

Instructions for installation, operation, and maintenance of 5/15 kV type VacClad-W arc resistant metal-clad switchgear



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⚠ WARNING

HAZARD OF ELECTRICAL SHOCK OR BURN. OPERATING THE SWITCHGEAR ASSEMBLY OUTSIDE OF ITS RATINGS MAY CAUSE FAILURE RESULTING IN PROPERTY DAMAGE, SEVERE PERSONAL INJURY, OR DEATH. THE SWITCHGEAR ASSEMBLY MUST BE OPERATED WITHIN ITS NAMEPLATE RATINGS.

⚠ WARNING

HAZARDS OF ARC FLASH, ARC BLAST, AND ELECTRIC SHOCK EXIST WHEN THIS EQUIPMENT IS ENERGIZED, WHICH MAY LEAD TO DEATH OR SEVERE INJURY.

ALL WORK ASSOCIATED WITH THIS ELECTRICAL EQUIPMENT MUST BE PERFORMED ONLY BY QUALIFIED PERSONNEL AS DEFINED IN NFPA-70. CONSULT NFPA-70E, OSHA, AND ANY OTHER APPLICABLE REGULATION PERTAINING TO OPERATOR SAFETY PRIOR TO SERVICING EQUIPMENT. THE QUALIFIED PERSONNEL MUST FOLLOW ALL APPLICABLE PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS.

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VERIFY NO VOLTAGES ARE PRESENT ON ALL INCOMING AND OUTGOING CONDUCTORS, AND ANY ENERGY SOURCES CONTAINED WITHIN THE EQUIPMENT PRIOR TO SERVICING, THEN GROUND (CONNECT TO EARTH) ALL INCOMING AND OUTGOING CONDUCTORS ATTACHED TO THIS EQUIPMENT AND TO ANY INTERNAL ENERGY SOURCES.

⚠ DANGER

ALL APPLICABLE SAFETY CODES, SAFETY STANDARDS, AND SAFETY REGULATIONS MUST BE ADHERED TO WHEN INSTALLING, OPERATING, OR MAINTAINING THIS EQUIPMENT.

Section 1. Introduction

1.1 Purpose

This instruction bulletin covers the installation, operation, and maintenance of a 5/15 kV Type VacClad-W Arc Resistant Metal-Clad Switchgear Indoor Housing Assembly. It is not encompassing of all possible contingencies, variations, and details that may arise during installation, operation, or maintenance of this equipment.

1.2 Application and description

The Eaton 5/15 kV type VacClad-W arc resistant metal-clad switchgear indoor housing assembly provides centralized control and protection of medium voltage power equipment and circuits in industrial, commercial, and utility installations involving generators, motors, and feeder circuits. Arc resistant switchgear provides additional protection in the event of an internal arcing fault. Eaton's arc resistant switchgear meets or exceeds ANSI/IEEE C37.20.2 as they apply to metal-clad switchgear and IEEE Guide C37.20.7 for arc resistant rating type 2B. The assemblies also conform to CSA C22.2 No. 31. type VCP-W vacuum circuit breakers meet or exceed all ANSI and IEEE standards applicable to AC high voltage circuit breakers rated on a symmetrical current basis. The switchgear also exceeds all seismic requirements contained in the International Building Code and the California Building Code.

1.3 Documentation reference

Refer to the customer drawing package for order specific information. For further information on installation and application, refer to the applicable technical data, publications, and/or industry standards. Download Eaton electronic information from www.eaton.com.

For receiving, handling, storing and installation instructions: IB022014EN.

For plenum and duct installation: IB48077.

For VCP-W breaker: IB131006EN.

For switchgear mounting to a foundation: Job Floorplan Document.

For breaker lifting device: IB02100002E.

For sample Ground and Test Device: Refer to document received with the device.

For AMPGARD medium voltage motor control centers: IB48076.

1.4 Eaton contact information

For additional information about Eaton products please call 1-800-525-2000 or log onto www.eaton.com. Additional Medium Voltage Switchgear information regarding Pricing/Aftermarket, Customer Service, Engineering/Technical Information, or Warranty, can be found by calling 1-800-345-4072.

Eaton Electrical Services and Systems (EESS) can be reached at 1-800-498-2678.

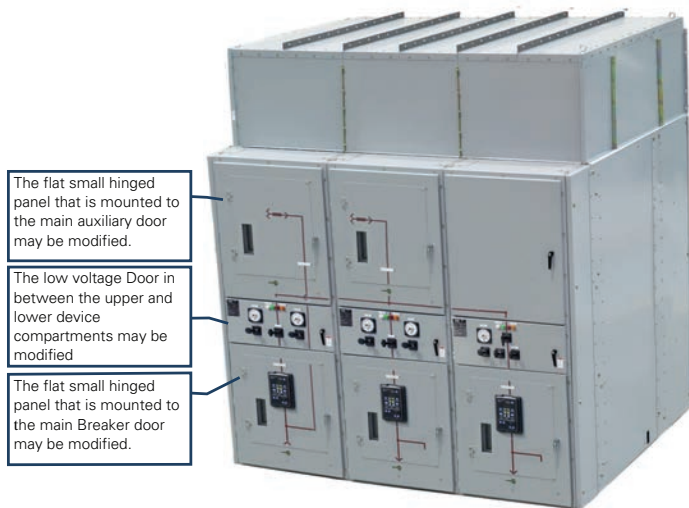
If further information is desired regarding this particular installation or application information, contact the local Eaton sales office, reference Eaton's Consulting Application Guide, or the appropriate industry standards.

1.5 Modifications to switchgear

⚠ CAUTION

MODIFICATIONS TO THE SWITCHGEAR ENCLOSURE CAN COMPROMISE THE ARC RESISTANT PROPERTIES OF THE SWITCHGEAR. DOORS THAT OPEN TO ENCLOSED LOW VOLTAGE COMPARTMENTS ARE THE ONLY PARTS THAT MAY BE MODIFIED FOR MOUNTING COMPONENTS DUE TO THE TYPE 2B ARC RESISTANT RATING. THESE DOORS ARE FOUND IN FRONT OF THE RELAY BOX AND SOMETIMES IN THE MIDDLE SECTION, BUT THIS EXCEPTION NEVER INCLUDES THE MAIN CELL DOOR OR ANY SIDE SHEETS. ANY OTHER MODIFICATION COMPROMISES COMPLIANCE WITH IEEE C37.20.7. PLEASE CONTACT THE FACTORY WITH ANY RELATED QUESTIONS.

Panel modifications



The flat small hinged panel that is mounted to the main auxiliary door may be modified.

The low voltage Door in between the upper and lower device compartments may be modified

The flat small hinged panel that is mounted to the main Breaker door may be modified.

The steel that is revealed when opening these modifiable panels may not be modified under any circumstances.

Figure 1. Panel Modifications.

1.6 Safety precautions

⚠ WARNING

ONLY QUALIFIED ELECTRICAL PERSONNEL WITH TRAINING AND EXPERIENCE ON HIGH VOLTAGE APPARATUS SHALL BE PERMITTED TO WORK ON THIS EQUIPMENT. THEY SHALL BE FAMILIAR WITH THE WORK TO BE PERFORMED, AS WELL AS INDUSTRY AND LOCAL SAFETY PROCEDURES AND STANDARDS.

1. Read and understand these instructions before attempting installation, operation, or maintenance of the switchgear assembly.
2. Disconnect all low voltage and medium voltage power sources to the switchgear assembly before working on the equipment per Occupational Safety and Health Act (OSHA) and lockout procedures. Verify that the voltage has been removed. Ground load and line side connections. Observe National Electrical Code (NEC), OSHA, and local procedures and standards. This includes visual inspections while any door is open, making any adjustments inside or outside the enclosure, performing maintenance, or installing replacement parts.
3. Never leave a breaker in an intermediate position in its compartment. Always continue to lever the breaker to the fully connected position, the "TEST" position, or fully withdrawn position. Do not attempt to open the door unless the breaker is in the disconnect position.
4. Never try to disconnect or open the secondary circuit of a current transformer that is generating secondary current. In this situation, the transformer develops a dangerous high voltage across the secondary terminals.

⚠ CAUTION

BEFORE ATTEMPTING ANY WORK, EITHER DE-ENERGIZE AND GROUND THE CIRCUIT BY OPENING THE BREAKER OR SHORT-CIRCUIT THE SECONDARY OF THE CURRENT TRANSFORMER.

5. The user is responsible for conforming to all applicable code requirements with respect to grounding the switchgear assembly.

⚠ CAUTION

BEFORE ENERGIZING THE SWITCHGEAR ASSEMBLY, ENSURE THAT THE FOLLOWING ITEMS 6 THROUGH 10 ARE TRUE.

6. The switchgear assembly is secured on a true and level surface according to the floor plan of the customer drawings.
7. Confirm all hardware is in place and tightened per Table 3.
8. Confirm no tools or objects are left inside the enclosure.
9. Confirm all devices, covers, doors, panels, etc., are secured.
10. Before start up, perform a field power frequency withstand (Hi-Pot) test, using test voltages given in Table 1.

Table 1. Power Frequency Withstand Test Voltages.

| Rated Maximum Voltage (kV) | Power Frequency Withstand (rms) (kV) |
|----------------------------|--------------------------------------|
| 4.76 | 14.25 |
| 8.25 | 27 |
| 15.0 | 27 |
| 27.0 | 45 |
| 38.0 | 60 |

11. For additional safety information and safe-use practices for your VCP-W circuit breaker, refer to IB131006EN.

Section 2. Installing indoor switchgear

For information regarding the receiving, handling, storing, and installation of the equipment, please reference IB022014EN: Instructions for receiving, handling, storing and installation of medium voltage switchgear, in addition to the customer drawing package. Instruction bulletins and drawings are located inside the upper compartment door of the first vertical section.

The detail box contains kits, bus, splice-plates, boots, tape kits for taping cable to riser joints, and hardware required for installation of the switchgear.

2.1 Floor requirements

The finished foundation surface shall be flat and level within 0.06 inch (1.6 mm) in 36 inches (914 mm) in any direction, left to right, front to back, and diagonally. Alternatively, a local flatness "FF" value of 50 or higher and an accompanying "FL" value of 37 to 40 as defined in industry standard ASTM-E1155-96 and industry standard ACI 117-90 may be used to establish the flatness and levelness of the finished foundation.

2.2 Power cable installation or close-coupling with other equipment

When connecting power cables to metal-clad switchgear, or when connecting metal-clad switchgear to other equipment (for example, MV MCC, power transformer, non-seg bus duct), all connection points must be insulated after the connections are made (refer to the section on Field taping procedure for general guidance), and minimum electrical clearances between live parts in adjacent phases (phase-to-phase) and from live parts to ground (phase-to-ground) as recommended in Table 2, must be maintained to preserve dielectric withstand capability of the metal-clad switchgear.

Table 2. Minimum Clearance Chart for Insulated Connections.

| kV Rating of the MVA Switchgear | Phase-to-Phase in. (mm) | Phase-to-Ground in. (mm) |
|---------------------------------|-------------------------|--------------------------|
| 5 | 3 (76.2) | 3 (76.2) |
| 15 | 3.5 (88.9) | 3.5 (88.9) |

2.3 Installation procedure

Step 1

Bolt the groups together through the tie bolt holes, leaving the hardware loose, until all sections are placed using the following procedure.

- A. Obtain the tie bolt hardware kit located in the Shop Order Detail Box. Install a flat washer on bolt end, insert the bolt through a hole, then install a flat washer, split-lock washer, and nut. Torque the hardware per the specifications contained in Table 3 once all the units are placed

Table 3. Bolt Tightness Values for All Hardware Connections.

| Bolt Size inches (mm) | 0.25 (6.35) | 0.31 (7.87) | 0.38 (9.65) | 0.50 (12.7) | 0.62 (15.75) |
|-----------------------|-----------------------------------|-------------|-------------|-------------|--------------|
| Bolt Material | Torque Value in Foot Pounds (N•m) | | | | |
| High-strength Steel | 5 (6.78) | 12 (16.27) | 20 (27.12) | 50 (67.8) | 95 (128.82) |
| Silicon Bronze | 5 (6.78) | 10 (13.56) | 15 (20.34) | 40 (54.24) | 55 (74.58) |

- B. Remove the rear covers or open the rear doors (if applicable) of the cells on the side of the shipping split. Install tie bolts between the shipping splits. Refer to Figure 2 for the tie bolt locations. Bolt holes #13 - #20 can be accessed from the rear module.
- C. Open all the front doors. Refer to Figure 2 for the tie bolt locations. Insert and tighten the tie bolts between the front upright members at each shipping split. Bolt holes #1 - #12 can be accessed from the front module.

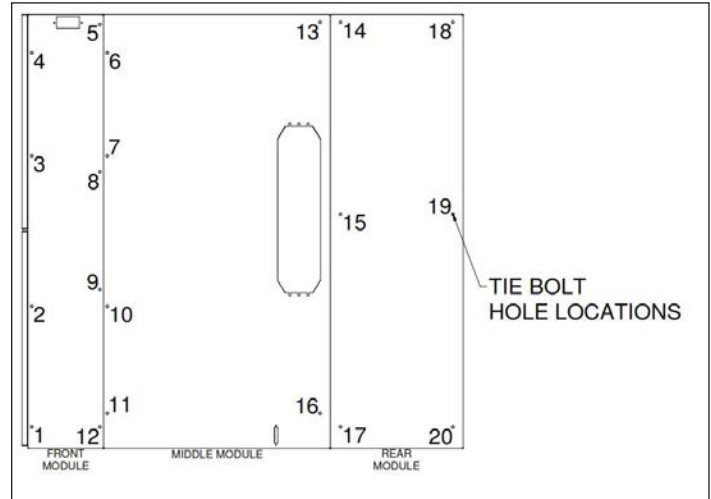


Figure 2. Typical Tie Bolt Locations.

Step 2

Check the entire lineup to make sure it is level and plumb prior to securing the switchgear base to the foundation.

Step 3

Remove all shipping blocks or braces located inside the switchgear.

- A. Remove all shipping bracing (painted yellow) for dynamic flaps, components, and bus support.
- B. Examine all meters, relays, etc., and remove any shipping blocks or braces.
- C. Remove the lifting angles from top of the units and discard them.

Step 4

Connect the ground bus.

- A. The standard ground bus is a 0.25 in. x 2 in. (6.4 mm x 50.8 mm) copper bus bar bolted to the cross members of the frame in the bottom of each switchgear unit. The ground bus runs through the center of each unit, through the length of the entire switchgear assembly. Install a ground link and hardware (ground link located in detail box) to connect the shipping sections. Tighten connections per Table 3.



Figure 3. Ground Bus Installation.

- B. Connect the switchgear assembly to the station ground conductors. Solderless terminals are provided on the ground bus at each end of the switchgear assembly for this purpose. The connection shall be made as direct as possible. The connection shall be large enough to carry the ground fault current of the installation. NEVER encase the ground bus in a metal conduit.

⚠ CAUTION

THE SWITCHGEAR INSTALLATION MUST BE PROPERLY GROUNDED.

Note: For the design and installation of a grounding system, refer to Electrical Power Distribution for Industrial Plants (IEEE Std 141); Grounding of Industrial and Commercial Power Systems (IEEE Std 142); and the NEC, Articles 100, 200, and 250.

For generating stations and larger substations, the ground resistance should be 1 ohm or less. For industrial plants and small substations, the ground should be less than 5 ohms (the NEC states that the ground resistance should never exceed 25 ohms).

Step 5

Connect the high-voltage bus between the shipping sections.

- A. Remove the horizontal metal barriers from the cable compartment in the rear of the switchgear. Remove the bus barriers (same as removed in earlier steps). Also remove any other components such as cable termination devices, surge protection devices, etc., that interfere with access to the bus compartment.

Note: The rear assembly of switchgear may vary. Figures 3 and 4 show the removal of the necessary barriers.



Figure 4. Main Bus Installation with Bus Barriers Installed. Viewed from Rear with Doors Open (Typical 1-High Construction Shown).



Figure 5. Main Bus Installation with Bus Barriers Removed.

- B. Obtain the pieces of bus for connecting the applicable shipping group. Each section is labeled and shipped in the carton with the Detail Box.

- C. The surfaces in the bus joints are plated. Clean the plated surfaces of the bus section with isopropyl alcohol if necessary.

Note: Plating may show signs of tarnish over time. This does not affect the functionality.

- D. Slide the section of main bus through the supports in the side of the vertical section. Slide the rubber snubber along the bus until it fits inside the opening in the bus support.

The splice plates and hardware are bolted to the end of the bus in each of the adjoining vertical sections. Sandwich the end of the bus bar between the splice plates and fit the other end of the section between the splice plates on the end of the bus in the adjacent section. Bolt the splice plates together on each end of the bus section (see Figure 5). Do not tighten until all joints throughout the line-up are installed.

⚠ WARNING

USING THE WRONG HARDWARE MAY RESULT IN REDUCED CLEARANCE AND / OR MAY CAUSE DAMAGES.

- E. Repeat these steps for each section of bus at each shipping break.
- F. Torque the bolts in the bus joint to the values shown in Table 3. Make sure all structure and tie bolts (see Steps 3 and 4) are torqued prior to torquing bus-joint bolts.
- G. Install the boots over the bus joint at shipping splits.

Step 6

Connecting the internal control wiring and wiring which connects to external equipment.

- A. Reconnect the internal control wiring that was disconnected at the factory for shipping. The wiring as well as the connecting points are labeled.
- B. Connect the wiring from external equipment to the terminal blocks located in the centrally located small control compartment, or within the upper front compartment or the lower front compartment of the vertical section inside the arc resistant hinged doors as shown on the switchgear electrical connection diagrams.

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- C. Do not modify the switchgear enclosure in any way in order to connect control wiring. When wiring connections which pass between low voltage and medium voltage sections within a switchgear section, use the openings provided.
- D. Once the wiring is completed, reseal the openings through which the wiring passes. There are two types of sealing systems: one is a non-adjustable opening (see Figure 6A) and the other is an adjustable opening (see "Figure 6B. Adjustable - High Voltage Side" and "Figure 6C. Adjustable - Low Voltage Side"). Refer to the applicable section that follows to complete this process.



Figure 6A. Caulk Filling Between Low and Medium Voltage Sections.



Figure 6B. Adjustable - High Voltage Side.

Instructions for installation, operation, and maintenance of 5/15 kV type VacClad-W arc resistant metal-clad switchgear



Figure 6C. Adjustable - Low Voltage Side.

Fixed opening

- E. If it is necessary to install additional wiring between any sections in the front of a switchgear vertical section, it is necessary to remove the factory installed caulk, install additional wiring, then reapply caulk as described in paragraph F or paragraph G below.
- F. Fill all wiring openings through which wiring passes from the center mounted control compartment to the upper front compartment or to the lower front compartment (see "Figure 6A. Caulk Filling Between Low and Medium Voltage Sections."). Bundle wires together on each side of the opening with a wire tie prior to applying caulk (silicone sealant certified to MIL-A-46106, Type I).
- G. Fill all wiring openings through which wiring passes from the center mounted low voltage compartment to medium voltage compartments with caulk as shown in Figure 6A. Bundle wires together on each side of the opening with a wire tie prior to applying caulk (silicone sealant certified to MIL-A-46106, Type I).

Adjustable opening

- H. If it is necessary to install additional wiring between any sections in the front of a switchgear vertical section, or to install wiring from external equipment, it is necessary to disassemble the wiring pass-through system, install additional wiring, then reassemble the wiring pass-through system as described in paragraph I or paragraph K below.
- I. Wrap gasket material 1C19549H01 at least 1½ times around the wire bundle where it passes through the opening of the pass-through system.
- J. Slide the movable plate of the pass-through system until the gasket is compressed and fills the opening completely. Tighten hardware to fasten the plate in place.
- K. Place a 3/16" wide wire tie about 1/2" (12.7 mm) from the edge of the gasket material on each side of the opening.

Customer installed external control wiring entering the top or bottom of a switchgear vertical section

M. For top entry of external low voltage conductors, there are two removable cover plates (see "Figure 6D. External Control Wiring Plate.") on the top front of each vertical section. Water-tight conduit hubs or water-tight gland fittings must be mounted in the cover plates to pass multi-conductor jacketed cables or multiple unjacketed wires ran in conduits into the switchgear. If bundled unjacketed conductors are to be brought into the front section of the switchgear, they must be brought through a water-tight conduit hub in a workmanship manner (protection of insulation), then the conductors must be bundled together and conduit hub filled with caulk as described for the internal wiring in paragraphs F and G above.



Figure 6D. External Control Wiring Plate.

N. For bottom entry of external low voltage conductors, there are two removable cover plates on the floor of the front of a vertical section. For any foundation method it is the responsibility of the customer to provide a suitable means to seal to prevent escape of arc products or accommodate the escape of arc products through the cutouts made in the cover plates. Sub-paragraphs a and b following are suggestions for two commonly encountered foundations.

- a. For switchgear installed on a concrete slab foundation, conduits are typically installed prior to the switchgear being set in place. For this situation, it is recommended the cover plates be cut to clear each conduit, reinstalled and sealed with caulk around the perimeter of the conduit, and around the wires or multiple conductor cables entering each conduit.
- b. For switchgear installed on a steel floor, conduits may be installed prior to installation of the switchgear or after switchgear is installed. In this case, it is recommended the same procedure be followed as described in paragraph M for conduits, jacketed multiple conductor cables, or bundled unjacketed conductors.

Step 7

Replace the metal barriers and any other parts that may have been removed to gain access to the main bus compartments.

Step 8

Connect the main power cables.

A. Before connecting a cable, determine its phase. The switchgear system is supplied with connections for phasing 1-2-3, left to right (viewed from the front) unless indicated otherwise on the shop order drawings.

- B. If two systems are to be paralleled, make sure the phase rotation and the phase angles match. They must be the same to prevent damaging the equipment. The phase rotation must conform to the phase rotation on the shop order drawing so that the instruments, meters, and relays will operate properly.
- C. When forming cables to fit inside the cable compartment, avoid sharp bending or kinking. Make sure cables do not rest on sharp corners or edges that could damage the insulation.
- D. Follow the instructions of the cable manufacturer to determine what minimum bending radius is permitted. Follow the instructions on insulating the joints so the insulation will taper properly through the correct gradient. The insulation will vary with the type and size of cable and with the service voltage for which it was designed.
- E. NEMA 2 hole patterns are usually furnished. The connection must be insulated according to the recommendation of the cable manufacturer.
- F. If potheads or other types of terminators are furnished, follow the instructions of the manufacturer when connecting the cable to them. Tape (or otherwise insulate) the entire joint, including the flexible connectors (see the "Metal-clad switchgear field sequence current transformer connections" section of this manual).
- G. If zero sequence transformers are used, pass the power cables through the transformer (refer to Figure 58) for proper installation.
- H. Replace all metal barriers, vertical section of the bus barrier, and any other components removed during installation of the high-voltage bus at shipping splits. Replace them in the reverse order in which they were removed.
- I. Close all hinged rear covers then install and tighten all bolts (refer to Figure 7A and 7B).



Figure 7A. Assembled Switchgear (Shown with Rear Doors Opened).

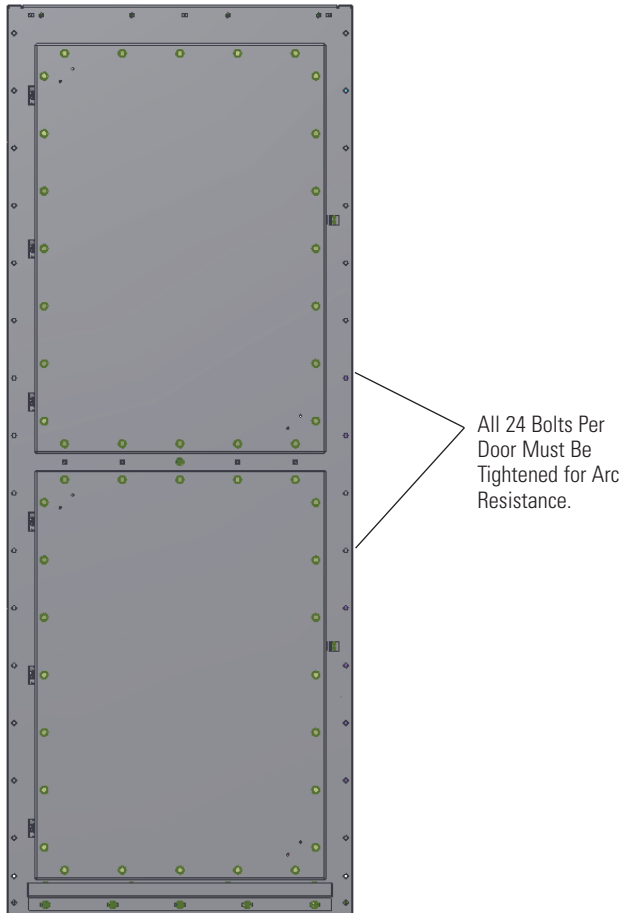


Figure 7B. Assembled Switchgear (Shown with Rear Doors Closed).

Step 9

5/15 kV arc exhaust assembly instructions.

Refer to IB48077 for arc exhaust plenum and duct assembly instructions.

Step 10

Inserting breaker.

A Lower compartment direct roll-in-breaker.

Push the breaker into the breaker compartment until the breaker T-handle latches over the moving block on the levering screw assembly. In this position, the breaker is considered in the Disconnect position.

B Upper compartment or non-direct roll-n-breaker.

1. The breaker compartment has an interlock assembly on the compartment levering assembly, located on both the left and right hand rail assemblies. The purpose of the interlock assembly is to prevent the breaker from being removed from the compartment without the extension rails in place.

2. In order to insert or remove a breaker, a set of extension rails must be inserted into the left hand and right hand rail assemblies. This is achieved by inserting the appropriate rail, identified with a label, diagonally into the slot such that the extension rail, when lowered, unlocks the interlock allowing an installed circuit breaker to roll forward. The rolling surfaces of the compartment rail and extension rail are flush.
3. In this position, the breaker can be inserted or removed from the breaker compartment (see Figures 8A and 9).

Note: If circuit breakers are equipped with casters for rolling directly from the floor to the breaker compartment, then only the upper compartments will contain the safety interlock assemblies. In order to remove or install a lower circuit breaker equipped with "Direct-Roll-In" casters you must remove the bracket shown in Figure 8B. These brackets **MUST** be re-installed with the circuit breaker in place in order to provide arc resistant protection per IEEE C37.20.7.

Step 11

Checking pan operation.

A Close and secure the breaker cell door. The door is secured when the visual indication flag (seen through the breaker position viewing window), displays the green "Door Secured" indication (see Figure 13).

B To operate the breaker at this time (test position mode), it is necessary to connect the secondary harness with the breaker.

Automatic secondary: For an automatically engaged secondary harness, rack the breaker into the test position identified by the Breaker position indication (BPI) label.

In these positions, the breaker control circuit can be tested offline. (Breaker is not connected to the primary circuit.)

C Movement of the breaker from the Disconnect or Test position to the Connect position.

1. As the breaker is racked from Disconnect or Test, it will automatically open if it is closed.
2. To prevent damage with a manually engaged secondary, the breaker secondary control plug must be manually engaged with the receptacle on the compartment levering system, before the breaker is moved to the connected position.
3. Rotate the levering crank in a clockwise direction until the indicator located on the left hand picture frame can be seen through the breaker door viewing window, or until the breaker cover plate aligns with the connect position location given on the BPI label (item 8) if so equipped.

D Movement of the breaker from the Connect position to the Disconnect or Test position:

1. As the breaker is racked from Connect, it will automatically open if it is closed.
2. Insert the levering crank onto the hex drive nut on the levering system. In order to engage the hex drive nut, you must push in the levering system slider.
3. Rotate the levering crank in a counter-clockwise direction until the breaker is in the Test or the Disconnect position.

Note: The breaker secondary control receptacle on the compartment levering system is automatically disengaged from the breaker secondary plug when moved to the Disconnect position.

4. The breaker compartment door can only be opened when the breaker is in the Disconnect position.

Step 12

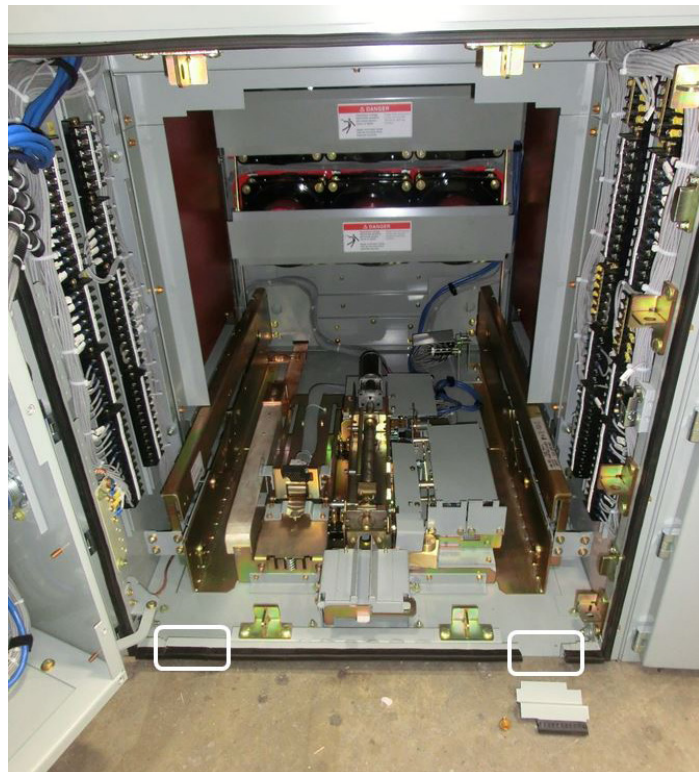
Test the breaker and cell interface per IB131006EN. This applies to both the direct roll-in breakers and non-direct roll-in VCP-W circuit breakers.



Figure 8A. Insertion of the Draw-out Extension Rails.



Figure 9. Lifting and Setting the Breaker in the Housing.



These brackets must be removed to insert or remove a circuit breaker. **These brackets must be re-installed** with the circuit breaker in place in order to provide arc resistant protection per IEEE C37.20.7.

Figure 8B.

Step 13

Check the drawout voltage transformers, control power transformers, or fuse truck assemblies in the auxiliary compartments.

A. Inserting of the extension rails.

1. The drawout auxiliary assembly compartment has a safety interlock assembly on the compartment levering assembly, located on both the left and right hand rail assemblies. The purpose of the interlock assembly is to prevent the drawout auxiliary assembly from being removed from the compartment without the extension rails in place (see Figure 8A).
2. In order to insert or remove a drawout auxiliary assembly, a set of extension rails must be inserted into the left hand and right hand rail assemblies. This is achieved by inserting the appropriate rail, identified with a label, diagonally into the slot such that the extension rail, when lowered, unlocks the interlock, allowing an installed drawout auxiliary assembly to roll forward. The rolling surfaces of the compartment rail and extension rail are flush.
3. In this position, the breaker can be inserted or removed from the auxiliary compartment (see Figures 8A and 9).

B Installing the draw out assembly in the auxiliary compartment (usually shipped installed).

1. Using a portable lifting device, place the drawout assembly onto the extension rails. (See Figure 10 for typical lifting of a draw out device and Figures 40 and 41 for typical auxiliary drawers mounted on the extension rails). Ensure all four wheels are on the extension rails before removing the yoke.

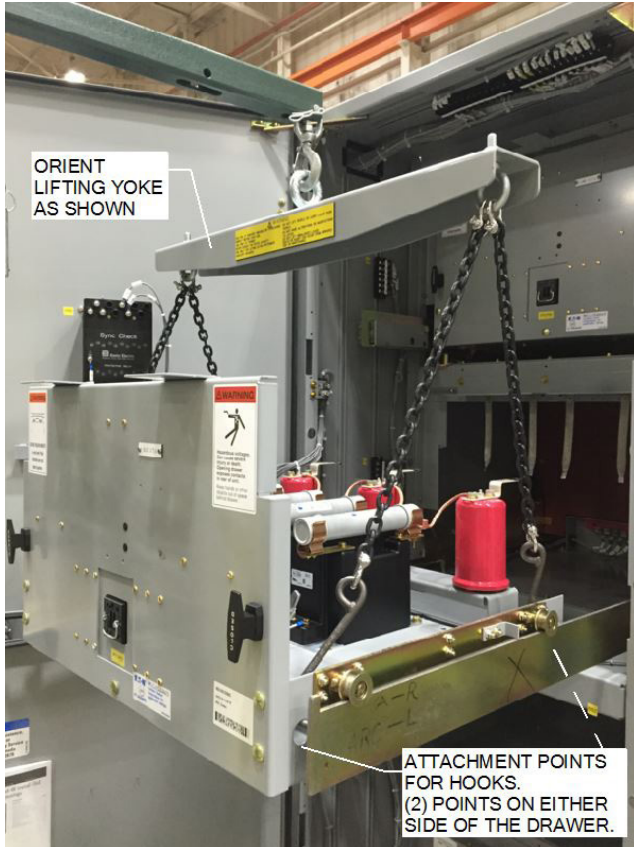


Figure 10. Lifting and Setting the Auxiliary onto the Extension Rails

2. Push the drawout assembly into the compartment until the drawout assembly T-handle latches over the moving block on the levering screw assembly.
3. A cell interlock will be equipped on all CPT and/or fuse drawers (optional for VT drawers) and is mounted to the drawer (Refer to the bottom drawer of Figure 4). To engage the interlock, push the interlock bar up and turn on the secondary control breaker. For some applications, the secondary control breaker may be mounted separate from the drawer and a Kirk lock may be used. Refer to the scheme for proper Kirk lock operation.

C Check the fuses for continuity. Make sure there is proper contact in the fuse clips.

D Moving the drawout assembly from the "Disconnect" to the "Connect" position.

1. In order to move the drawout assembly from the "Disconnect" to the "Connect" position, the compartment door must be closed and latched.
2. Lift the sliding window on the door and insert the levering crank through the hole and onto the hex drive nut on the levering assembly.
3. Rotate the levering crank in a clockwise direction until the indicator located on the left hand picture frame is visible through the door viewing window. If equipped with a BPI pan rotate the levering crank in a clockwise position until the cover of the drawout auxiliary assembly is aligned with the "Connect" position given on the BPI label.

Note: Once the drawout assembly leaves the "Disconnect" position, the compartment door cannot be opened.

E Check the following drawout drawer functions.

1. With the drawer fully inserted into the "Connect" position, check to make sure the primary contacts and secondary contacts are engaged when the drawer is connected, using a low voltage light or other continuity verifying device. They should engage when drawer is within 1.0 in. (25.4 mm) of being closed.

Note: In this position, the compartment door cannot be opened, so in order to check the engagement, remove the door lock defeat screw and insert an allen wrench into the hole to push the interlocking bar back, clearing the interlocking block (see Figure 11). This will allow the door to open. Once the interlock is defeated and the door is opened, it cannot be closed until the drawout assembly is returned to the "Disconnect" position. In order to rack the drawout assembly to the "Disconnect" position, the open door interlock flaps in front of the drive nut must be removed pushed to the side for the levering crank to reach the drive nut.

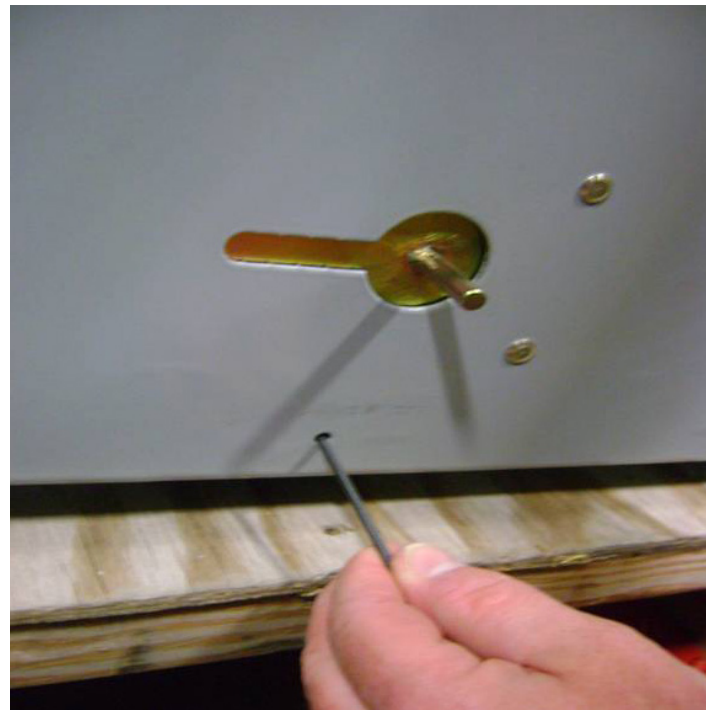


Figure 11. Door Interlock Defeat.

2. With compartment door opened, rotate the levering crank in a counter-clockwise direction until the drawout assembly comes to a stop in the "Disconnect" position.
3. Attached to the front of the shutter are flexible grounding straps. As the drawer is racked out to the "Disconnect" position, the grounding straps should brush against the fuses and ground them simultaneously.
4. Replace the screw in the door lock defeat hole and close the door.

2.4 Perform a loading check

Perform a loading check on both the control and primary circuits to assure the system is ready for operation.

Section 3: Description of arc resistant VacClad-W switchgear

3.1 Arc resistant switchgear general discussion

Arc resistant metal-clad switchgear is metal-clad switchgear tested for resistance to the effects of arcing due to an internal fault. The occurrence of arcing inside switchgear produces a variety of physical phenomena. For example, the arc energy resulting from an arc developed in air at atmospheric pressure will cause a sudden pressure increase inside the enclosure and localized overheating. This results in both severe mechanical and thermal stresses on the equipment. Moreover, the materials involved in or exposed to the arc may produce hot decomposition products, either gaseous or particulate, which may be discharged to the outside of the enclosure.

IEEE guide C37.20.7, provides procedures for testing the resistance of metal-clad and metal-enclosed medium voltage switchgear under conditions of arcing due to an internal fault. The arc resistant switchgear is classified by accessibility types in the two documents as follows.

- **IEEE Std C37.20.7, 2007** – IEEE Guide for Testing Metal-Enclosed Switchgear Rated Up to 38 kV for Internal Arcing Faults.
- **Accessibility Type 1**
Switchgear with arc resistant designs or features at the freely accessible front of the equipment only.
- **Accessibility Type 2**
Switchgear with arc resistant designs or features at the freely accessible exterior (front, back, and sides) of the equipment only.
 - **Type 2B**
Switchgear with arc resistant features inside control compartments in addition to the Type 2 requirements.

The IEEE Guide defines internal arcing short-circuit current as the maximum value of the RMS symmetrical prospective current applied to the equipment under conditions of an arcing fault for the arcing duration specified by the manufacturer. The preferred value of the internal arcing short-circuit current is the rated short-time current of the equipment. **The preferred arcing duration is indicated as 0.5 sec at the rated power frequency of the equipment.**

A single test is done to verify resistance of switchgear against pressure as well as burn through. The actual values (which may be higher or lower than the preferred values) of the internal short-circuit current and arcing duration are specified by the manufacture on the equipment ratings nameplate.

Arc resistant features are intended to provide an additional degree of protection to the personnel performing normal operating duties in close proximity to the equipment while the equipment is operating under normal conditions. Several conditions must be met for the equipment to perform as required. These conditions are considered normal operating conditions for proper application of arc resistant switchgear designs and are as follows.

1. All doors and covers providing access to high-voltage components are properly closed and latched.
2. A plenum and duct assembly is properly installed on top of the switchgear, when applicable.
3. Pressure relief devices are free to operate.
4. The fault energy available to the equipment does not exceed the rating of the equipment (short-circuit current and duration).
5. There are no obstructions around the equipment that could direct the arc fault products into an area intended to be protected.
6. The equipment is properly grounded.

The equipment may be used without additional protection where the fault level and the fault duration are within the equipment ratings. When coupled with other protective schemes, selected to operate within the rated duration of the equipment, the damaging effects of the arcing fault associated with fault duration can be minimized.

3.2 Description of breaker and auxiliary compartment door features and interlocks

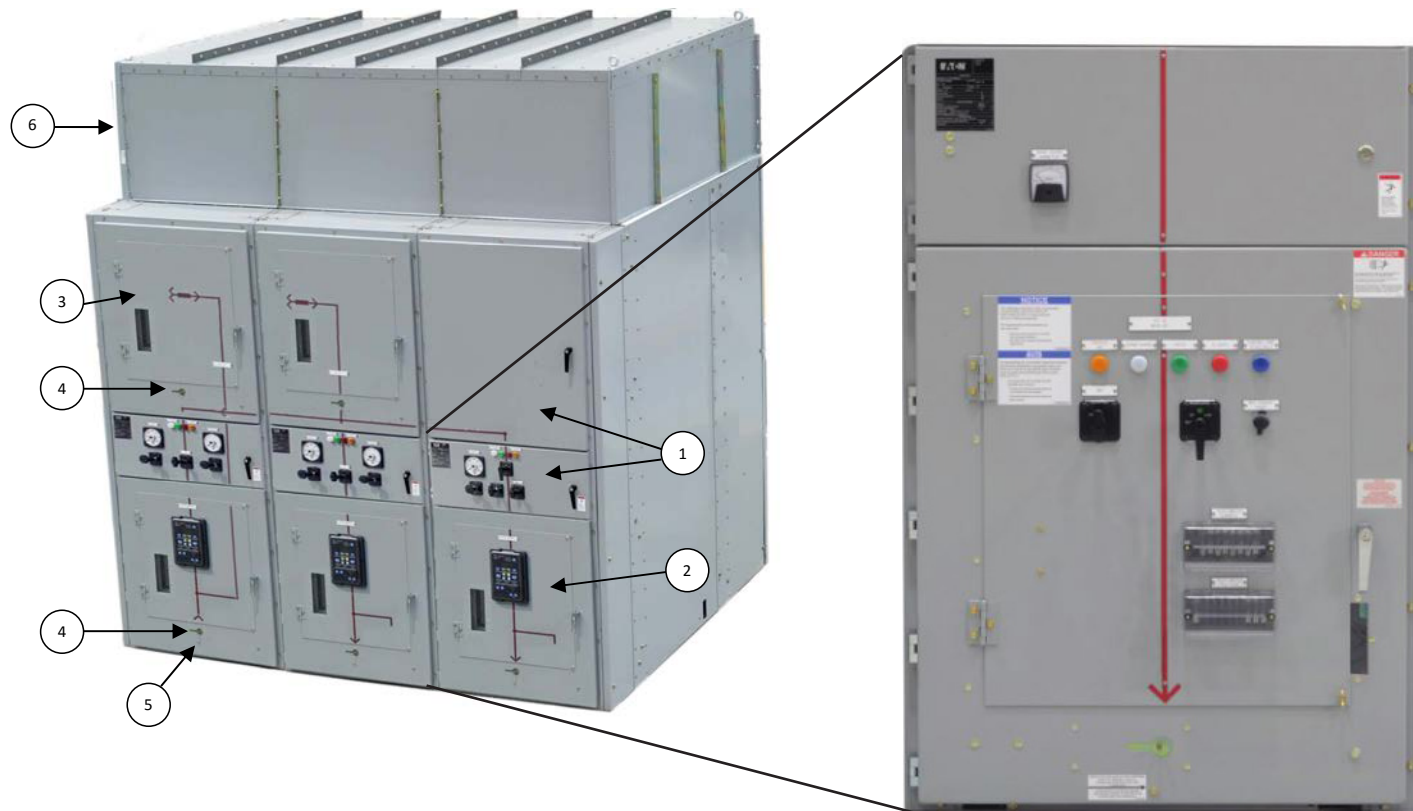


Figure 12. Breaker and Auxiliary Compartment Door Features and Interlocks.

| Identification # | Component |
|------------------|------------------------------------------------------------------|
| 1 | Low Voltage Controls Compartment Door |
| 2 | Breaker Compartment Door with Low Voltage Controls Compartment |
| 3 | Auxiliary Compartment Door with Low Voltage Controls Compartment |
| 4 | Levering Crank Opening |
| 5 | Door Lock Defeat |
| 6 | Arc Exhaust Plenum |

Description of Figure 12 balloons

⚠ CAUTION

DO NOT PUT A BREAKER INTO SERVICE WITH THE SAFETY VENTILATION FLAP CLOSED. THE FLAP WILL AUTOMATICALLY CLOSE IN THE EVENT OF AN INTERNAL ARC. FAILURE TO REMOVE THE SHIPPING BRACE WILL PREVENT AUTOMATIC CLOSURE OF THE SAFETY FLAP DURING AN INTERNAL ARC.

1. Low voltage controls compartment door

The low voltage controls compartment door can be opened. This compartment can be used to mount protective relays, meters, and other control lights and devices.

2. Breaker compartment door with low voltage controls compartment

All connection and disconnection of the breaker **MUST** be done with the breaker compartment door closed. The breaker door is interlocked with the breaker to prevent opening of the door while the breaker is connected. The door can only be opened when the breaker has been completely racked out to the "Disconnect" position. A second interlock prevents the racking in of the breaker if the door is not closed.

The door is arc-resistant rated and equipped with a breaker position viewing window in addition to hardware indication. The viewing window allows the user to determine the position of the breaker ("Connect," "Disconnect" or "Test") without opening the low voltage controls compartment or the door.

BPI label (not shown) - The BPI label is visible through the viewing window. The label allows accurate visible representation of breaker location at all times (refer to #8 in Figure 22).

In conjunction with the viewing window, the hardware indication provides visual verification that the door is completely secure and will resist any arc event. A green "Door Secured" indication will be displayed when the door latching system is secure, while a red "Door Unsecured" indication will appear when the system is not completely latched (refer to Figure 13).



"Door Secured" and arc-resistant

Indication "Door unsecured"

Indication "Door Secured"

Figure 13. Hardware Indication Seen Through the Viewing Window.

Integrated on the arc-resistant door is a smaller door which can be opened to access the low voltage controls compartment. This compartment can be used for mounting protective relays, meters, and other control lights and devices and is equipped with a fixed window.

Fixed window (not shown) - The fixed window can be used to observe the breaker operations counter as well as the breaker contact position (OPEN or CLOSED).

3. Auxiliary compartment door with low voltage controls compartment

All connection and disconnection of the auxiliary devices (CPT, VT, or fuse truck) **MUST** be done with the door closed. The auxiliary door is interlocked with the auxiliary truck to prevent the opening of the door while the auxiliary device is connected. The door can only be opened when the auxiliary device has been completely racked out to the "disconnect" position. A second interlock prevents the racking in of the auxiliary devices if the door is not closed.

The door is arc-resistant rated and equipped with an auxiliary position viewing window in addition to hardware indication. The viewing window allows the user to determine the position of the auxiliary device without opening the low voltage controls compartment or the door.

In conjunction with the viewing window, the hardware indication provides visual verification that the door is completely secure and will resist any arc event (refer to Figure 13).

Integrated on the arc-resistant door is a smaller door which can be opened to access the low voltage controls compartment. This compartment can be used for mounting protective relays, meters, and other control lights and devices and is equipped with a fixed window.

Fixed window (not shown) - The fixed window can be used to observe the breaker operations counter as well as the breaker contact position (OPEN or CLOSED).

⚠ WARNING

ALL DOORS AND PANELS MUST BE PROPERLY CLOSED AND FASTENED FOR THE ARC RESISTANT FEATURE OF THE SWITCHGEAR TO BE OPERATIVE.

4. Levering crank opening

The breaker may be connected and disconnected only when the breaker door is closed. With the door closed, slide the cover to expose the hexagon head of the levering-in screw. Insert the levering crank and rotate clockwise to connect the breaker, and counter-clockwise to move the breaker to the "Test" position.

5. Door lock defeat

The breaker compartment door automatically locks itself closed when the breaker is moved from the "Disconnect" position. It then becomes impossible to activate the door handle.

In case of emergency it is possible to defeat the locking mechanism by removing the screw and inserting a 3-4 in. (76.2-101.6 mm) long allen wrench to push the interlock bar out of the way (see Figure 11).

Important: In order to re-close the door after defeating the interlock, the levering-in assembly must be moved to the "Disconnect" position. Failure to do so will prevent the door from closing properly.

6. Arc exhaust plenum

Arc resistant switchgear with an arc resistant rating above 40 kA must be equipped with an exhaust plenum. The plenum ships separate, and must be installed (see IB48077).

3.3 Safety features

VacClad-W switchgear is manufactured with several built-in interlocks. These interlocks are intended to protect persons working on the equipment. Never make these interlocks inoperative. Doing so can damage property and cause severe injury.

The following are several of the built-in features.

1. Code plates

A code plate is fastened to the bottom front edge of the breaker compartment. There is also a coding plate fastened to the front of the breaker. If the breaker has a lower interrupting rating than the rating of the compartment, or if the voltage and continuous current characteristics do not match, the coding plate on the compartment will prevent the entrance of the breaker into the compartment.

Note: Even with the code plates, it is possible to put a breaker, whose control wiring is not coordinated with that compartment, into the compartment. Always check the shop order drawing to make sure the control wiring of the breaker and the compartment are both the same.

2. Automatic shutter

An automatic shutter, shown in Figures 15 and 16, covers the primary disconnecting contacts when the breaker is withdrawn from the operating position. The shutter prevents persons who are working on the switchgear from accidentally touching the primary contacts. Shutters also cover the stationary disconnects for draw out transformers and primary fuses.

⚠ CAUTION

DO NOT MANUALLY RAISE OR REMOVE THE SHUTTER UNLESS MAIN CONTACTS ARE DE-ENERGIZED, GROUNDED, AND SAFETY PROCEDURES HAVE BEEN INITIATED TO MAKE SURE THE CIRCUITS CANNOT BE ENERGIZED. FAILURE TO EXERCISE CAUTION MAY RESULT IN BODILY INJURY AND PROPERTY DAMAGE.



Figure 14. Automatic Shutters - Ring Type CTs with Shutters Closed and CT Barrier Removed



Figure 15. Automatic Shutters - Ring Type CTs with Shutters Open and CT Barrier Removed.

3. Polyester CT barrier

An optional polyester CT barrier restricts inadvertent access to the CT's (see Figure 22). To remove the CT barrier, remove the two 9 in. (228.6 mm) bolts located at the top of the barrier.



Figure 16. Ring Type CTs with Shutters Closed and CT Barrier in Place.

4. Door interlock

An interlock bar is fastened to linkage connected to the levering-in assembly, preventing the breaker door from opening when the breaker/drawer is not in the "Disconnect" position. This interlock can be defeated by removing the screw and inserting an Allen wrench to push the interlock bar out of the way.

5. Ring type current transformers

The ring-type current transformers are mounted so they slip over the primary contact insulating high voltage terminal on the rear wall of the breaker compartment. There is space for a maximum of four standard accuracy transformers per phase (two on each high voltage terminal of the breaker).

They are mounted so they can be reached from the front of the enclosure (see Figures 15 and 16. This makes it possible to add or to change transformers when the switchgear is de-energized without disconnecting high-voltage connections or breaking the primary insulation. The polarity marks on the transformers show the relative instantaneous polarity in the primary and secondary windings. The equipment's electrical drawings show how to connect the transformers to give the polarity needed to operate relays, instruments, and meters.

6. Key interlocks

Key interlocks are often supplied in conjunction with disconnecting switches, dummy elements, and special compartments to which access is to be denied unless the circuit breakers controlling the power to these no-load-switching devices have been withdrawn to the "Test" position. The operation of key interlock schemes is generally described by a note or keying chart on the shop order assembly drawings.

For auxiliary drawer interlocks refer to Section 2.3.

For the circuit breaker pan key interlock refer to Figure 17.

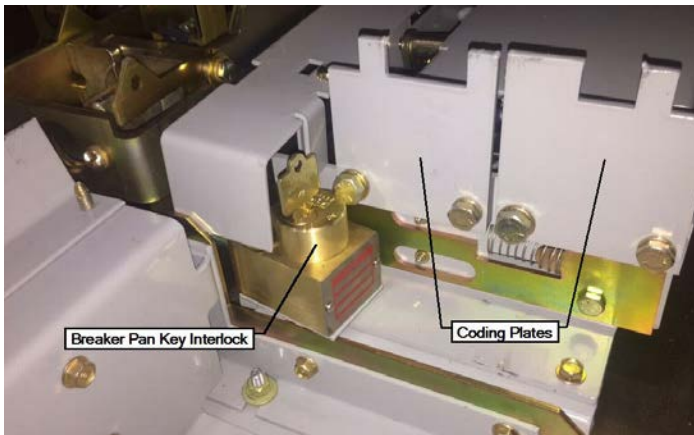


Figure 17. Breaker Pan Key Interlock.

CAUTION

TO FACILITATE MANUFACTURE AND INSTALLATION PROCEDURES, A KEY IS USUALLY SUPPLIED WITH EACH LOCK. BEFORE PLACING SWITCHGEAR WITH KEY INTERLOCKS IN OPERATION, THE KEY SCHEME MUST BE CAREFULLY CHECKED, AND ONLY THE PROPER KEYS LEFT IN THE LOCKS. ALL EXTRA KEYS MUST BE REMOVED AND DESTROYED OR STORED WHERE NOT AVAILABLE SINCE IMPROPER USE OF SPARE KEYS WILL DEFEAT THE INTERLOCKING SCHEME.

7. Lockout-tagout (LOTO) features

Shutter LOTO

LOTO provisions are featured in the rear of the circuit breaker pan assembly. This assembly controls the opening of the shutters. In order to lockout the shutters in the closed position, a padlockable shutter kit is required (refer to Figure 18).

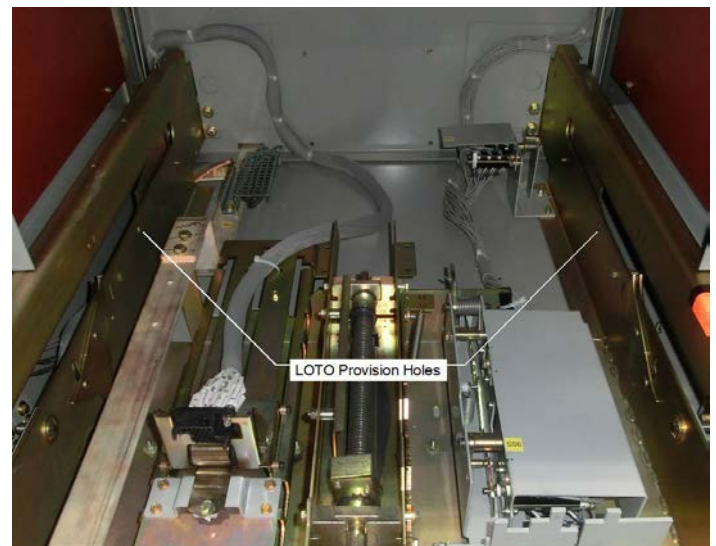


Figure 18. LOTO Provision Holes in the Circuit Breaker Pan.

The Padlockable Shutter Pin (Eaton Part # 1C19648) should be inserted into these provision holes according to the steps in Figure 19.

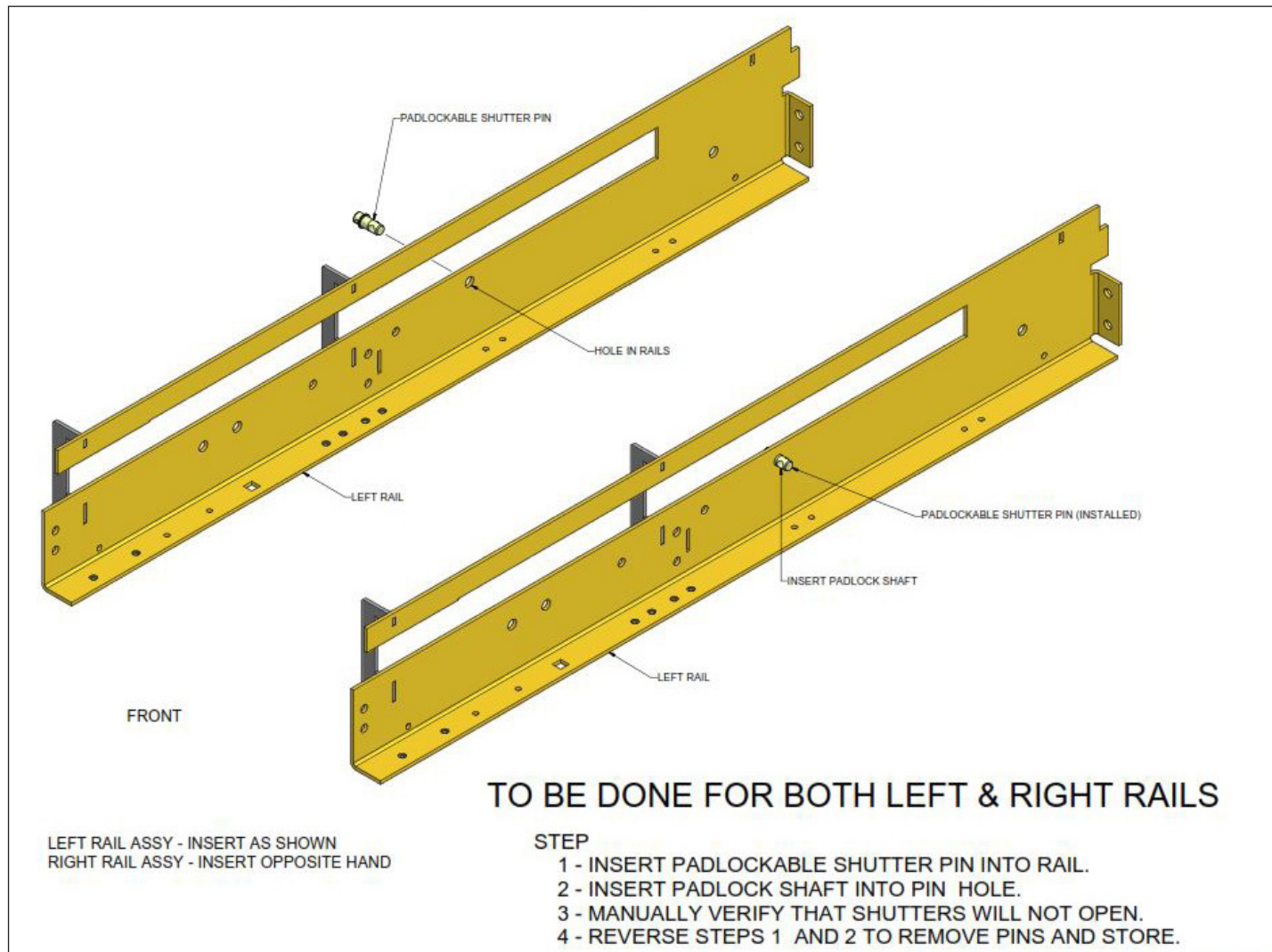


Figure 19. Insertion of the Padlockable Shutter Pins into the LOTO Provision Holes.

Circuit breaker pan LOTO

LOTO provisions are featured in the front of the circuit breaker pan assembly to prevent movement of the breaker.

1. Move the breaker to the fully withdrawn position.
2. Move the LOTO slider to the left in order for the LOTO slider to engage the slider used for racking.
3. Insert a LOTO option (refer to Figure 21) into the circuit breaker pan LOTO provisions (see Figure 20).
4. When it is safe to do so, remove the lock to allow the LOTO slider to move to the right, when racking the breaker is required.

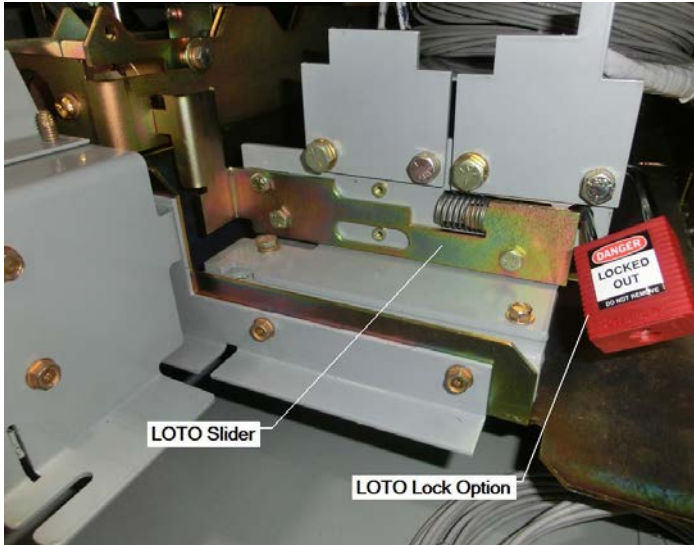


Figure 20. Lockout-Tagout Provision for Circuit Breaker Lockout.



Figure 21. Several Acceptable Lockout-tagout Options.

Note: The LOTO options shown in Figure 21 only includes a handful of accepted options. Other options may also work with the breaker pan LOTO provision.

3.6 Breaker pan assembly

Refer to Figure 22 to identify components of the breaker pan assembly.

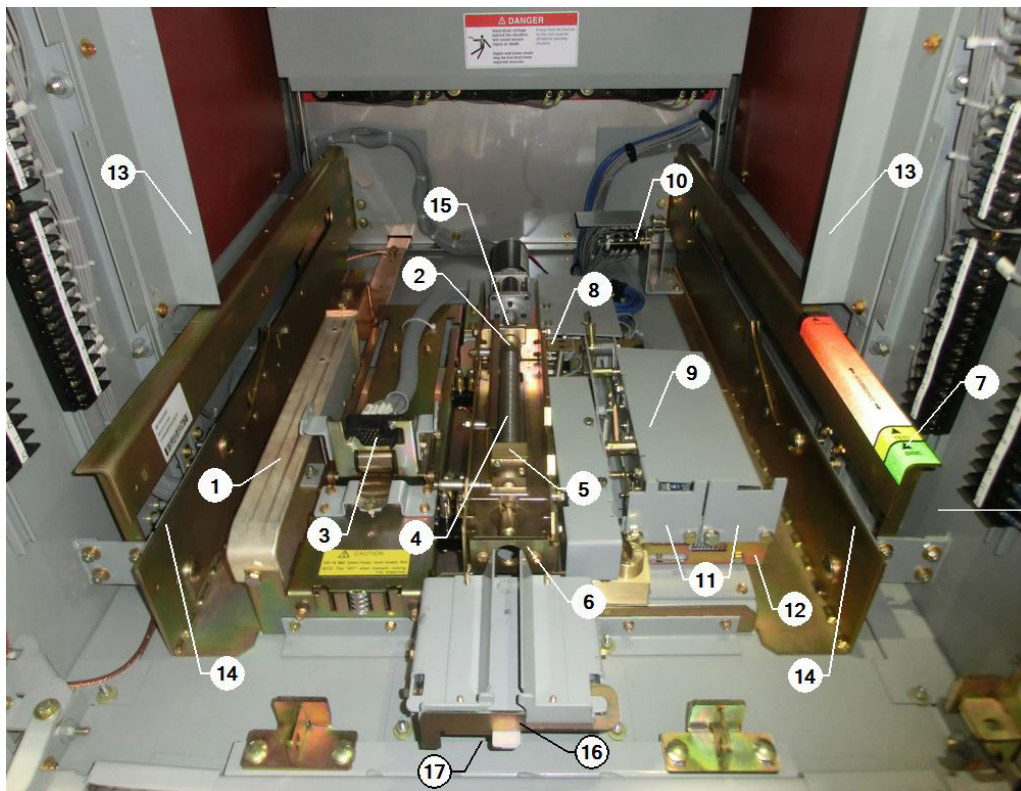


Figure 22. Breaker Pan Assembly with MR2 Installed.

Description of Figure 22 balloons

1. Grounding contact grounds the breaker in all positions .
2. The levering system prevents removal of the breaker in any position other than the "Disconnect" (or "Test") position.
3. The control wiring is arranged for pullout disconnecting by means of a 25-point female receptacle arranged to connect to a male plug on the breaker. The secondary disconnect is the connection for the control leads between the removable breaker and the stationary housing (see the breaker instruction book for further description).
- Automatic secondary:** Figure 22 indicates an automatically engaged secondary as offered on the BPI pan assembly and requires no manual input from the customer to engage the secondary harness. The secondary harness will engage automatically when the breaker is levered-in to the discrete "Test" position. The secondary harness will then disengage automatically when the breaker returns to the "Disconnect" position.
4. Racking screw performs breaker insertion and withdrawal.
5. Moving block couples to breaker for insertion and withdrawal.
6. Slider is used with #8 to prevent levering a closed breaker . May also be used in conjunction with #12 to padlock a breaker in either position.
7. Indicates when the breaker is in the fully connected position .

BPI label: Figure 22 represents positive indication of breaker location at any position through use of a colored label mounted on the top flange of the right hand rail assembly. Green indicates the "Disconnect" position, yellow indicates the "Test" position and red indicates the "Connect" position. Upon arriving at any of the three discrete positions; "Disconnect," "Test," and "Connect," there is a black mark that aligns with the breaker cover to indicate exact location.

8. Slider interlocks prevent removing a closed breaker.
9. The breaker mechanism-operated compartment (MOC) switch is an assembly of switches that is operated by a lever on the breaker mechanism. It can contain as many as 15 normally closed and 15 normally open contacts (beneath the cover) in the standard design. The MOC switch is activated by the breaker closing. It extends a plunger out the bottom of the mechanism and pushes down on the MOC switch operating mechanism . This, in turn, transmits the motion to operate the switch.
10. The switch truck operated compartment (TOC) has nine poles in the normal design – four contacts make and five break as the breaker is levered to the "connected" position . As the breaker is being levered into the connected position, a bracket on the breaker pushes the TOC switch lever during the last inch of travel. As a result, the TOC switch can be used to electrically indicate whether or not the breaker is in the connected position (beneath cover).
11. Coding plates: (see Safety features).
12. Provision for padlocking a breaker in any position. Also a location for a key interlock.
13. Metal framework provides a closed barrier to the primary compartment when the breaker is connected.
14. Rail on which the breaker rolls.
15. MR2 Integral racking provisions for inclusion during manufacturing or aftermarket (MR2 installed in Figure 22).
16. Interlock to inhibit racking of the breaker with the door open.
17. Interlock to inhibit the opening of the breaker door when the breaker is not in the "Disconnect" position (underneath bracket, not shown).

Section 4: Adjusting and testing

4.1 Adjusting and testing

Step 1

After the switchgear has been installed and connected to the apparatus it is to control, give it a final check before it is put into service.

Note: Make sure the apparatus being controlled is not connected to the system while the tests are being carried out.

The testing equipment will depend on the size and type of installation. Use portable voltmeters. Use a low voltage continuity testing device to verify correct continuity of circuits.

Step 2

Examine all wiring circuits to make sure they have not been damaged or loosened during shipment or installation.

Step 3

Make sure all the connections are correct before the equipment is operated. "Light out" connections between the switchgear and remote apparatus such as instrument transformers, auxiliary switches, and remote control and interlock circuits.

Step 4

Coordinate the settings of the relays with other parts of the system in accordance with the standards or operating practice of the purchaser.

Step 5

If the covers are removed from meters, relays, or other devices for installation or test, handle them carefully. Replace the covers as soon as possible to keep dust and dirt out of the components.

Step 6

Perform a loading check of the control circuits. Before energizing the control circuits, check the control bus with an ohmmeter to make sure there are no short circuits in the control wiring. If an ohmmeter is not available, connect a small fuse in series with the source of the control power. This will protect the control wiring against damage. (The fuse should be one-fourth the normal rating of the circuit).

4.2 Front door adjustments

If the door will not latch, the hasps of the latching mechanism can be adjusted to fit. These hasps are adjusted prior to shipment, but variations in the floor can cause issues in the field. With the door closed, access the hasps through the control compartment. Access plates are provided on the sides of the control box for this specific purpose. Adjust the hasps as necessary so the latching rod will clear all the holes and latch smoothly. Refer to the Figure 23 to identify these components.

4.2.1. Door adjusting

Step 1

Ensure the four (40 kA and 50 kA ratings) or eight (63 kA rating) hasp assemblies are installed in the breaker/auxiliary cell as shown (see Figure 23).

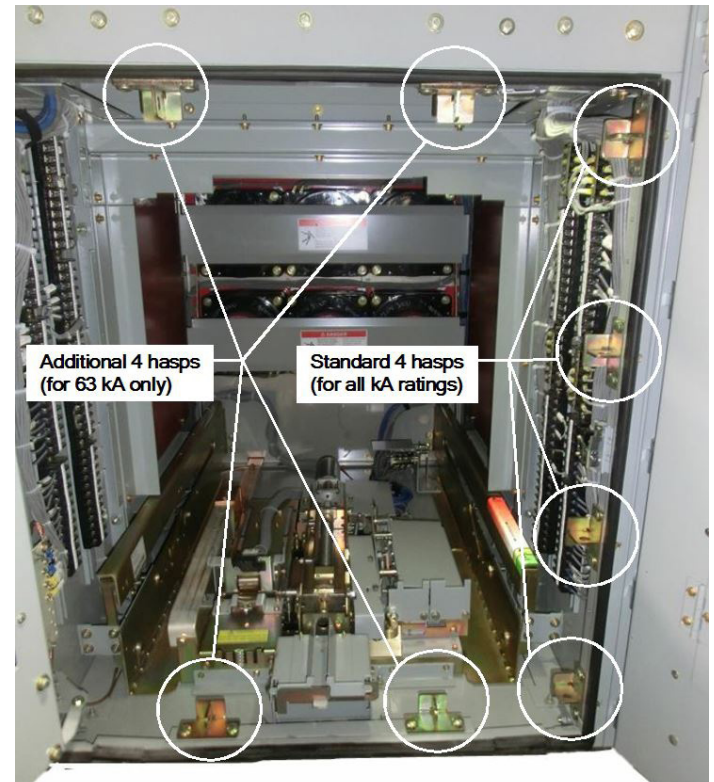


Figure 23. Location of the Hasp Assemblies.

Step 2

Device Cell: Open the low voltage controls compartment door on the arc-resistant door (see Figure 24).



Figure 24. Opening the Low Voltage Controls Compartment Door on the Arc-resistant Door.

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Step 3

Close the breaker/auxiliary door as much as possible. If it does not shut all the way, the assembler should identify the hasp(s) that interfere(s) with the welded U-shaped brackets on the door (see Figure 25). If the door shuts all the way, proceed to Step 5.

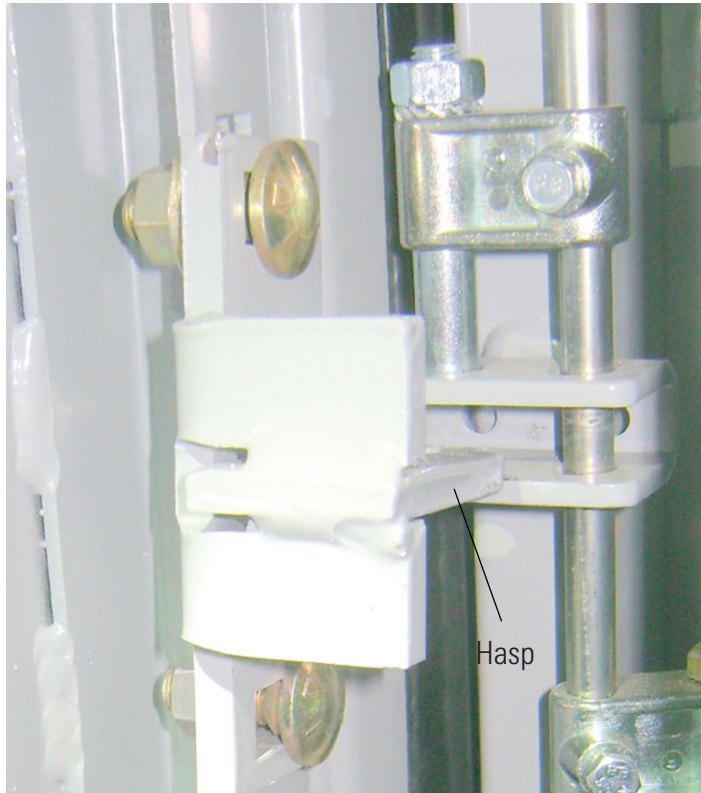


Figure 25. Identifying the Hasp(s) Interfering with Door Closure.

Instructions for installation, operation, and maintenance of 5/15 kV type VacClad-W arc resistant metal-clad switchgear

Step 4

Loosen the indicated hardware and adjust the interfering hasp assembly to locate it at the center of the U bracket as shown (see Figure 26). Secure the hasp assemblies in this new position by tightening the indicated bolts. All hasp assemblies interfering with door closure need to be adjusted as discussed. When all the necessary hasps have been adjusted, the door can then be closed.

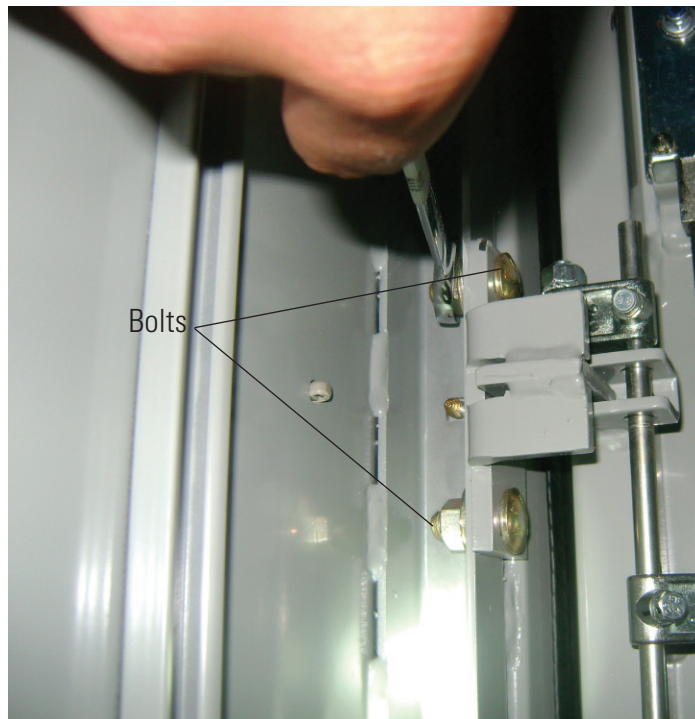


Figure 26. Adjusting the Hasps Interfering with Door Closure.

Step 5

Rotate the door handle to the 'closed' position (see Figure 27) and proceed to Step 8. If the handle cannot be rotated to the closed position, identify the hasp(s) that interfere with the latching rods on the door (see Figure 28).

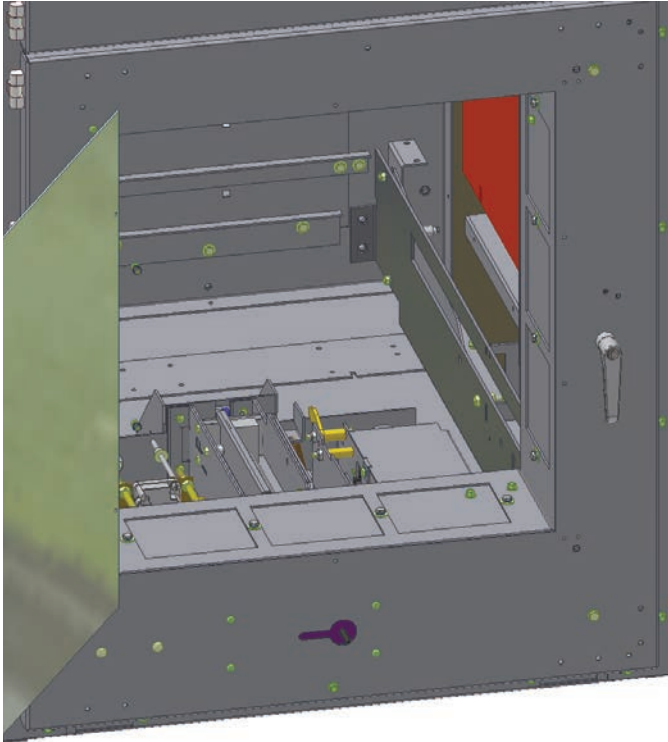


Figure 27. Door Handle in the Closed Position.

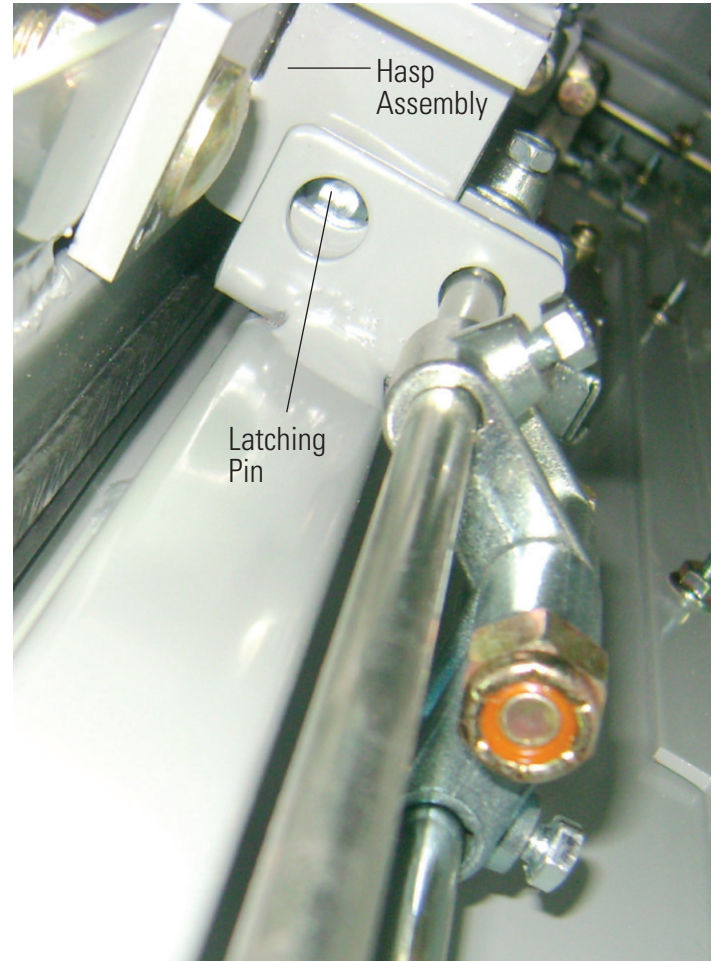


Figure 28. Identifying the Hasp(s) Interfering with Latching Rod Operation.

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Step 6

Loosen the indicated hardware (see Figure 29) and adjust the interfering hasp to locate the latching pin at the center of the hasp's oval hole (see Figure 30). Secure the hasp in this new position by tightening down on the indicated bolts. All hasp assemblies interfering with latching rod operation need to be adjusted as discussed. When all the necessary hasps have been adjusted, the door handle can then be rotated to the closed position.

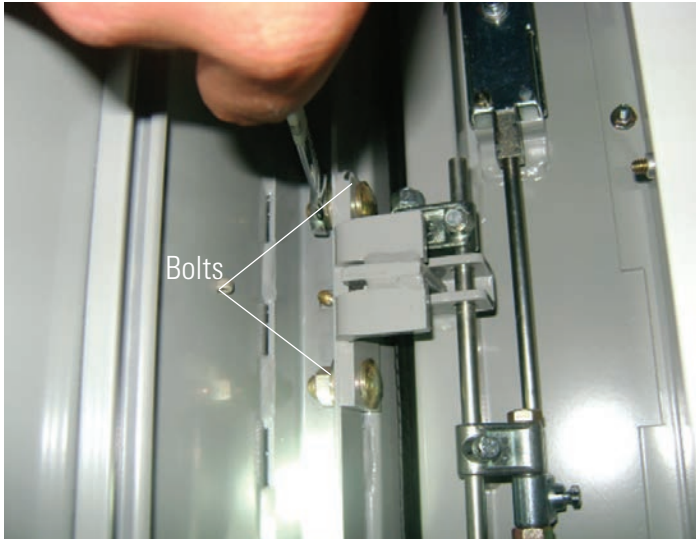


Figure 29. Adjusting the Hasps Interfering with Latching Rod Operation.

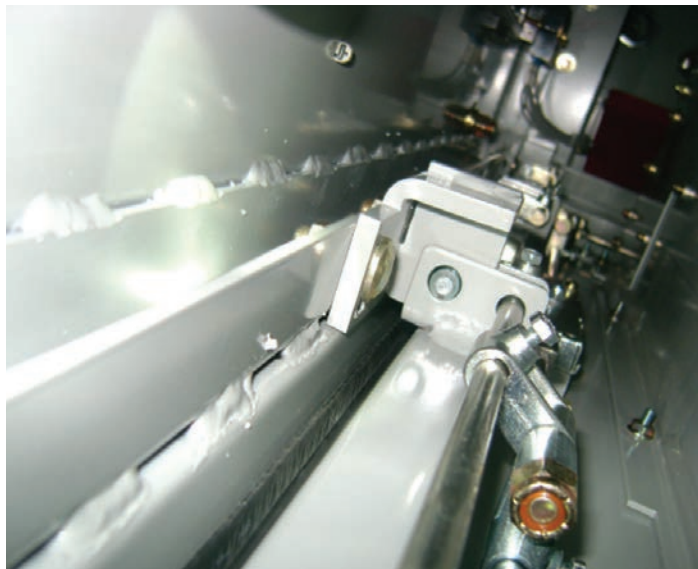


Figure 30. Proper Latching Rod and Hasp Alignment.

Instructions for installation, operation, and maintenance of 5/15 kV type VacClad-W arc resistant metal-clad switchgear

Step 7

Turn the door handle to closed position (see Figure 27).

Step 8

Device Cell: Secure the low voltage controls compartment door on the arc-resistant door (see Figure 31).



Figure 31. Securing the Low Voltage Controls Compartment Door on the Arc-resistant Door.

Section 4.2.2 Door troubleshooting

Step 1

Rack (counter-clockwise direction) the breaker/auxiliary all the way out and try to rotate the door handle (clockwise) to the "open" position (see Figure 32). If the handle cannot be rotated proceed to Step 2.



Figure 32. Racking the Breaker/Auxiliary.

Step 2

Using an Allen wrench, try to push the interlock plunger through the bottom of the door as shown (see Figure 33). If the plunger can be pushed into the cell, rotate the door handle to the open position. If the handle cannot be rotated or if the plunger cannot be pushed, proceed to Step 3.

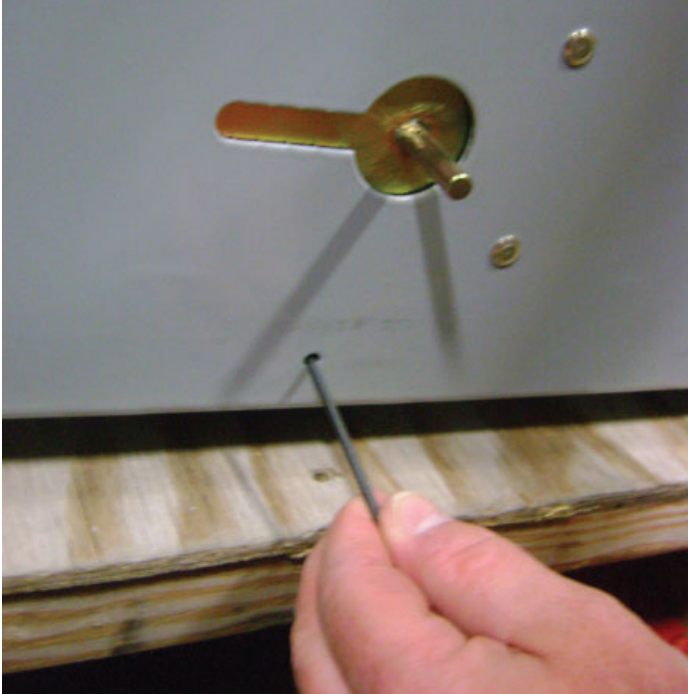


Figure 33. Pushing the Interlock Plunger through the Bottom of the Door.

Step 3

Device Cell: Open the low voltage controls compartment door on the arc-resistant door (see Figure 24).

Step 4

Using a 7/16" wrench, remove all the access plates as shown (see Figure 34).

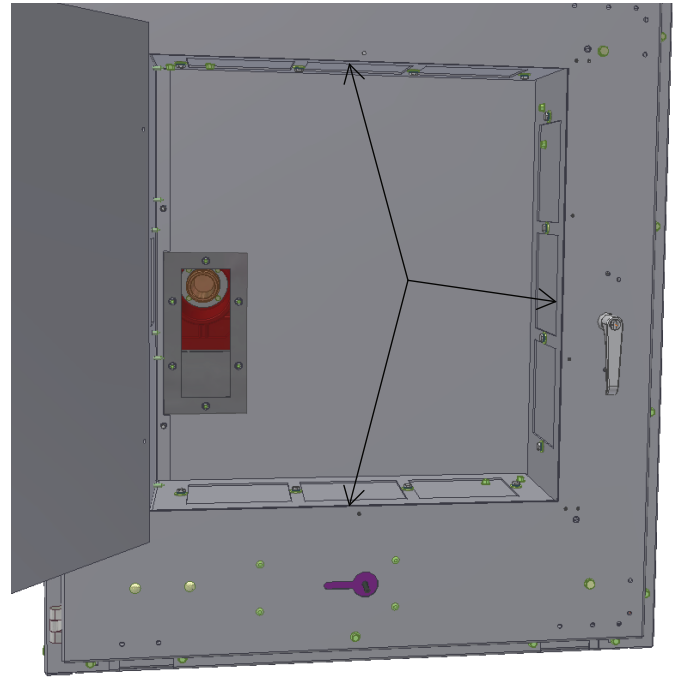


Figure 34. Location of the Access Plates.

Step 5

Through the openings provided by removal of the access plates, identify the hasp(s) that has (have) gone out of alignment (see Figure 35).

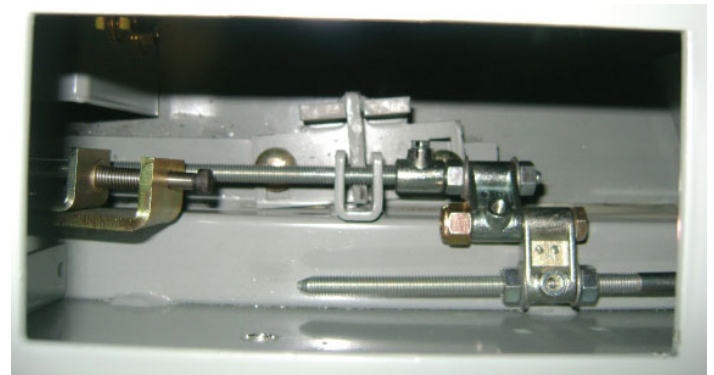


Figure 35. Identifying the Misaligned Hasp(s).

Step 6

Loosen the indicated hardware (see Figure 36) and adjust the hasp assembly to locate it at the center of the U-shaped bracket as shown (see Figure 37). Secure the hasp in this new position by tightening down on the indicated bolts. All hasp assemblies identified in Step 5 need to be adjusted as discussed.



Figure 36. Adjusting and Realigning the Hasps.



Figure 37. Proper Alignment of the Hasps.

Step 7

After all misaligned hasps have been adjusted, reinstall the access plates.

Step 8

Device Door: Secure the low voltage controls compartment door on the arc-resistant door (see Figure 31).

Section 5: Operation of the system

Step 1

Study and understand the electrical drawings furnished with each switchgear system.

Step 2

Install the circuit breaker in the "Disconnect" position.

Manual secondary: To engage the secondary harness, lift and pull the secondary disconnect forward to engage the control circuit.

Automatic secondary: To engage the secondary harness, rack the breaker to the test position to engage the control circuit.

Check that the breaker operates.

Step 3

A green light on the hinged instrument panel on the front of the breaker compartment shows the breaker is "open". A red light shows the breaker is "closed". Refer to the diagrams supplied with the switchgear for the control scheme details, indicating light colors, and functions.

Step 4

The details of the breaker control schemes vary from one installation to another. They comply with the requirements set forth by IEEE, NEMA, and ANSI. All of the electrical control schemes are designed to coordinate electrically with the mechanical design of the breaker

Section 6: Inspection and maintenance

6.1 Safety precautions

Refer to the "Safety precautions" section of this manual.

⚠ WARNING

WHEN INSPECTING, REPAIRING, AND PERFORMING MAINTENANCE ON SWITCHGEAR, THE FACT THAT DANGEROUS VOLTAGES MAY EXIST MUST BE KEPT IN MIND. PRECAUTIONS MUST BE TAKEN TO INSURE THAT PERSONNEL DO NOT COME IN CONTACT WITH ENERGIZED HIGH VOLTAGE PARTS. FAILURE TO DO SO MAY RESULT IN DEATH, PERSONAL INJURY, OR PROPERTY DAMAGE.

Some common general precautions for high voltage work are:

Connections

All connections should be considered energized until the personnel expecting to work on them is assured that the circuits are de-energized, and until every possible precaution has been taken to see that there is no chance of a circuit being energized while the crew is working.

Switches

Switches, which have been opened to de-energize a circuit to permit work on equipment, should be locked or blocked open and a suitable visible warning device placed on them.

Grounding

Do not work on parts normally carrying current at high voltage until these parts have been disconnected and grounded to the ground bus. The purchaser should make provisions for connecting adequate, flexible ground leads to every part of the switching equipment.

6.2 Access to switchgear parts

6.2.1 High voltage parts

VacClad-W switchgear is a metal-clad design. All major parts of the primary circuit are isolated by grounded metal barriers and enclosed within separate compartments. For example, the circuit breaker, main bus, and primary line and load terminations are isolated from each other and enclosed in separate compartments, which are made from grounded metal barriers and covers. Access to high voltage parts can be gained by removing the covers and barriers. The covers and barriers should not be removed unless the parts to be exposed are de-energized.

6.2.2 Main contacts

Stationary main disconnecting contacts are located behind the automatic safety shutters. Upper and/or lower stationary contacts can be exposed by manually opening the shutters (see Figures 14 and 15). Do not expose any contacts unless all upper and lower high voltage parts are de-energized.

⚠ WARNING

FAILURE TO DO SO MAY RESULT IN DEATH, PERSONAL INJURY, OR PROPERTY DAMAGE.

6.2.2.1 Manually opening the shutters

1. Insert the breaker maintenance tool (see Figure 39), such that the handle rests on the welded rail support while making contact with the hardware assembly on the manual shutter extension (refer to Figure 38).

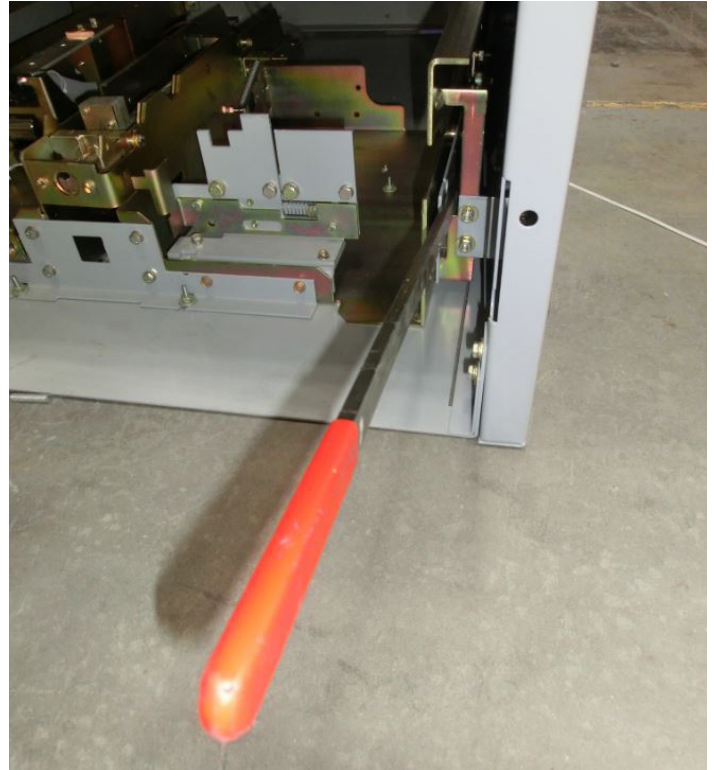


Figure 38. Insertion of Maintenance Tool into the Pan for Manually Opening the Shutters.

1. Push down on the maintenance to open the shutters (Refer to Figure 39).

Note: Shutters will close if pressure is removed from the maintenance tool. Shutters can be locked into place with the shutter lock kit or other manual means.



Figure 39. Hand Operation to Manually Open the Shutters.

6.2.3 Current transformers

Window type current transformers are installed over the primary contact insulating tubes in the front of the unit (see Figures 14 and 15). All primary circuits must be de-energized prior to gaining access to any CTs.

6.2.4 VT and primary fuses

Disconnecting transformers and fuses: Racking out the drawer automatically disconnects and grounds the moving high-voltage parts. Shutters automatically cover the primary disconnects (see Figures 40, 41, and 42).

⚠ WARNING

DO NOT ATTEMPT TO REMOVE THE BACK COVERS OR TO OPEN OPTIONAL REAR DOORS, THE DISCONNECTING ASSEMBLIES, OR THE SHUTTERS UNLESS THE HIGH VOLTAGE CIRCUITS TO THE COMPARTMENT ARE DE-ENERGIZED AND PRECAUTIONS HAVE BEEN TAKEN TO PREVENT ENERGIZATION. FAILURE TO DE-ENERGIZE THE CIRCUIT MAY RESULT IN BODILY INJURY OR DEATH. WHEN ENERGIZED, THE CIRCUIT CARRIES LETHAL HIGH VOLTAGES.



Figure 40. Typical Fuse Drawer Drawn Out onto Extension Rails.



Figure 41. Typical VT Drawer Drawn Out onto Extension Rails.



Figure 42. Typical Auxiliary Compartment (VT Compartment Shown with VT Drawer Removed).

6.2.5 Control equipment

With the exception of apparatus such as current transformers and rear-mounted heaters, control equipment and wiring is generally accessible without exposing high voltage parts.

6.3 Inspection and maintenance schedule

To assure high-quality service, a definite maintenance schedule, systematically followed, is essential. Plant, operating, and local conditions vary to such an extent that the schedule must be prepared to suit the conditions. However, the following general requirements should be helpful in setting up the program.

⚠ WARNING

BEFORE ATTEMPTING ANY INSPECTION OR MAINTENANCE, BE SURE THAT ALL PRIMARY AND CONTROL CIRCUITS HAVE BEEN DE-ENERGIZED AND GROUNDED AS REQUIRED AND THAT PROPER STEPS HAVE BEEN TAKEN TO BE SURE THAT THEY WILL REMAIN DE-ENERGIZED UNTIL ALL WORK IS COMPLETED. FAILURE TO DO SO MAY RESULT IN BODILY INJURY OR ELECTROCUTION. WHEN ENERGIZED, CIRCUIT CARRIES LETHAL HIGH VOLTAGE.

6.3.1 Individual devices

The maintenance schedule for individual devices, such as circuit breakers, relays, and so on, should be based upon recommendations contained in the individual instruction book for the device. These operations should be coordinated with the overall program to result in the least operating inconvenience and circuit shutdown.

6.3.2 Overall maintenance

The switchgear installation should be given a thorough overall maintenance check at the end of the first year in service because it provides an opportunity to evaluate conditions at an early point in the life of the equipment. Where conditions are abnormal, more frequent inspection and maintenance is necessary. Where conditions warrant, a longer period of time between maintenance periods may be used. The following require attention.

1. Buses and connections

De-energize the primary circuits and remove the cover plates from the primary compartments. Before cleaning, take megohmmeter (megger) readings between phases and each phase to ground. Inspect for signs of overheating or weakened insulation. Remove dust from buses, connections, supports, and enclosure surfaces. A vacuum cleaner with a long nozzle will be of assistance. Wipe clean with distilled water and wipe dry.

After buses have been dusted and wiped clean, take megger readings again between phases and each phase to ground. Keep a record of these readings for future reference in determining when trends occur that would indicate a lowering of the insulation resistance.

Periodic high-potential tests are not required after initial start-up and are recommended only after repair of high voltage buses or installation, or when the trend of megger readings indicates it to be advisable (refer to Figure 19).

2. Primary disconnecting contacts and primary contact insulating tubes

Remove each breaker from its compartment. De-energize the primary circuits and expose the primary contacts and their supports by manually opening automatic safety shutters. Wipe clean with a cloth moistened in a non-flammable solvent. Inspect for abnormal wear or overheating. Discoloration of the surfaces is not harmful unless corrosion due to atmospheric conditions is severe, resulting in deposits on the surface. Check each breaker while it is out of the housing for all items recommended in the instruction book applying to that particular type of breaker.

3. Other disconnecting contacts

Inspect all secondary disconnecting contacts, such as those on auxiliary drawout assemblies, for abnormal wear, fatigue, or overheating. Replace if necessary. Otherwise treat the same as the main disconnecting contacts above.

4. Control contactors

Contacts should be inspected and dressed or replaced when the surface becomes pitted. Unless repetitive duty has been experienced, little attention should be required.

5. Instruments, relays, and other panel mounted devices

Individual devices should be maintained according to the specific instructions supplied for each device. Remove all relay covers and inspect the interiors for dust or dirt. Relay test personnel can easily perform this operation during periodic relay testing.

6. Secondary wiring

Check all wiring connections for tightness, including those at the current and voltage transformers and at the terminal blocks where circuits leave the switchgear. Make sure that all secondary wiring connections are properly connected to the switchgear ground bus where so indicated.

7. Mechanical parts

Visually check and manually operate mechanical moving parts such as the shutter, TOC and MOC switch assemblies, the position interlock, hinged doors, and the drawout features of the auxiliary drawout assemblies. Examine mechanical mating parts such as the breaker secondary contacts blocks, guide rails, and trippers. Grease the racking screw and the plunger/operating mechanism of the MOC switch.

8. Ventilation

Switchgear is equipped with a metal bracket used to hold the safety flap in position during shipping. The safety flap will close automatically in the event of an internal arc. The closed position is easily recognized by the red color of the flap seen through the front grill opening. DO NOT PUT A BREAKER INTO SERVICE WITH THE SAFETY FLAP CLOSED. This will prevent proper breaker ventilation and may cause severe overheating. REMOVE THE ORANGE METAL SHIPPING BRACE BEFORE PUTTING A BREAKER INTO SERVICE BUT ONLY AFTER ENCLOSURE IS IN FINAL POSITION. Failure to remove the bracket will prevent automatic closure during an internal arc.



Figure 43. Typical Front Ventilation Dynamic Flaps.

9. Battery and charging equipment (optional)

The control battery is such an important item in switchgear operation that it must be given special periodic attention if it is to give reliable service for a long period of time. Periodic inspections and test are recommended in the battery supplier(s) instructions. At the same time the battery is checked, inspect the battery charger and remove accumulations of dust and dirt. On all chargers having a manual transfer switch for setting the charging rate, check carefully to be sure that the selector switch is returned to the value appropriate for a floating charge at the end of the periodic inspection. Serious damage to the control battery can occur if the charger is left on a high charging rate for an extended period of time.

10. Records

The condition of each switchgear unit at the time of inspection should be listed in a permanent record to become a guide for anticipating the need for replacements or for special attention between the regular maintenance periods. Megger tests are suggested for checking the insulation. A series of these tests will indicate any tendency toward a reduction in dielectric strength of the insulation. Megger readings should be taken before and after cleaning the equipment and, where possible, under similar conditions at successive periods. Records should include the megger reading, the temperature, and the humidity.

The readings will vary with the extent and design of the bus structure. In contrast with a small installation, the longer switchgear assemblies will have a more extensive bus structure with a greater number of insulators and, thereby, a larger number of parallel insulation resistance paths to ground which will tend to decrease megger readings. This variation in insulation resistance between different switchgear assemblies emphasizes the value of a series of readings, which can be charted to establish a normal insulation level so that progressive weakening of the insulation can be recognized.

11. Abnormal conditions

Local conditions such as high humidity, salt-laden atmosphere, corrosive gases, heavy dust, or severe circuit operating conditions, are considered to be abnormal. They will require more frequent inspections.

It should be emphasized that a series of inspections should be made at quarterly intervals until the progressive facts of the local conditions can be analyzed to determine a schedule which will maintain the equipment in satisfactory condition.

In some locations, conditions may be so harsh that the frequency of maintenance will interfere with operating and production schedules. In such cases, consideration should be given to the possibility of enclosing the switchgear equipment in a relatively tight room and supplying a sufficient quantity of clean air to maintain a positive pressure in the room. Under such conditions, maintenance schedules may then be established on a more normal basis. Such an arrangement might also provide for cooling the air where the ambient temperature is relatively high, thus further improving operating conditions.

Section 7: Lubrication

VacClad-W Switchgear is designed so that lubrication in usual service is infrequently required under normal conditions. However, unusual service conditions such as high humidity, salt-laden atmosphere, corrosive gases, or severe circuit operating conditions, may demand more frequent relubrication. All mechanical parts have been lubricated during assembly with molybdenum disulphide grease (Eaton Electrical Material No. 53701QB). The application of the lubricants should be held to a minimum to reduce the accumulation of dust and dirt.

7.1 Where to lubricate

- 1 MOC Switch (Refer to #10 in Figure 22) – Grease (Eaton Electrical Material No. 53701QB) should be applied to the three locations where the rotary switch assemblies link to the Push Bar assembly (see Figure 44). This should be done at least every three years.

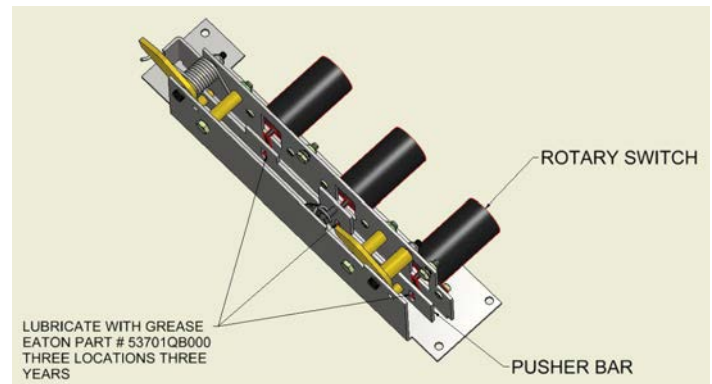


Figure 44. Lubrication Locations for the MOC Switch.

- 2 Racking Screw (Refer to #5 in Figure 22) – With the breaker removed, apply grease (Eaton Electrical Material No. 53701QB) to the racking screw (see Figure 45). Grease should be applied with a brush using a motion perpendicular to the axis of the threaded shaft. It is important the grease is applied to the face of the threads. Apply to the length of the exposed threads and then move the nut from disconnect to connect to distribute the grease.

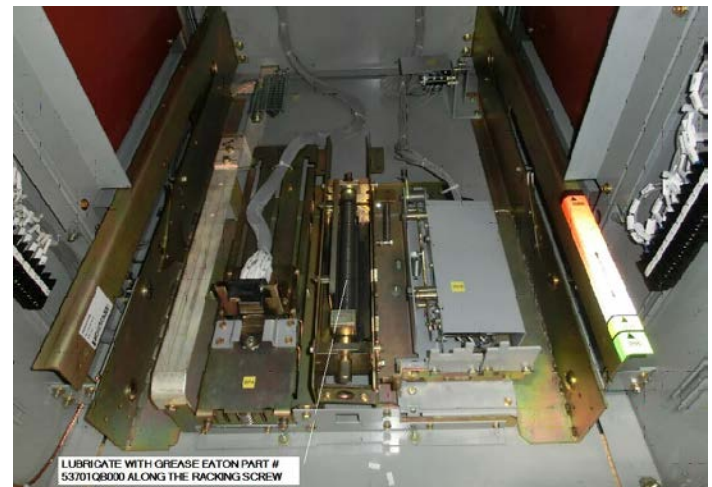


Figure 45. Lubrication Location for the Racking Screw.

Section 8: Renewal parts

When ordering renewal or spare parts, include as much information as possible. In many cases, the style number of the new part can be obtained from identification on the old part. Always include a description of the part. Specify the rating, structure number, and shop order number of the switchgear housing in which the part is to be used. See Reference Guide RP02201001E for renewal parts list.

Section 9: Accessories

9.1 Standard accessories

Each new VacClad installation is provided with a set of accessories. Depending upon customer's specifications and the nature of the installation, the accessories will include one or more of the following.

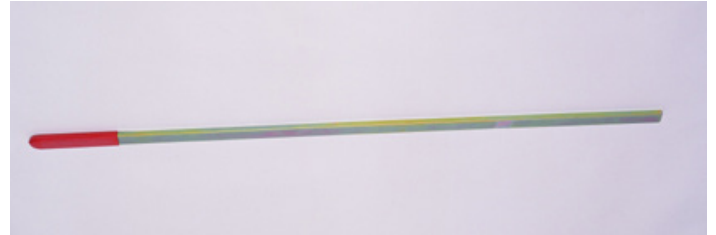


Figure 46. A Maintenance Tool.

The maintenance tool is used for manually charging the breaker closing spring and manually opening the shutter. For proper use of maintenance tool involving manual operation of the shutters, reference "Main contacts" in the Inspection and maintenance section of this manual. For other uses involving the circuit breaker, reference the VCP-W Circuit Breaker, IB131006EN.



Figure 47. A Levering Crank.

The levering crank is used for moving the breaker or auxiliary drawers between the "Disconnect" and "Connect" positions.



Figure 48. Breaker Lifting Yoke.

The breaker lifting yoke is used for attachment to breaker on or off breaker compartment extension rails. I.L. 32-275-1 provides complete instructions.



Figure 49. Auxiliary Lifting Yoke.

The auxiliary lifting yoke is used to lift CPT, fuse, or VT drawout drawers off the extension rails.



Figure 50. Extension Rails.

The extension rails are used for extending the cell rails so that a breaker or auxiliary drawer can be rolled out of its compartment on extension rails for maintenance or removal.

9.2 Optional accessories - test cabinet

1. Test cabinet

A test cabinet is used for electrically opening and closing of the breaker when it is outside its housing. For operation of the test cabinet reference IL32-275-4. For operation of the accompanying test jumper, reference IL32-275-5.



Figure 51. Test Cabinet and Test Jumper.

2. Portable lift device

The portable lifting device is used for raising or lowering the breaker to the compartment extension rails and either lifting the breaker onto or off the rails (see Figure 52).

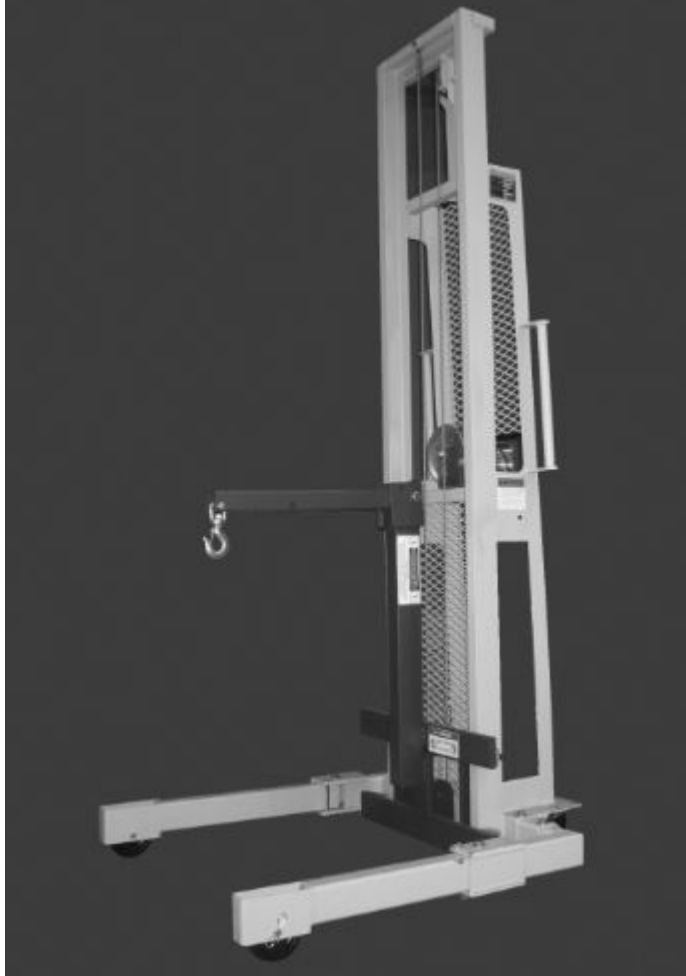


Figure 52. Portable Lift Device.

3. Dockable transport dolly

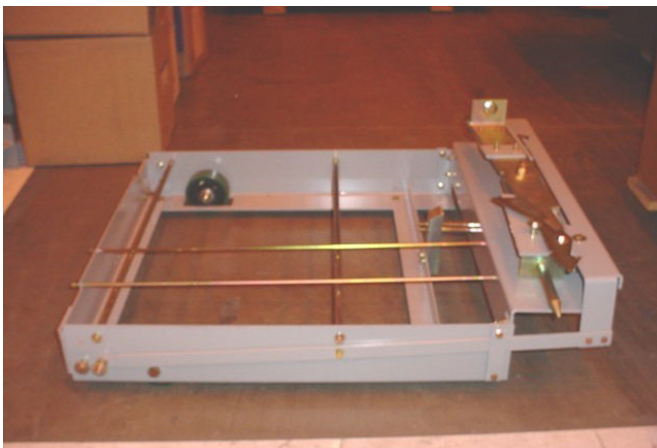


Figure 53. Dockable Transport Dolly.

The dockable transport dolly is used for removing the breaker from the lower compartment without lifting (bottom compartment only). This device “docks” with the lower breaker pan assembly in place of the extension rails. IL32-275-6 provides complete instructions.

4. Breaker ramp assembly

The breaker ramp assembly is used for inserting or removing a breaker from the bottom compartment of a vertical section without the need of any lifting device.



Figure 54. Breaker Ramp Assembly.

5. Ground and test device

The ground and test device provides a convenient means to ground a circuit for maintenance work, apply potential for cable testing, and access both bus and line circuits for “phasing out” tests.



Figure 55. VCP-W Manual Ground and Test Device.

Section 10: Metal-clad switchgear field taping procedure (5/15 kV)

10.1 Busbar taping

Materials for taping

Reference Figures 56 and 57 below for details on proper busbar taping.

- Filler: A putty-like material:
Trade name: Scotchfil® or Nashau® 102. Pieces of insulating tape may be used.
- Insulating tape and pad – High voltage EPR insulating tape:
Trade name: Scotch® 130C.

10.3 Cable termination taping

If cable termination insulation boots are not provided, Eaton recommends using tape material, Trade name: Scotch 130C, for all cable termination insulation. Refer to 3M's taping method instructions, Tape Method for Insulating Bus-Bar Connections 5-35 kV to meet ANSI C37.20 requirements, for installation techniques when using this tape.

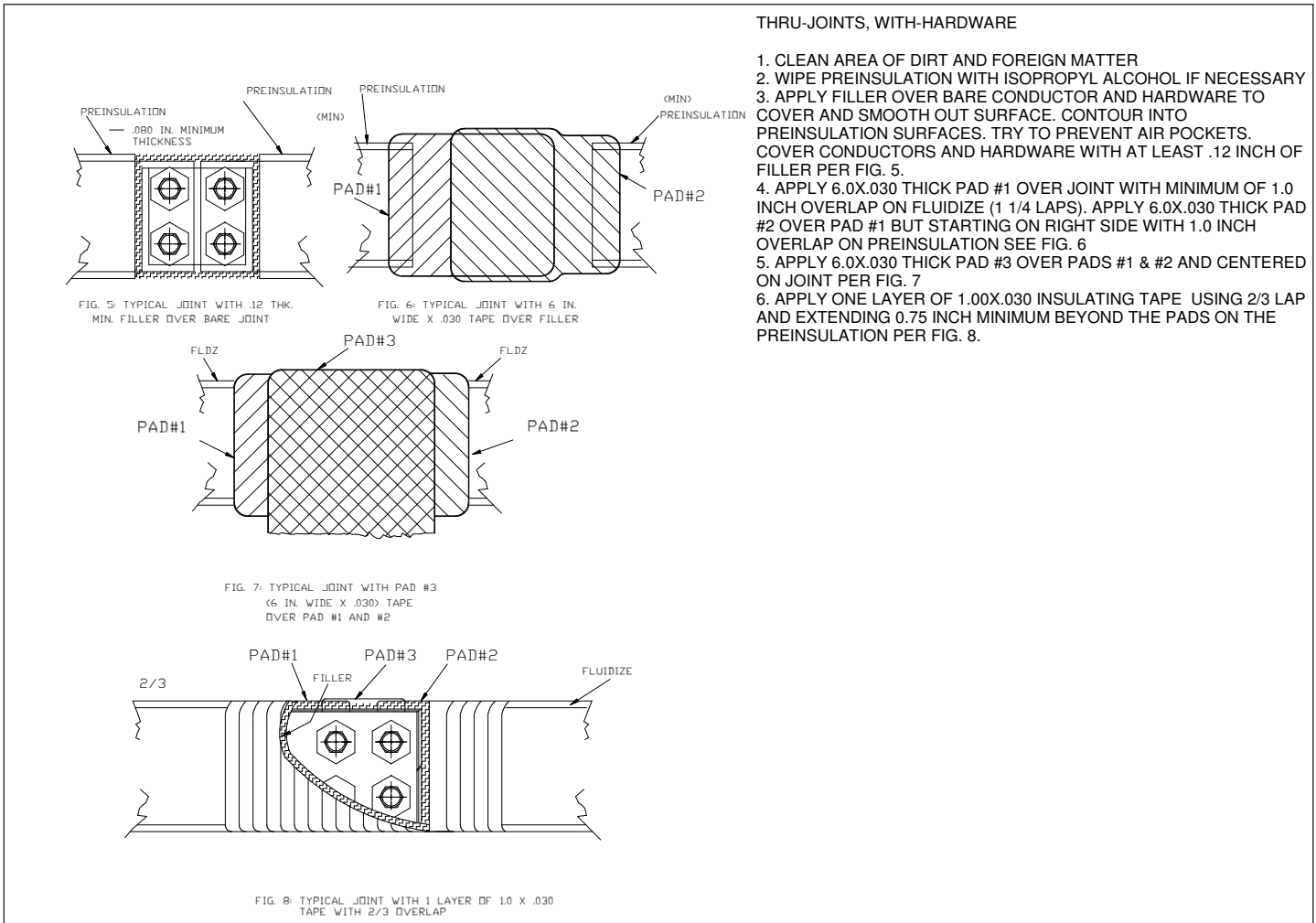


Figure 56. Thru-joint Field Taping Methods.

10.2 Using an insulating boot

Step 1

Clean the area of dirt and foreign matter. Use a clean, dry cloth or, if necessary, dampen slightly with distilled water. Do not use any abrasives or solvents.

Step 2

Place the boot over the joint so it fits in place. Fasten together with plastic wire ties. Cut off excess ends of plastic wire ties.

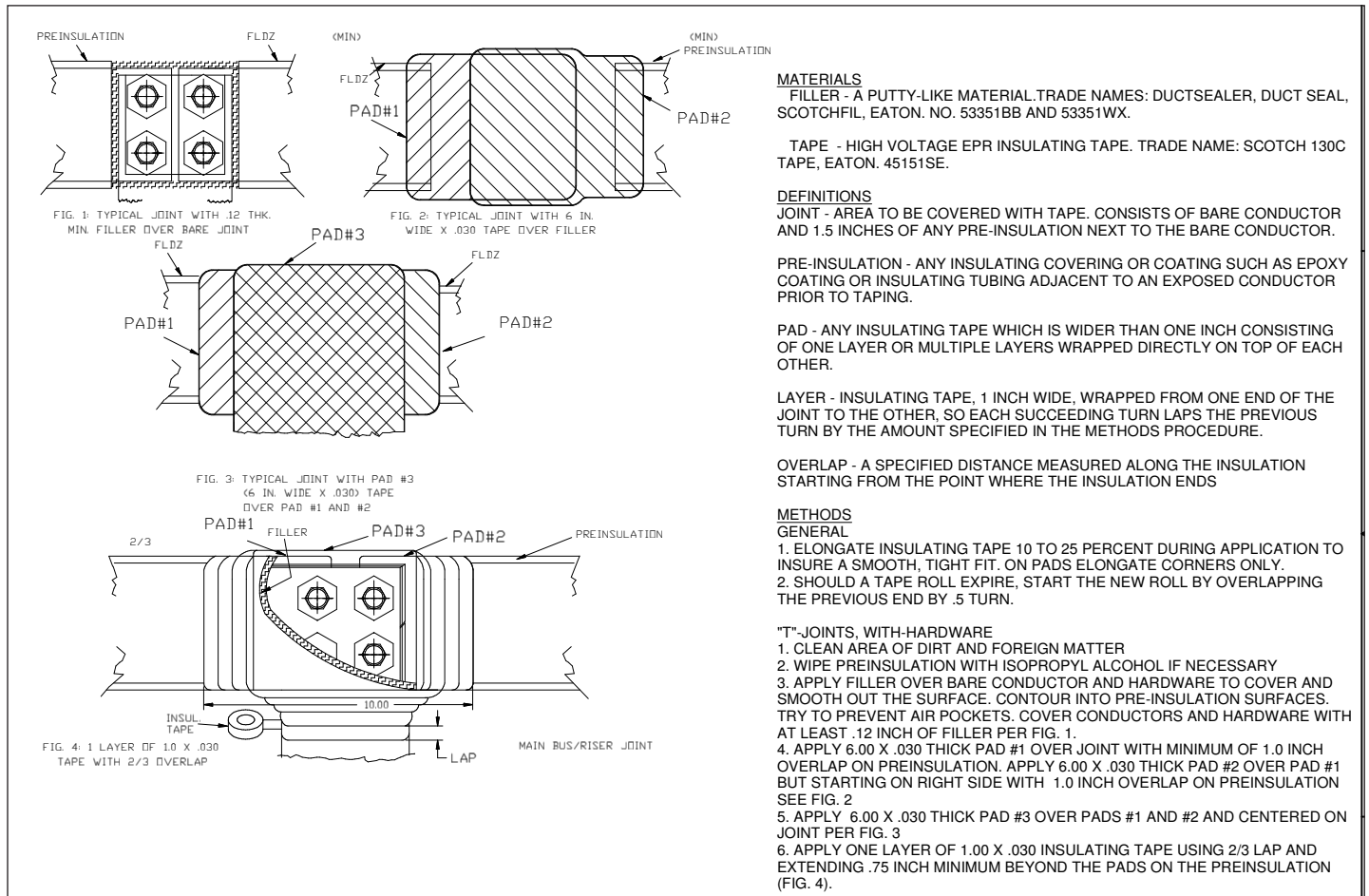


Figure 57. T-joint Field Taping Methods

Table 4. Taping Chart.

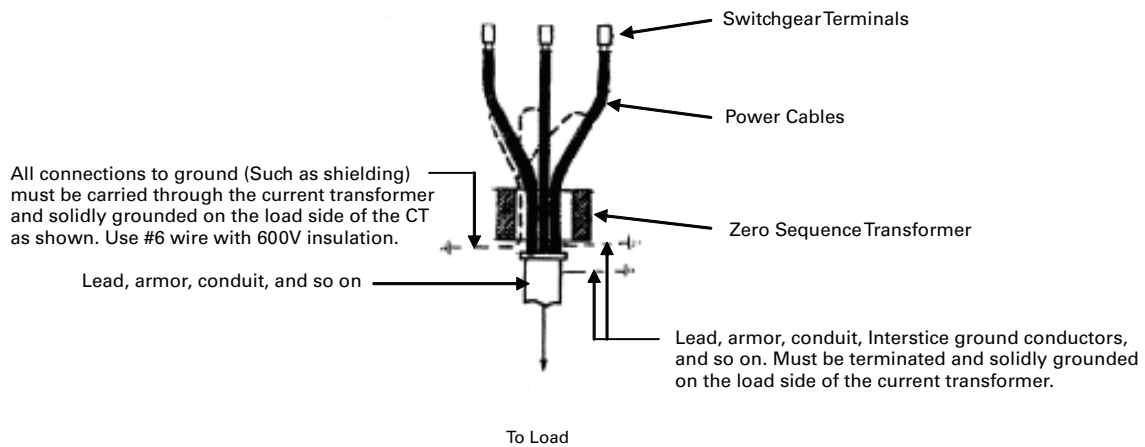
| Switchgear Voltage kV | Pre-insulation or Pad Overlap Minimum | | Insulating Tape | |
|--------------------------|---------------------------------------|-------------|-----------------|----------------|
| | in (mm) | Lap of Tape | Layers | Number of Pads |
| Up to 5 | 1.50 (38.1) | 0.5 | 1 | 1 |
| 7.5 and 15 | 1.50 (38.1) | 0.66 | 1 | 2 |

10.4 Responsibility of installer

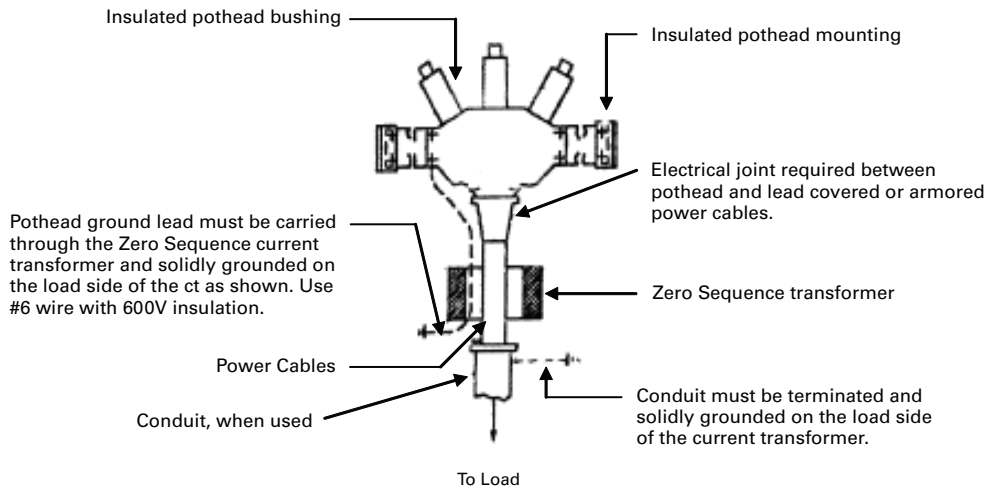
- For incoming or outgoing terminations, these approved materials are not supplied by Eaton and must be obtained and installed by others as identified above in the definitions.
- For connections involving shipping splits within an assembly, or connecting to a transformer, or to an AMPGARD MCC, or to an MVA switchgear assembly, insulating materials will be supplied by Eaton only if necessary. It is the responsibility of the installer to insulate the connections in accordance with these instructions.
- For an assembly that does not have continuous insulating sleeving on the phase bus conductors, cable connections or bus connections to other apparatus, insulation of these connections must be made.

CAUTION

FAILURE TO INSTALL FIELD INSULATION WHERE NECESSARY IN ACCORDANCE WITH THESE INSTRUCTIONS WILL COMPROMISE THE ELECTRICAL RATINGS OF THE SWITCHGEAR ASSEMBLY. INSTALL FIELD INSULATION TO MAINTAIN THE ELECTRICAL RATINGS.



Cable connections to switchgear terminals when used with Zero Sequence Transformers



Cable connections to switchgear terminals when used with Insulated Pothead.

Figure 58. Zero Sequence Current Transformer Connections.

Notes:

Instruction Booklet IB02201001E

Effective July 2016

Revision #3

Notes:

Instructions for installation, operation, and
maintenance of 5/15 kV type VacClad-W
arc resistant metal-clad switchgear

Notes:

Instruction Booklet IB02201001E

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Revision #3

Instructions for installation, operation, and
maintenance of 5/15 kV type VacClad-W
arc resistant metal-clad switchgear

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