breaker to the TEST/DISCONNECT position. Check the mechanical circuit breaker position indicator before and after the racking operation to assure the circuit breaker operation has been performed. Unplug the secondary disconnect from the stationary cubicle connection point. Close the circuit breaker door and then install a padlock on the racking port cover to prevent insertion of a racking mechanism, and padlock the circuit breaker compartment door to prevent access to the selected circuit breaker compartment. Once the circuit breaker is racked to the Test/Disconnect position and padlocks are secured, this circuit breaker cannot be racked into the CONNECTED position and the compartment cannot be accessed. Requires 2 distinct padlocks.

Option B)

Eliminate all sources of power to the substation. Rack the circuit breaker out, disconnect the secondary coupler, then remove the circuit breaker from the compartment. Once the circuit breaker has been removed, padlock the shutters in the closed position. This will prevent inserting a circuit breaker into the CONNECTED position. Padlock or Tagout the circuit breaker compartment door, to prevent insertion of a circuit breaker or connection of the secondary disconnect by unauthorized personnel. Require minimum of 1 padlock.

Paint Refinishing

Indoor switchgear is finished with durable powder coat paint finish. To refinish damaged areas, remove all loose paint, rust, scale, oil or grease. Sand any scratches smooth using 220 grit paper or finer.

Touch up the repaired area using the touch up paint included with the equipment. If major repair is necessary, replacement parts may be necessary.

Application of special paint will be per the manufacturer's Product Data Sheet, which includes instructions on thinning and application.

Circuit Breaker Lift Truck

Under normal conditions, no special maintenance procedures or lubrication is required for this device. If the cable is abraded under any condition, it should be inspected for broken strands or other damage and replaced if necessary.

10. Repair And Replacement

Circuit Breaker Troubleshooting

Table 10-1: Diagnosis and Troubleshooting for Malfunctioning During Operations

MALFUNCTION	POSSIBLE CAUSE	SOLUTION
The circuit breaker cannot be racked into connected position from test position	The racking handles on the circuit breaker are not in position	Adjust the frame and handles
	The circuit breaker is closed	Open the circuit breaker
	Shutter is not completely open	Visually check shutter drive mechanism
	Secondary plug is disconnected	Insert the secondary plug
The circuit breaker cannot be racked out to test position from connected position	The circuit breaker is closed	Open the circuit breaker
The circuit breaker cannot be closed	The secondary plug is not inserted	Insert and lock secondary plug
	No control power supply	Turn on control power supply
	The circuit breaker is not fully in test/connected position	Rack circuit breaker to test or connected position
	The closing spring has not been charged	Charge the closing spring
The circuit breaker cannot be opened	No control power supply	Turn on control power supply
	Opening coil not working	Check power supply for opening release

For help with the following removal and replacement operations, refer to Publication#DEH-50001 SecoVac Vacuum Circuit Breaker Installation Manual

- Closing mechanism
- Vacuum bottles
- Counter
- Spring charge indication switch
- Shutter mechanism

Circuit Breaker Spare Parts

For spare part details, please refer to Publication#DEH-50001 SecoVac Vacuum Circuit Breaker Installation Manual.

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www.electrification.us.abb.com/services

For service, call:

1-888-434-7378 (US)

1-540-387-8617 (International)

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