

# Instructions for installation, operation, and maintenance of 38 kV type VacClad-W arc resistant metal-clad switchgear



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Read and understand these instructions before attempting installation, operation, or maintenance of this equipment. This equipment must be installed and serviced only by qualified electrical personnel. Retain this document for future use.

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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.**

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**⚠ 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.**

**DO NOT ATTEMPT ANY WORK ON THIS EQUIPMENT SUCH AS INSTALLING COMPONENTS, PERFORMING ANY EXAMINATIONS, PERFORMING ANY ADJUSTMENTS, PERFORMING ANY SERVICING, OR PERFORMING ANY MAINTENANCE WHILE IT IS ENERGIZED. BEFORE PERFORMING ANY WORK, FOLLOW ALL APPROPRIATE HAZARD ASSESSMENT AND ENERGY CONTROL PRECAUTIONS AND PROCEDURES.**

**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.**

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**⚠ DANGER**

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

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**Section 1: Introduction**

**1.1 Purpose**

This instruction bulletin covers the installation, operation, and maintenance of a 38 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 38 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 2. 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. Download Eaton electronic information from [www.eaton.com](http://www.eaton.com).

For more information on installation and application, refer to the applicable technical data, publications, and/or industry standards publications.

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

For VCP-W breaker: IB3A74792.

For switchgear mounting to a foundation: job floor plan document.

For sample ground and test device: refer to the document received with the device.

**1.4 Eaton contact information**

For additional information about Eaton products please call 1-800-525-2000 or log onto [www.eaton.com](http://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**

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**⚠ CAUTION**

**MODIFICATIONS TO THE SWITCHGEAR ENCLOSURE CAN COMPROMISE THE ARC RESISTANT PROPERTIES OF THE SWITCHGEAR. DOORS THAT OPEN TO THE ENCLOSED LOW VOLTAGE COMPARTMENTS ARE THE ONLY PARTS THAT MAY BE MODIFIED FOR MOUNTING COMPONENTS DUE TO THE TYPE 2 ARC RESISTANT RATING. THESE DOORS ARE FOUND IN THE UPPER 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.**

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Figure 1. Panel Modifications.

### 1.6 Safety precautions

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**⚠ 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.**

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1. Read and understand these instructions and any additional instructions identified in this document 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 the door is open, making any adjustments inside or outside the enclosure, performing maintenance, or installing replacement parts.

3. Never leave a breaker or transformer drawer in an intermediate position in its compartment. Always crank the breaker or transformer drawer 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 carrying load current. In this situation, the transformer develops a dangerous high voltage.

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**⚠ CAUTION**

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

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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 torqued per Table 3.
8. Confirm that no tools or objects are left inside the enclosure.
9. Confirm that all devices, covers, doors, panels, and so on, are in place.
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 IB3A74792.

**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 booklets and drawings are located inside the upper compartment door of the first vertical section and online at [www.eaton.com](http://www.eaton.com).

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

**2.1 Floor requirements**

The finished foundation surface shall be flat and level within 0.06 in. (1.6 mm) in 36 in. (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 installations 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 MVS Switchgear	Phase-to-Phase in. (mm)	Phase-to-Ground in. (mm)
38	8.25 (209.6)	8.25 (209.6)

**2.3 Installation procedure**

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 the bolt end, insert the bolt through a hole, and 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 in. (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 #15 - #23 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 - #14 can be accessed from the front module.



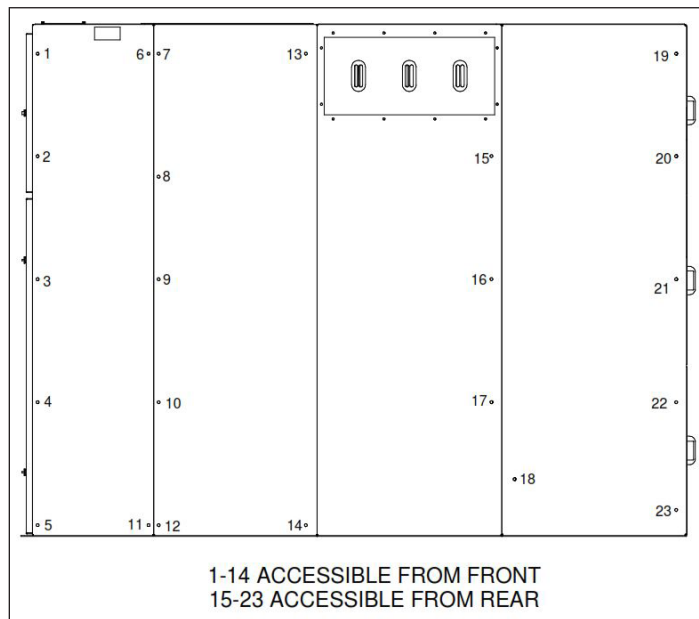
2. Check the entire lineup to make sure it is level and plumb prior to bolting or welding the base members of the vertical section frame, front, and rear to the foundation.
3. Remove all shipping blocks or braces.
  - a. Remove shipping braces from the CT bushings in the main bus compartment and CT spouts in the cable compartment.
  - b. Examine all meters, relays, and so on, and remove any shipping blocks or braces. Remove lifting angles from top of the units and discard them.
4. Connect the ground bus.
  - a. The ground bus in the switchgear is assembled in sections. There is a joint in each housing. Solderless terminals are provided on the ground bus in each end unit. Use these terminals to connect the ground bus to the station ground. Make the connection as direct as possible. It should be large enough to carry the ground fault current of the installation. Never house it in a metal conduit.
  - b. The standard ground bus is a 0.25 in. x 2.00 in. (6.4 mm x 50.8 mm) copper busbar bolted to the cross members of the frame in the bottom of each enclosure. The ground bus runs through the center of each section through the length of the entire switchgear system. Install a ground link and hardware (ground link, located in the detail box) to connect the shipping sections. Tighten connections per Table 3.

**⚠ 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 resistance should be less than 5 ohms. (The National Electrical Code states that the ground resistance should never exceed 25 ohms.)



**Figure 2. Tie Bolt Locations.**



Ground Bus  
(Rear View)

**Figure 3. Ground Bus Installation.**

5. Connect the high voltage bus between the shipping groups.
  - a. Remove the horizontal metal barriers from the cable compartment in the rear of the switchgear. Remove the bus barrier. Also remove any other components such as potheads, surge suppressors, and so on, that interfere with access to the bus compartment.

**Note:** Rear assembly of switchgear may vary.

Figure 4 shows the removal of necessary barriers (typical).

- b. Obtain the section of bus that was removed to separate the groups for shipping. 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.

When the bus section is disconnected for shipping, the splice plates and hardware are left bolted to the end of the bus in each of the adjoining vertical sections. Sandwich the end of the disconnected section 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. Do not tighten until all joints throughout the line-up are installed.

**⚠ WARNING**

**USING WRONG HARDWARE MAY RESULT IN REDUCED CLEARANCE AND/OR MAY CAUSE DAMAGE.**

- e. Repeat these steps for each section of bus at each shipping break.
- f. Torque the bolts in the splice plate to the values shown in Table 3.
- g. Cover joints with the insulating boots provided. Figure 7 shows the main bus installation and insulating boots.



**Figure 4. Removal of Necessary Barriers.**

- 6. Connecting the internal control 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.
  - 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.

**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 6f or 6g below.

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- f. Fill all wiring openings through which wiring passes from the center mounted control compartment to the upper compartment or to the lower front compartment (see Figure 5). 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).

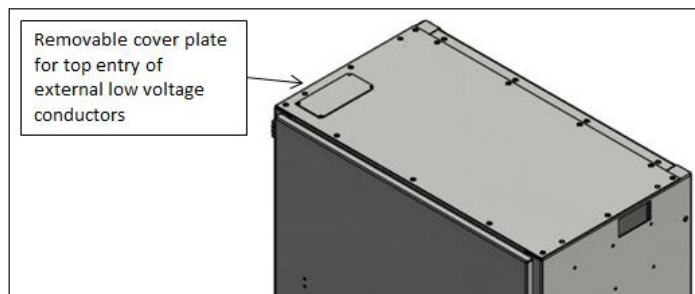


**Figure 5. Caulk Filling Between Low and Medium Voltage Sections.**

- g. Fill all wiring openings through which wiring passes from the center mounted low voltage compartment to the medium voltage compartments with caulk as shown in Figure 5. 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).

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

- h. For top entry of external low voltage conductors, there are removable cover plates (see Figure 6) 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 6f and 6g above.



**Figure 6. External Control Wiring Plate.**



- i. For bottom entry of external low voltage conductors, there are removable cover plates on the floor of the front of a vertical section. For any foundation method, it is the responsibility of that 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. i1 and i2 following are suggestions for two commonly encountered foundations.
  1. 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.
  2. 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 h for conduits, jacketed multiple conductor cables, or bundled unjacketed conductors.
7. Replace the metal barriers and any other parts that may have been removed to gain access to the main bus compartments.
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 the 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 that 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).
- g. If zero sequence current transformers are used pass the power cables through the transformer (see Figure 39) 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 rear covers then install and tighten all bolts. Refer to Figure 7.



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

9. 38 kV arc skirt assembly instructions.

Parts for arc skirt assembly are listed on the parts lists for the order and supplied detail for field installation on top of the switchgear lineup. Install the arc skirt assembly as follows.

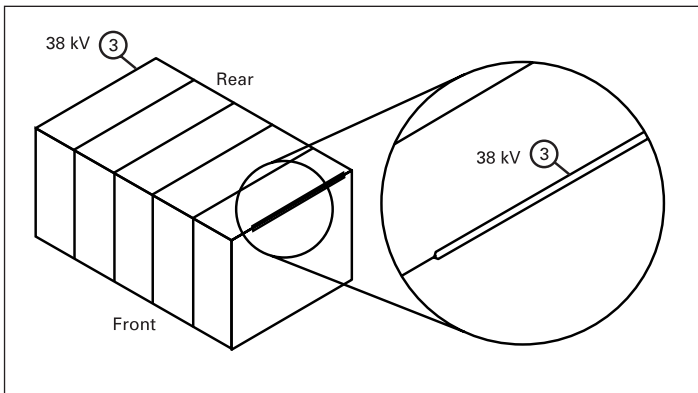
The following instructions and illustrations show how to assemble the arc skirts to a 38 kV switchgear enclosure. The arc skirts are mounted to the roof to provide a degree of protection in the event of an arc fault inside the enclosure. The arc skirts are designed to direct the arc byproducts away from personnel working near the enclosure.

It is important to completely read and to understand the instructions before beginning any assembly.

**Table 4. List of Parts Used.**

Item Number	Description	Eaton Number
1	38 kV front/rear vertical skirt	1C95598H01
2	38 kV side vertical skirt	1C95598H02
3	38 kV side vertical skirt-mounting strip	1C95598H04
4	38 kV vertical skirt seam cover	1C95598H05
5	38 kV side horizontal skirt	1C95700H02
6	38 kV middle horizontal skirt	1C95700H08
7	38 kV end horizontal skirt	1C95700H09
8	38 kV skirt support	1C95700H06

Step 1: Assembly of vertical skirt mounting strips (Figure 8). Bolt one vertical skirt-mounting strip (Item 3) to the extreme left roof and one to the extreme right roof. Use the existing roof bolts to secure the skirt-mounting strips. Mount as shown in Figure 8.



**Figure 8. Assembly of Skirt-Mounting Strips.**

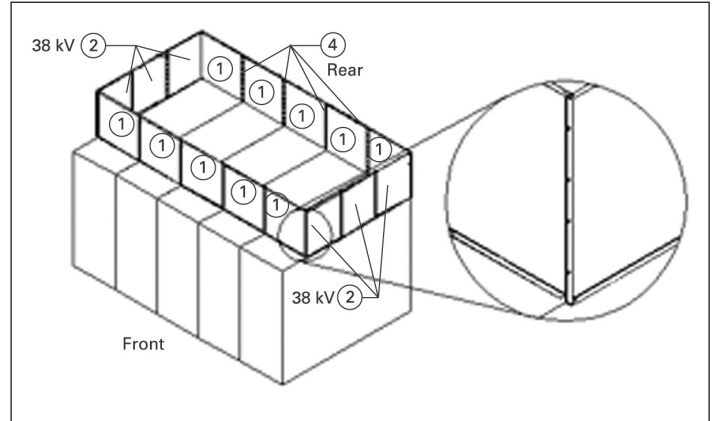
Step 2: Assembly of the front and side vertical arc skirts (Figure 9). Important: all vertical arc skirts are mounted with the bent flanges pointing outward.

Install the front and rear vertical arc skirts (Item 1) with the large slotted holes to the bottom. Use the existing hardware to bolt the front and rear vertical arc skirts to the roof.

Mount the left and right vertical arc skirts (Item 2) to the vertical arc skirt-mounting strip installed in Step 1. Use 0.25 in. (6.4 mm) bolts with a flat, lock, and nut to secure arc skirts to mounting strip.

Attach the seam covers (Item 4) to the inside of every vertical arc skirt joint. Use 0.25 in. (6.4 mm) bolts with a flat, lock, and nut to secure the seam covers to the arc skirts.

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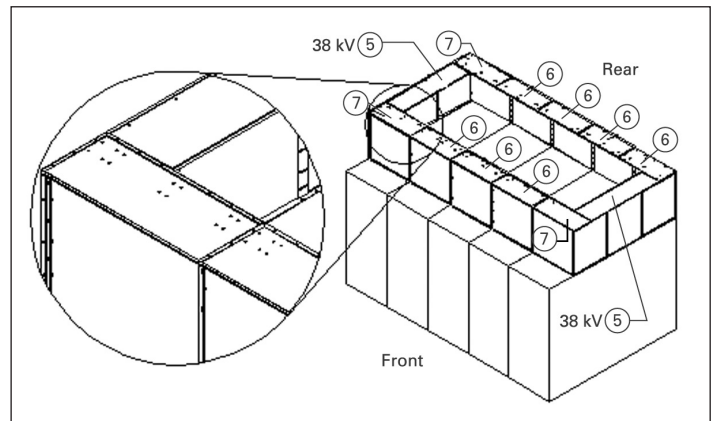


**Figure 9. Mounting of Vertical Arc Skirts and Seam Covers.**

Step 3: Assembly of the front and side horizontal arc skirts (Figure 10). Important: all horizontal arc skirts are mounted with the bent flanges pointing upward.

Bolt the front and rear horizontal arc skirts (Items 6 and 7) to the vertical arc skirts using 0.25 in. (6.4 mm) bolts with a flat, lock, and a nut. Do the same with the side horizontal arc skirts.

Connect the side horizontal arc skirt (Item 5) to the end horizontal skirt (Item 7) using 0.25 in. (6.4 mm) bolts with a flat, lock, and a nut.



**Figure 10. Assembly of the Horizontal Arc Skirts.**

Step 4: Assembly of the skirt supports (Figure 11). Important: All skirt supports are mounted with the bent flanges pointing downward.

Bolt the arc skirt supports (Item 8) to the underside of the horizontal arc skirts using 0.25 in. (6.4 mm) bolts with a flat, lock, and a nut as shown in Figure 11.

Space the arc skirt supports at equal distance from one another, and be sure to install all the arc skirt supports received.

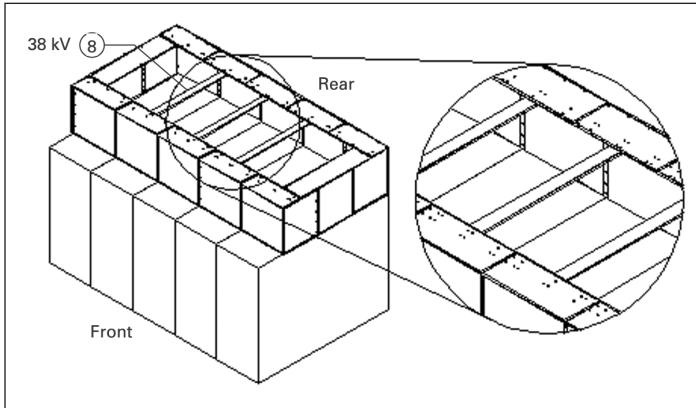


Figure 11. Mounting of the Arc Skirt Supports.

10. Check the operation of the levering in system in each of the breaker compartments. Refer to the breaker Instructional Booklet, IB3A74792, for additional details on manual and electrical operation checks of the breaker.
  - a. Push the breaker into the breaker compartment until the breaker lift/pull handle latches over the moving block on the racking screw. Channels are provided on the floor sheet to assist in the alignment of the breaker wheels as it is moved into the compartment. In this position, the breaker is considered in the Disconnect position.
  - b. In order to place the breaker in the Test position mode, you must pull the secondary plug handle forward until the secondary plug, located on the compartment levering pan, fully mates with the breaker secondary plug. In this position, the breaker compartment 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. Before the breaker can be moved from the Disconnect or Test position to the Connect position, the breaker must be open.
    2. Insert the levering crank onto the hex drive nut on the racking screw. In order to engage the hex drive nut, you must push a safety slider in and out of the way of the hex nut.
 

**Note:** If the breaker is closed, you will not be able to push the safety slider in to engage the hex drive nut. You must trip the breaker by means of either the Open pushbutton on the front of the breaker or electrically using the control circuit.
    3. Rotate the levering crank in a clockwise direction until the torque limiter on the levering crank “breaks” free. As a check, the red indicator on the levering system can be seen through the window on the front of the levering system.
  - d. Movement of the breaker from the Connect position to the Disconnect position:
    1. Before the breaker can be moved from the Connect position to the Disconnect or Test position, the breaker must be open.
    2. Insert the levering crank onto the hex drive nut on the racking screw. In order to engage the hex drive nut, you must push the safety slider in and out of the way of the hex nut.
 

**Note:** If the breaker is closed, you will not be able to push the safety slider in to engage the hex drive nut. You must trip the breaker by means of either the Open pushbutton on the front of the breaker or electrically using the control circuit.

3. Rotate the levering crank in a counter-clockwise direction until the breaker is in the Test of the Disconnect position.

**Note:** The secondary plug on the compartment pan assembly is automatically disengaged from the breaker secondary plug.

Test the breaker and cell interface per IB3A74792.

11. Refer to Sections 3.4 and 3.5 for further description of the fused VT drawers and interlocks. Check the drawout transformer drawers in the auxiliary compartments.
  - a. Unbolt and remove the front covers of the auxiliary compartments.
  - b. The transformer drawers are shipped installed in the switchgear in the Disconnect position. There are yellow shipping braces located in the auxiliary compartments. This bracing secures the transformer drawer to the cell for shipping purposes only. Remove these braces and angles.
  - c. Remove the transformer drawers from the auxiliary compartments. After removing the drawers, check for any damage to the transformers, transformer fuses and fuse tubes, drawers, and cell parts.
  - d. The voltage transformer fuse is an integral part of the transformer. The fuse is located inside of a fuse tube mounted on top of the transformer. The transformer(s) are mounted on a drawer. Check the fuses for continuity. At one end of the fuse tube is a contact spring and at the other is a contact plate. Continuity can be checked between the two ends. See the Transformers and primary fuses section of this manual for directions on how to gain access and replace fuses.

### NOTICE

**DO NOT HANDLE THE FUSE TUBES FOR PURPOSES OTHER THAN CHANGING OUT FUSES. DOING SO, MAY CAUSE DAMAGE TO THE FUSE TUBES AND MATING PARTS.**

- e. Installation of the transformer drawer into auxiliary compartment:
  1. Confirm that the transformer drawer is in the fully retracted position prior to moving it into the compartment. The drawer is fully retracted when the upper-half section of the drawer is butted up against the lower-half section of the drawer (see Figure 14).

### NOTICE

**DO NOT HANDLE THE FUSE TUBES LOCATED ON TOP OF THE TRANSFORMERS WHILE MOVING IN THIS MANNER. THIS MAY CAUSE DAMAGE TO THE FUSE TUBES AND MATING PARTS.**

2. Move the transformer drawer into the auxiliary compartment until the drawer latches into place. An audible “clicking” noise can be heard when the drawer latches in place. Pull back on the drawer to confirm it is fixed and latched in place. In this position, the drawer and transformer(s) are considered in the Disconnect position.
3. Verify the primary shutters remain closed.
- f. Install the front cover and check the transformer fuse static ground plunger devices:
  1. Install and bolt the front compartment cover in place. The transformer drawer is fitted with a safety plate that blocks access to the racking screw until the drawer is in the compartment and the front compartment cover is in place.



- g. Movement of the transformer drawer from the Disconnect position to the Connect position:
  1. Rotate the racking cover plate knob to expose the nut at the front of the racking screw on the transformer drawer.
  2. Place the socket of the levering crank through the cover and onto the racking screw nut. Rotate the levering crank clockwise until the transformer drawer is in the Connect position. The Connect position is reached when the torque limiter on the levering crank "breaks" free. Check to make sure the primary and the secondary contacts are engaged when the transformer drawer is in the Connect position. Use the "lighting out" or "ringing" methods to verify.
  3. Verify that the primary shutters are open and have operated properly. The shutters can be viewed from within the closed compartment through the viewing window on the front cover.
  4. The front cover can not be removed when a transformer drawer is in the Connect position. The transformer drawer must be in the Disconnect position to remove the cover.
  
- h. Movement of the transformer drawer from the Connect position to the Disconnect position:
  1. Rotate the racking cover plate knob to expose the nut at the front of the racking screw on the transformer drawer.
  2. Place the socket of the levering crank through the cover and onto the racking screw nut. Rotate the levering crank counter-clockwise until the transformer drawer stops and is in the Disconnect position.
  3. Verify that the primary shutters are closed and have operated properly. The shutters can be viewed from within the closed compartment through the viewing window on the front cover.
  4. The front cover can now be unbolted and removed because the drawer is in the Disconnect position.

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

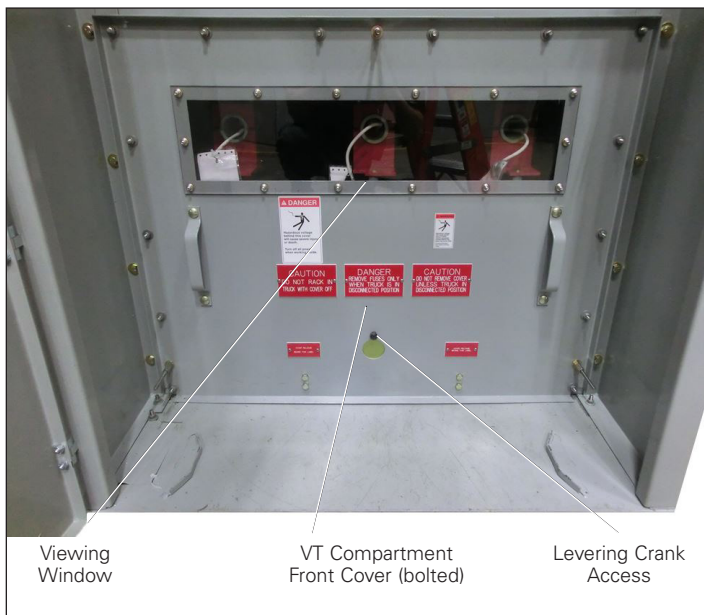


Figure 12. Typical VT Compartment.

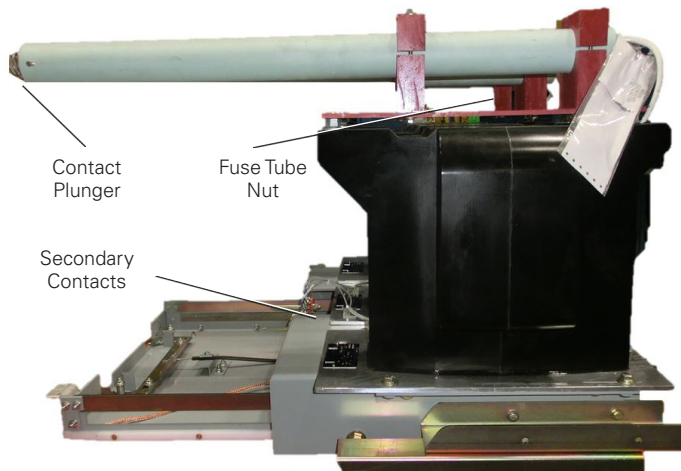


Figure 13. Typical VT Drawer Assembly (Shown Removed).

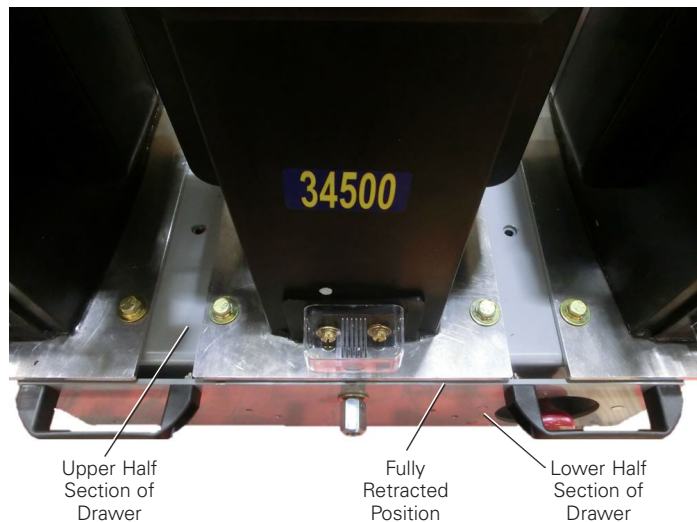


Figure 14. Transformer Drawer in the Retracted Position.

### Section 3: A further description of arc-resistant VacClad-W switchgear



Figure 15. Typical 38 kV Arc-Resistant Switchgear Assembly (Arc Skirts Not Shown).

#### 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 seconds 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 manufacturer 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 compartment door features and interlocks

Refer to Figure 16.

1. **Shipping brace**  
Remove the orange shipping brace before breaker is put into service, but only after the enclosure is in its final and permanent position. The safety flap must remain open during normal breaker operation in order to provide adequate ventilation. Do not put a breaker into service with the safety flap closed. The safety 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.
2. **Low voltage controls compartment door**  
The low voltage controls compartment door must be closed when breaker is in service. This compartment can be used to mount protective relays, meters, and other control lights and devices.
3. **Breaker compartment door**  
All connection and disconnection of the breaker must be done with the 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 Test/Disconnected position. A second interlock prevents the racking in of the breaker if the door is not closed.  
Do not rack in breaker with door open, as this negates the arc resistance feature and will prevent the door from properly closing afterwards, due to mechanical interference with the locking mechanism.
4. **Safety note**  
Important note: all doors and panels must be properly closed and fastened for the arc-resistant feature of the switchgear to be operative.



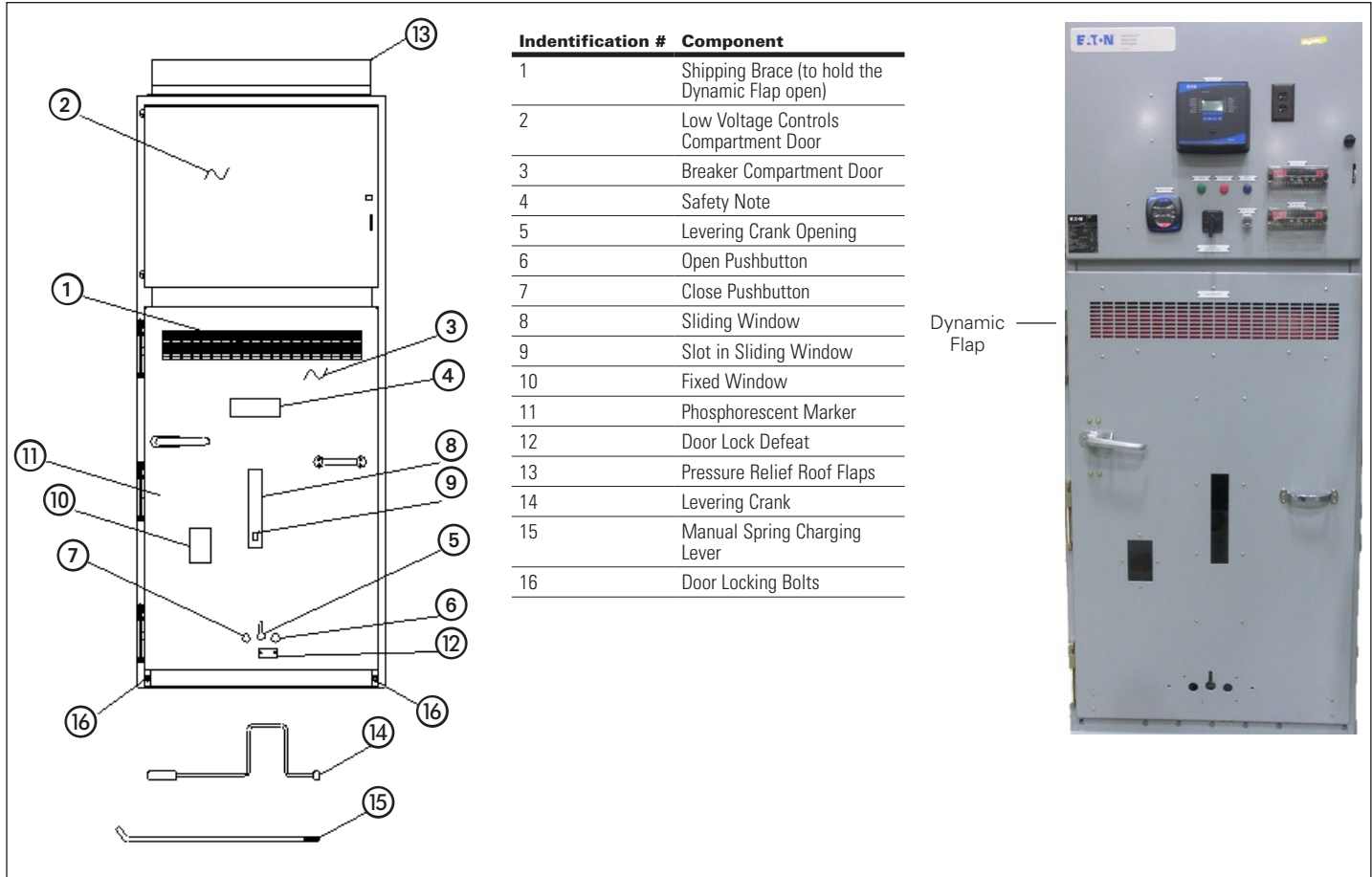


Figure 16. Switchgear Features and Interlocks.

5. Levering crank opening

The breaker must be Connected and Disconnected with the breaker door closed and using the levering crank. With the door closed, lift the cover to expose the hexagon head of the levering-in screw. Insert the levering crank and rotate clockwise to connect the breaker, and counterclockwise to move the breaker to the Test/Disconnected position.

6. Open pushbutton

With the door closed, press the right button to open the breaker main contacts.

7. Close pushbutton

With the door closed, press the left button to close the breaker main contacts.

8. Sliding window

This window is used for observing:

- Breaker position—Connected or Disconnected;
- Spring status—Charged or Discharged;
- Phosphorescent marker.

9. Slot in sliding window

The manual spring charging lever is inserted through the slot to manually charge the breaker springs. A vertical up and down movement of the lever will charge the breaker springs (approximately 38 movements are required).

10. Fixed window

This window is used to observe:

- Breaker operations counter;
- Breaker contact position (open or closed);
- The phosphorescent marker (see item 11);

11. Phosphorescent marker

The phosphorescent marker is only visible through the fixed window when the breaker is in the Connected position and serves to indicate such.

12. Door lock defeat

The breaker compartment door is automatically locked closed when the breaker is moved from the Test position to the Connected position. In case of an emergency, it is possible to defeat the door interlock while the breaker is in the Connected position. Be aware that by opening the breaker door while the breaker is in the connected position defeats all safety features of the arc-resistant switchgear. Remove the nameplate to expose a spring-loaded locking bar. Push the spring-loaded locking bar inward until it clears the locking tab on the door. The door can now be opened.

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

13. Pressure relief roof flaps

In the event of an internal arc, the explosion gasses and debris are projected through the pressure relief roof flaps. It is essential that the roof flaps are not prevented from opening by any physical obstruction after installation.

14. Levering crank

This crank is used to rack the breaker in and out. The socket is designed to prevent hot gasses from escaping the front module. Do not use any other tool to replace the levering crank.

15. Manual spring charging lever

This lever is used to manually "charge" the breaker.

3.3 Opening and closing of breaker compartment door

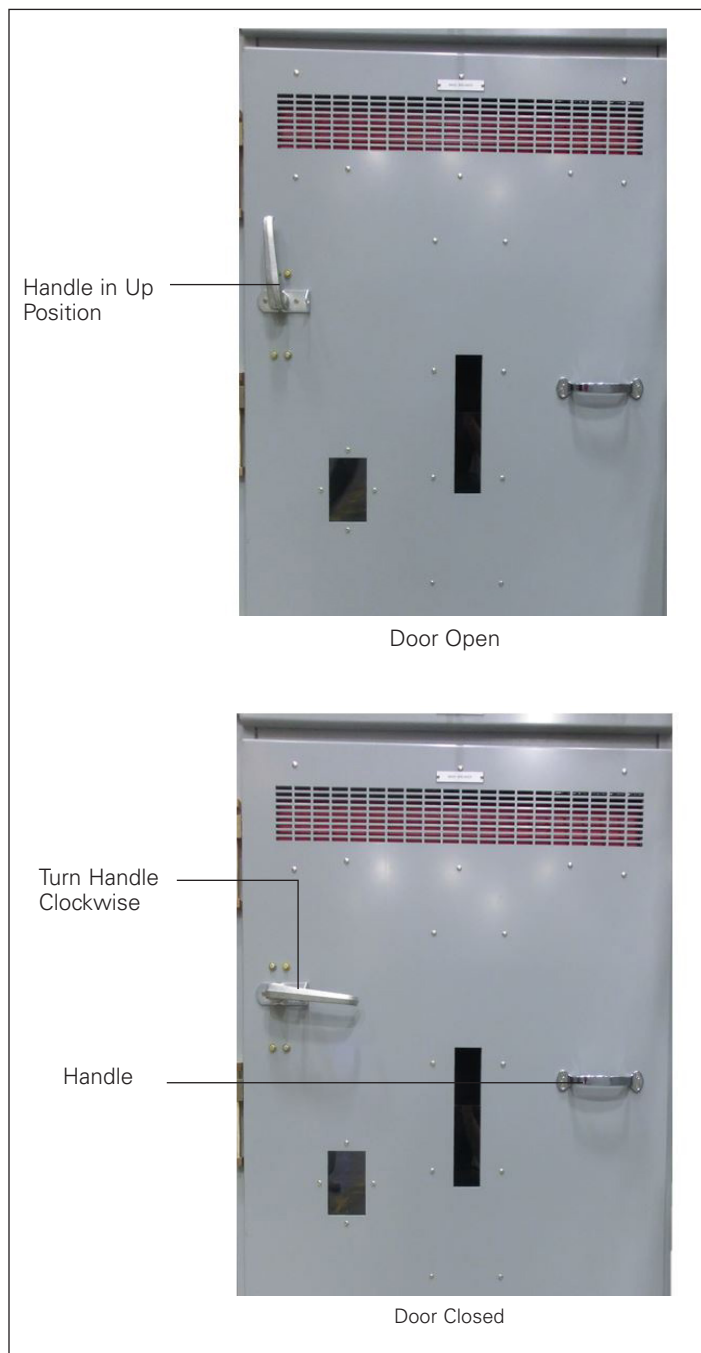


Figure 17. Opening and Closing of Breaker Compartment Door.

To open a closed door, follow the steps below:

1. Open the circuit breaker. Rack it out to the Test/Disconnected position.
2. Remove the two bolts located at the left and right lower corners of the door.

**Note:** The door is designed to capture the loose bolts, therefore the bolts should not be completely removed from the door.

3. Turn handle counterclockwise while lifting up on the grab handle. The door will slide upward approximately 0.75 in. (19.1 mm).
4. When the door is at its uppermost position, rotate the door open.

To close an opened door, follow the steps below:

1. Make sure that the breaker is in the Test/Disconnected position.
2. With the door at its uppermost position, rotate the door closed.
3. Turn handle clockwise while pushing down on the grab handle. The door will slide downward approximately 0.75 in. (19.1 mm). Make sure the slots in the bottom of the door are properly aligned with the pins in the floor.
4. Insert and tighten the two bolts located at the left and right lower corners of the door.

3.4 Fused VT compartment features and interlocks

Fused VTs are mounted on a drawer (Figure 13), which is then inserted into the VT compartment (Figure 12). The VT drawer is inserted (manually rolled) into the compartment until it can not be pushed further. The fused VTs must be in the disconnect position before inserting the drawer into the compartment. The primary shutter remains closed (Figure 18). To insert the drawer further from the disconnected position to the connected position, a front cover (Figure 23) must be bolted in-place. When the cover is in-place and bolted, an interlock assembly (Figure 23) allows the VT shutter to open as indicated in Figure 19. After bolting the front cover in-place, the fused VT drawer can be racked into the Connected position using a levering crank via access port (Item 5 in Figure 23) provided on the front cover. The Connected and Disconnected positions are indicated when the levering screw can not be turned any further.

The grounding and discharging of primary fuses is accomplished via grounding contacts (Item 14 in Figure 23) provided on the back of the front cover when the VT drawer is in the Disconnected position. The grounding of primary fuses when the VT drawer is in the Disconnected position can be verified by simply viewing through a viewing window provided on the front cover.

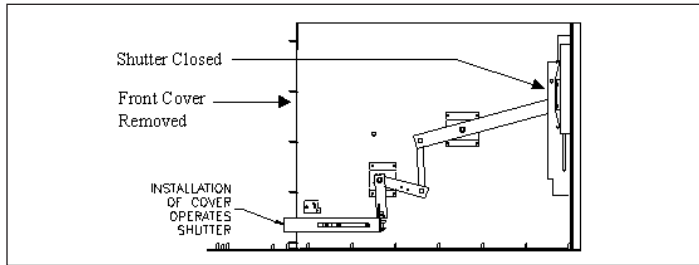
When the front cover is bolted-in place, its interlocking assemblies (Figure 23) interfaces with the VT drawer parts to provide the following interlocks.

- a. The front cover cannot be removed unless the VT drawer is in the fully Disconnected position.
- b. The VT drawer cannot be moved or racked toward the connected position unless the front cover is bolted in-place.

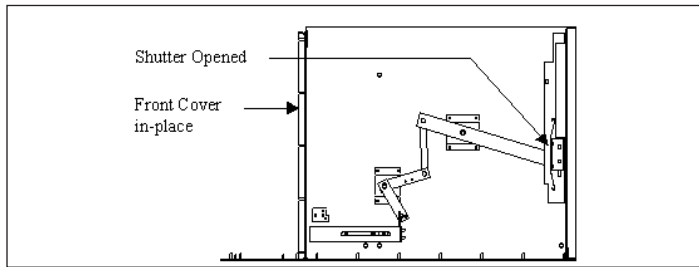
The interlocking is achieved as follows (Figures 21 and 22).

- When the VT drawer is in the fully Disconnected position, cover lifting angle disengages the drawer latch from the stop, allowing drawer to be racked into the Connected position, and drawer lifting angle disengages cover latch from the stop, allowing cover to be removed.
- When the VT drawer is not in the fully Disconnected position, cover latch engages the stop, preventing the cover from being removed.
- When the cover is removed, the drawer latch engages the stop, preventing racking of VT drawer from Disconnected to Connected positions.

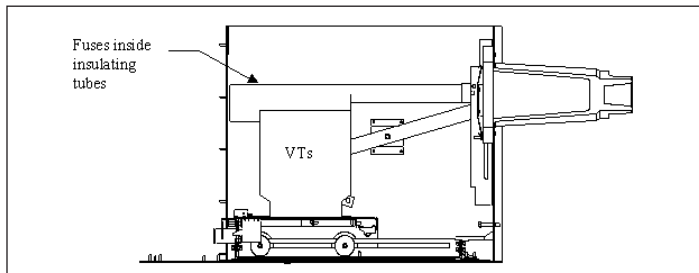
If it becomes necessary to remove the front cover when the VT drawer is not in the fully Disconnected position, the interlocking can be defeated by removing the interlock defeat covers (Figure 23), and lifting the drawer latch and cover latch from the stop, using a screwdriver or similar tool.



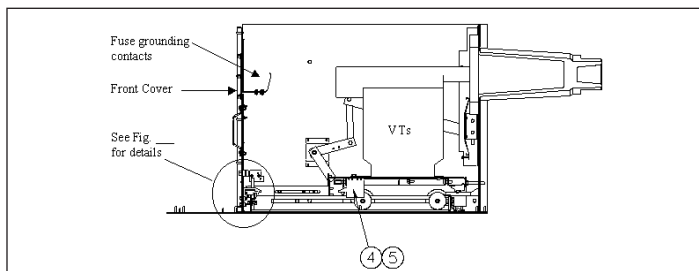
**Figure 18. VT Compartment Shown Without VTs, with Front Cover Removed (Side View).**



**Figure 19. VT Compartment Shown Without VTs, with Front Cover Bolted In-Place (Side View).**

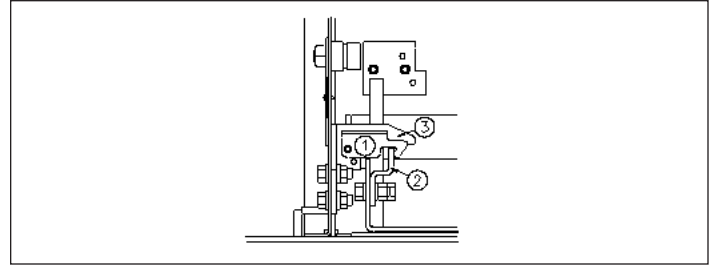


**Figure 20. Fused VT Assembly Shown in Disconnected Position with Front Cover Removed (Side View).**



**Figure 21. Fused VT Assembly Shown in Connected Position with Front Cover In-Place (Side View).**

## Instructions for installation, operation, and maintenance of 38 kV type VacClad-W arc resistant metal-clad switchgear



**Figure 22. Interlocking Details.**

### 3.5 Voltage transformers with fuses

The drawout fused VT assembly (Figure 13) is a removable element, consisting of a voltage transformer(s) with integral fuse(s) installed in a fuse tube assembly. The fused VT assembly(s) is mounted on a drawout drawer assembly.

The drawout drawer assembly is installed by rolling the assembly into the cubicle until the rear flange of bottom pan contacts the stops on the cubicle floor (Figure 12).

### **CAUTION**

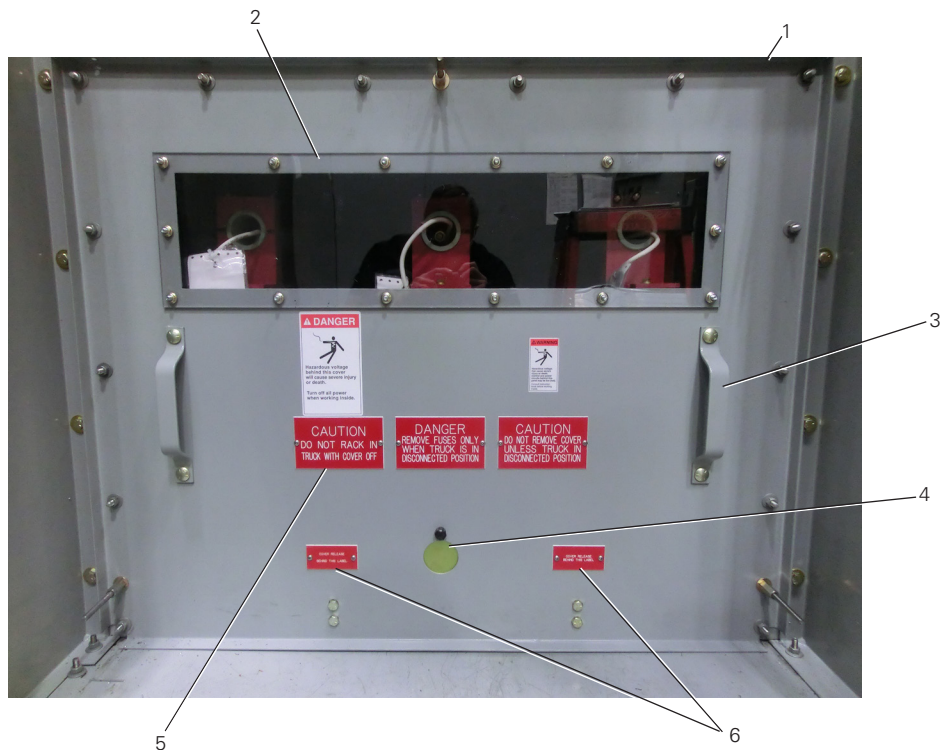
**THE FUSED VT ASSEMBLY MUST BE IN THE FORWARD (DISCONNECT POSITION) BEFORE INSTALLING THE DRAWOUT ASSEMBLY.**

After installation, the front cover (see Figure 12) is installed using 5/16-18 nuts, lock washers, and flat washers.

The standard breaker levering crank is used to rack the assembly to the connect position. The levering crank is inserted through the access hole on the front cover onto the levering screw hex drive. As the carriage reaches the connect position, the eight pole moving and stationary secondary contacts mate primary contact is made with plunger type contacts on the fuse tube assembly.

Racking the levering screw counterclockwise will move the drawout assembly to the withdrawn position. Ground contacts on the front cover automatically ground and discharge the primary fuses. A viewing window provides visual indication of the drawout assembly and fuse grounding.

Interlocks prevent removal of the front cover when the drawout drawer assembly is not in the withdrawn position and prevent insertion of the drawout drawer assembly when the cover is not in place.



Identification #	Component
1	Cover
2	Viewing Window
3	Handles
4	Levering Crank Access
5	Caution Labels
6	Interlock Defeat Access

Figure 23. VT Compartment Front Cover Assembly.

### 3.6 Safety features

Eaton’s VacClad-W switchgear is manufactured with several built-in features. 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.

#### Coding plates

A coding 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 don’t match, the coding plate on the compartment will prevent the entrance of the breaker into the compartment.

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

#### Automatic shutter

An automatic shutter, shown in Figure 24, covers the primary disconnecting contacts when the breaker is withdrawn from the connect position. The shutter prevents persons who are working on the switchgear from accidentally touching the primary contacts. A roller on the breaker raises the shutter when the breaker is levered into the connected position. When the breaker is levered out, the shutter closes by spring action. Each shutter can be padlocked in the closed or open position manually (see Figure 25).

### **CAUTION**

**DO NOT MANUALLY RAISE OR REMOVE SHUTTER UNLESS PRIMARY CONTACTS ARE DE-ENERGIZED AND SAFETY PROCEDURES HAVE BEEN INITIATED TO MAKE SURE THE CIRCUIT CAN NOT BE RE-ENERGIZED. FAILURE TO EXERCISE CAUTION MAY RESULT IN BODILY INJURY AND PROPERTY DAMAGE.**



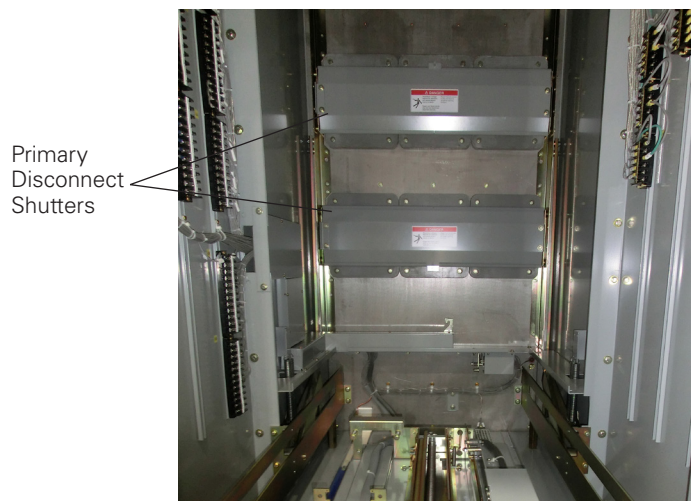


Figure 24. Breaker Primary Disconnect Shutters.

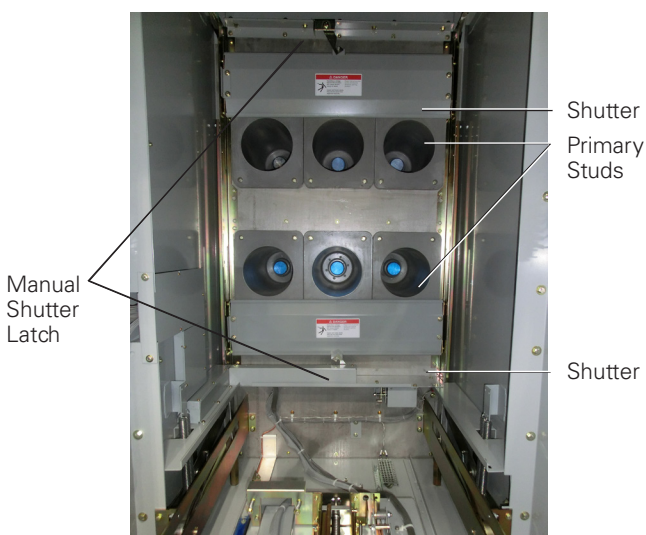


Figure 25. Manual Opening of Shutters (Breaker Compartment).

#### Door interlock

A bracket is fastened to linkage connected to the levering-in assembly, prevented the breaker door from opening when the breaker/drawer is in Connected position. This interlock can be defeated by removing the lock defeat name plate.

#### Ring-type current transformers

The ring-type current transformers are installed over the bus or line side primary bushings, which are located in the main bus compartment and line compartment, respectively. Maximum numbers of ring-type CTs that can be installed are as follows.

- Bus side bushings: Two sets of standard accuracy or one set of high accuracy.
- Line side bushings: Three sets of standard accuracy or one set of standard and one set of high accuracy.

The CTs are accessible from the rear of the enclosure only (see Figure 26). It is not possible to add or to change transformers until high voltage connections are removed. The polarity marks on the transformers show the relative instantaneous polarity in the primary and secondary windings. The diagrams show how to connect the transformers to give polarity needed to operate relays and instruments.

## Instructions for installation, operation, and maintenance of 38 kV type VacClad-W arc resistant metal-clad switchgear



Figure 26. Ring Type CTs.

#### 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.

The circuit breaker pan is equipped with provisions to mount a Kirk key to it. Refer to Figure 27 for the location of these provisions.

### **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 THEY ARE NOT AVAILABLE TO OPERATING PERSONNEL. THIS PROCEDURE IS NECESSARY BECAUSE IMPROPER USE OF SPARE KEYS WILL DEFEAT THE INTERLOCKING SCHEME.**

#### Lockout-tagout (LOTO) features

##### *Circuit breaker pan LOTO*

Lockout-tagout 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 (Refer to Item 6 in Figure 29).
3. Insert a LOTO option (see Figure 28) into the circuit breaker pan LOTO provisions (See Figure 27).
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.



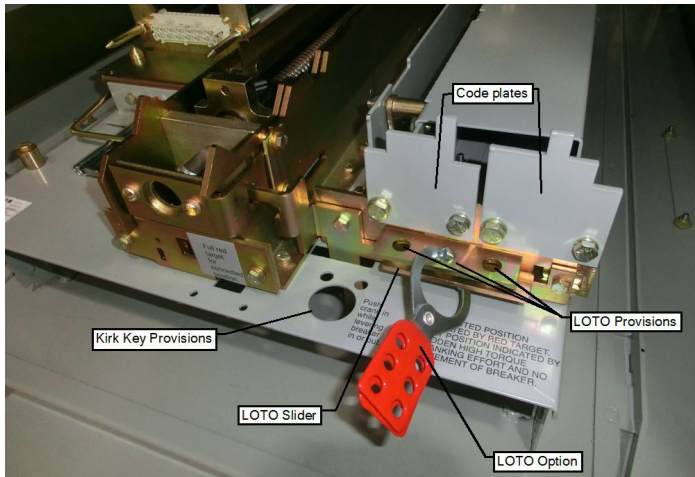


Figure 27. Lockout-Tagout Provision for Circuit Breaker Lockout.



Figure 28. Several Acceptable Lockout-Tagout Options.

**Note:** The LOTO options shown in Figure 28 only include a handful of accepted options. Other options may also work with the breaker pan LOTO provision.

### 3.7 Breaker pan assembly

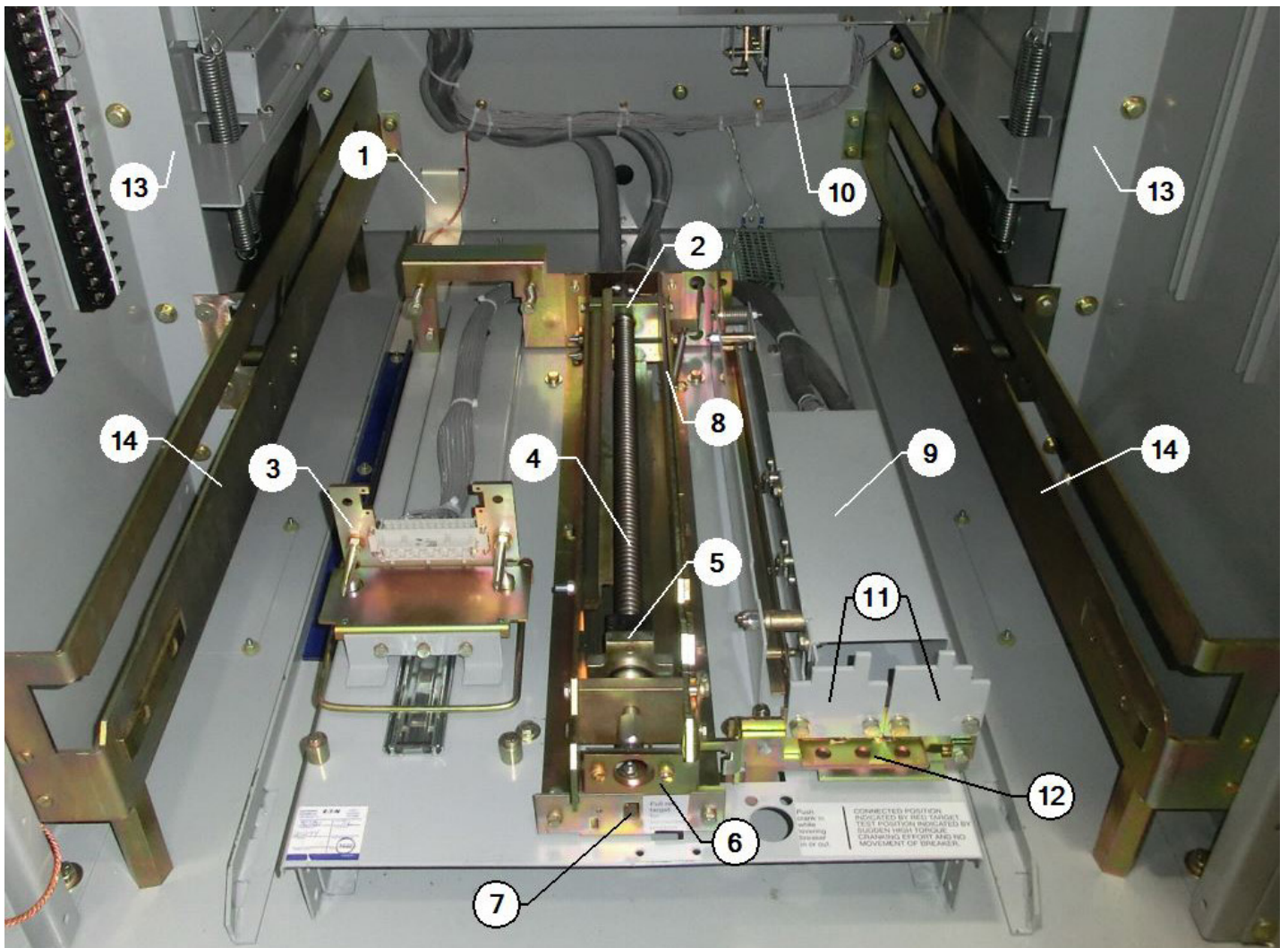


Figure 29. Pan Assembly.

**Figure 29 callouts**

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. Secondary disconnect assembly - Consists of a secondary plug handle, slider assembly, secondary plug, and control wires. The control wiring is arranged for pullout disconnecting by means of a female receptacle (secondary plug) 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 Instructional Booklet IB3A74792 for more description).
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. Represents positive indication of the breaker in the Connect position by use of a red flag that rotates into viewing position when the breaker is fully connected.
8. Slider interlocks prevent removing a closed breaker.
9. The mechanism operated cell (MOC) switch is an assembly of switches that is operated by a lever on the breaker mechanism. Refer to the shop order drawings for the number of NO and NC contacts provided. The MOC switch is activated by the breaker closing. It extends a lever out the bottom of the breaker mechanism pushing down on the lever of the operating mechanism on the MOC assembly. This, in turn, transmits the motion to operate the switch.
10. The truck operated cell (TOC) switch has nine poles. Four contacts make and five contacts break as the breaker is levered to the Connected position. As the breaker is being levered into the Connect 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 Connect position.
11. Coding plates - See Safety features.
12. Optional provision for padlocking (up to three locks) a breaker in any position.
13. Metal framework provides a closed barrier to the primary compartment when the breaker is connected.
14. Rail on which the breaker rolls.

**Section 4: Adjusting and testing**

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 the type of installation. Use portable voltmeters. Use a low voltage continuity testing device to verify correct continuity of circuits.

2. Examine all wiring circuits to make sure they have not been damaged or loosened during shipment or installation.
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.
4. Coordinate the settings of the relays with other parts of the system in accordance with the standards or operating practice of the purchaser.
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.
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.)

## Section 5: Operation of the system

1. Study and be sure to understand the diagrams furnished with each switchgear system.
2. Install the circuit breaker in the test position. Lift and pull forward secondary disconnect to engage the control circuit. Check that the breaker operates.
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 diagrams supplied for the switchgear for the control scheme details, indicating light colors, and functions.
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 schemes are designed to coordinate electrically with the mechanical design of the breaker.

## Section 6: Inspection and maintenance

### 6.1 Safety precautions

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 ensure that personnel do not come in contact with energized high voltage parts. Failure to do so could result in death, personal injury, or property damage.

Refer to Section 1, Safety precautions.

Some common general Precautions for high voltage work area:

#### 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

#### 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, 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.

#### 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 24 and 25). Do not expose any contacts unless all upper and lower high voltage parts are de-energized. Failure to do so could cause death, personal injury, or property damage.

#### 3. Current transformers

Window type current transformers are installed over the bushings in the rear of the unit (see Figure 26). These CTs are not easily removable. All primary circuits must be de-energized prior to gaining access to any CTs.

#### 4. VT primary fuses

Primary fuses are located inside the fuse tube(s), on top of the VTs. Withdraw the drawer to disconnect position using levering crank. When the drawer is in the disconnect position, the windings of the VTs are grounded through the ground fingers on back of the cover. Verify VT fuse grounding by simply viewing through the viewing window. Then remove the bolted front cover. The primary fuses can now be removed by removing ground plate on end of fuse tube. The VT drawer assembly can also be rolled out of the compartment if necessary.

#### 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 ensure 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.

#### **⚠ CAUTION**

**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 COULD RESULT IN BODILY INJURY OR ELECTROCUTION. WHEN ENERGIZED, CIRCUIT CARRIES LETHAL HIGH VOLTAGES.**

#### 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 requires attention.

##### 1. Buses and connections

De-energize primary circuits and remove cover plates from the primary compartments. Before cleaning, take "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 warm water and wipe dry.

After buses have been dusted and wiped clean, take "MEGGER" readings again between each phase and ground and between phases. 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 Table 1.

##### 2. Primary disconnecting contacts and supports (spouts)

Remove each breaker from its compartment. De-energize primary circuits and expose 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, leaving 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 drawout transformers for abnormal wear, fatigue, or overheating. Replace if necessary. Otherwise treat the same as 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 potential 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 fuse drawers. Examine mechanical mating parts such as the breaker secondary contacts blocks, guide rails, and trippers.

##### 8. Ventilation

Check all grillwork and air passages for obstructions and accumulations of dirt. Check to ensure that all dynamic flaps (Item 1 in Figure 16) are open to allow natural airflow. These flaps are designed to close automatically during an internal arcing fault.

##### 9. Battery and charging equipment

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 tests 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 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 condi-

tions, 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 bad 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 to 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. 53701 QB). 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 #9 in Figure 29) – 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 30). This should be done at least every three years.

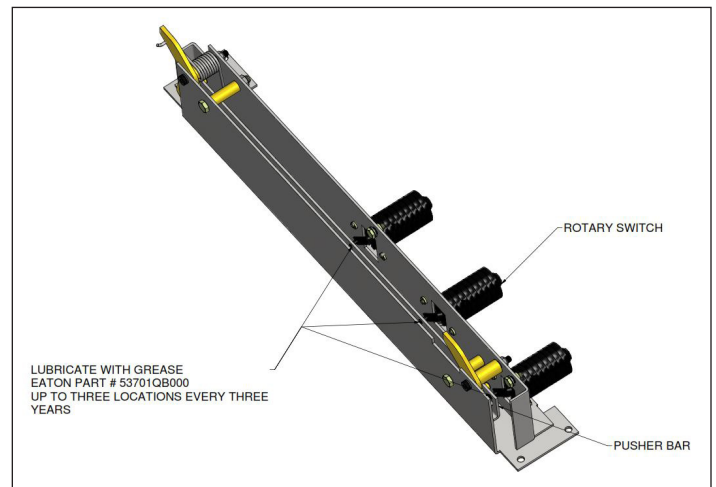


Figure 30. Lubrication Locations for the MOC Switch.



## 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.

# Instructions for installation, operation, and maintenance of 38 kV type VacClad-W arc resistant metal-clad switchgear

## Section 9: Accessories

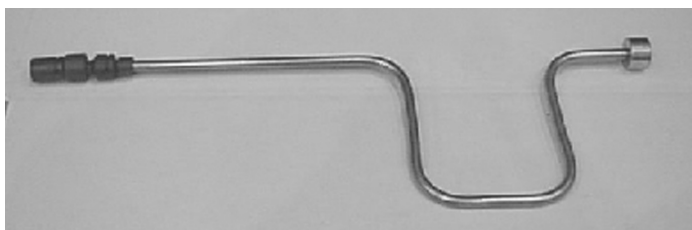
### 9.1 Standard accessories

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



**Figure 31. Manual Spring Charging Lever.**

Manual Spring charging lever is used for manually charging the breaker closing spring.



**Figure 32. Levering Crank.**

Levering crank is used for moving the breaker between the connected and disconnected positions.



**Figure 33. Fifth Wheel.**

Fifth wheel is used for maneuvering the circuit breaker.

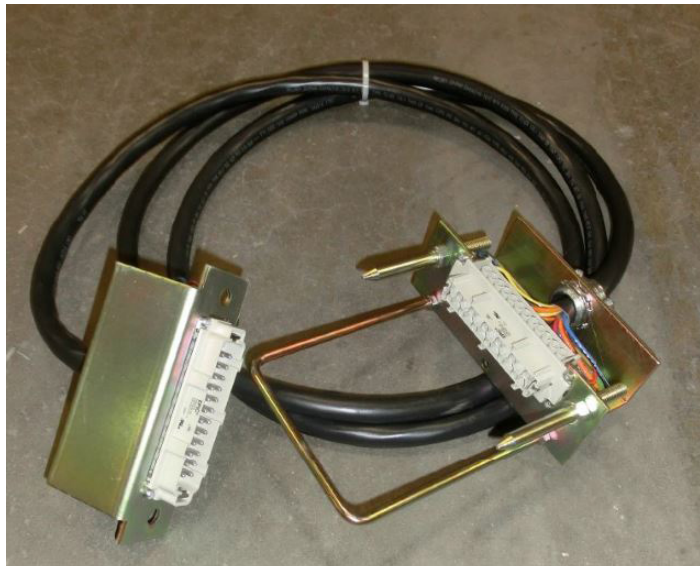


Figure 34. Test Jumper.

Test jumper is used for electrically operating the circuit breaker when it is outside its compartment. The test jumper is approximately 10 feet (3 m) long. It is provided with an electrical connector that matches circuit breaker secondary plug on one end and another connector that matches cell disconnect block on the other end. The test jumper is manually installed to connect breaker control wiring with cell wiring, thus allowing electrical operation of the circuit breaker via cell controls, as if the breaker were in the test position within the cell.

### 9.2 Optional accessories—test cabinet

A test cabinet is used for electrically opening and closing of the breaker when it is outside its housing. The cabinet includes terminals control power connections, set of pull-out fuse blocks for control power disconnect, necessary control equipment, and a cable harness. Control equipment normally includes close and trip push-buttons, and a capacitor trip device when applicable. One end of the cable harness is connected to terminals inside the test cabinet. The other end of the cable is provided with socket that matches the secondary disconnect block on the breaker. To operate the circuit breaker, rated control power is connected to the test cabinet control terminal blocks, and test cabinet cable socket is manually engaged with the secondary disconnect on the breaker. The breaker can then be opened and closed via pushbuttons provided on the test cabinet. The test cabinet can be mounted on the wall.



Figure 35. Test Cabinet Outline.

### 9.3 38 kV manual ground and test device

The manual ground and test device consists of a drawout element that can be inserted into a circuit breaker compartment in the same manner as the drawout vacuum circuit breaker element. The device includes six terminals and ground bus connections. Each terminal is isolated from each other and bus connections by insulating barriers. The upper and lower terminals are accessible by removing the respective front panel. The ground connection is located in the left lower front section of the device. The grounding of either upper or lower terminals is accomplished by manually installing grounding links (provided with the device) from either the upper or the lower terminals to the device ground connection, prior to insertion of the device into the breaker compartment. Cable testing or "phasing out" testing may be accomplished by connecting suitable test equipment as required to the terminals.

Because the grounding and test device has no making or interrupting ability, the circuits must be de-energized before the ground is connected or removed.

Refer to IL3A74795 for complete instructions for this device. Read them fully before using the device.



Figure 36. Manual Ground and Test Device.

## Section 10: Metal-clad switchgear field taping procedure (38 kV)

### 10.1 Busbar taping

#### Materials for taping

Reference Figures 37 and 38 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®.

### 10.2 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.

### 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.

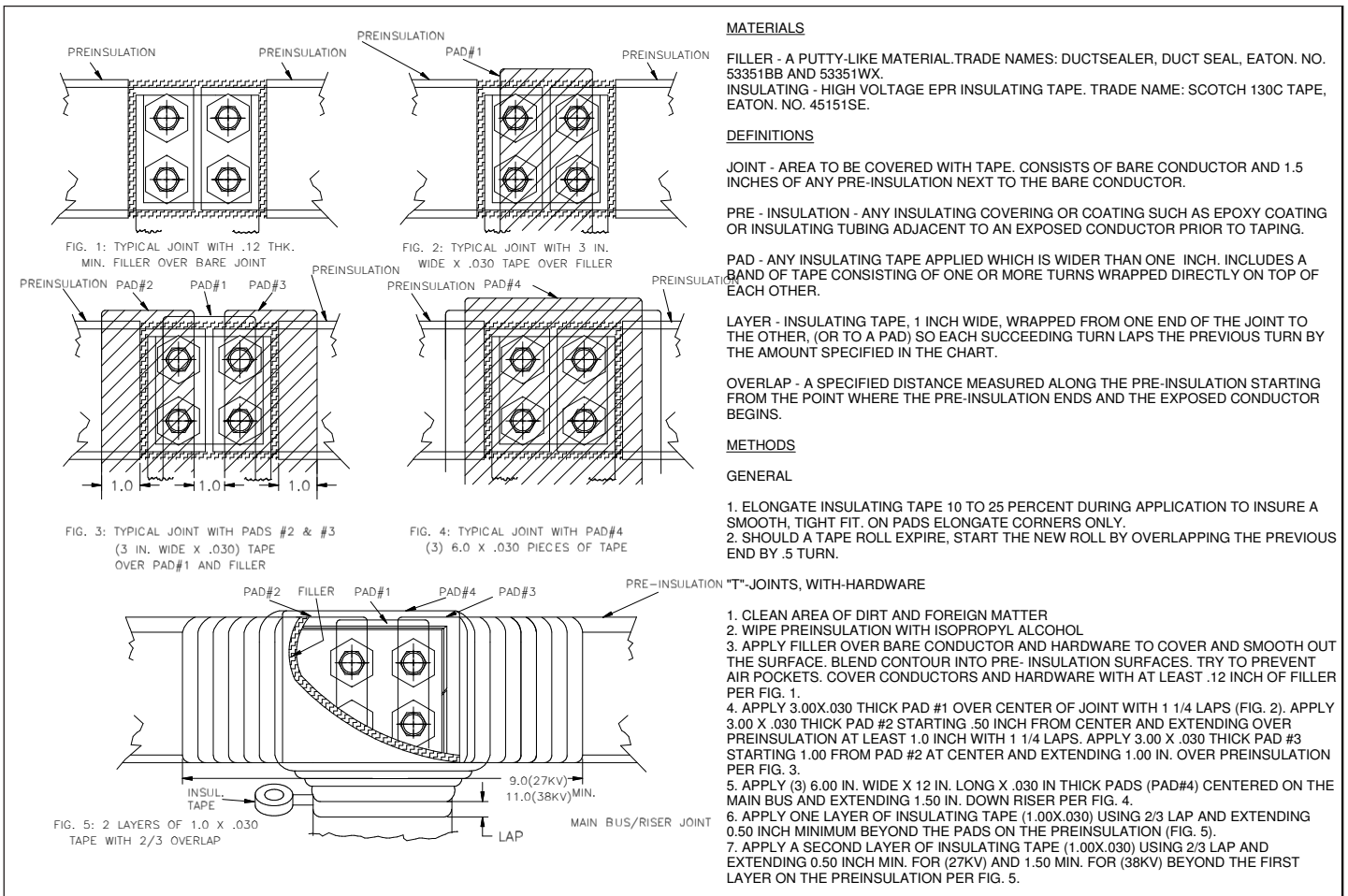


Figure 37. T-joint Field Taping Methods.



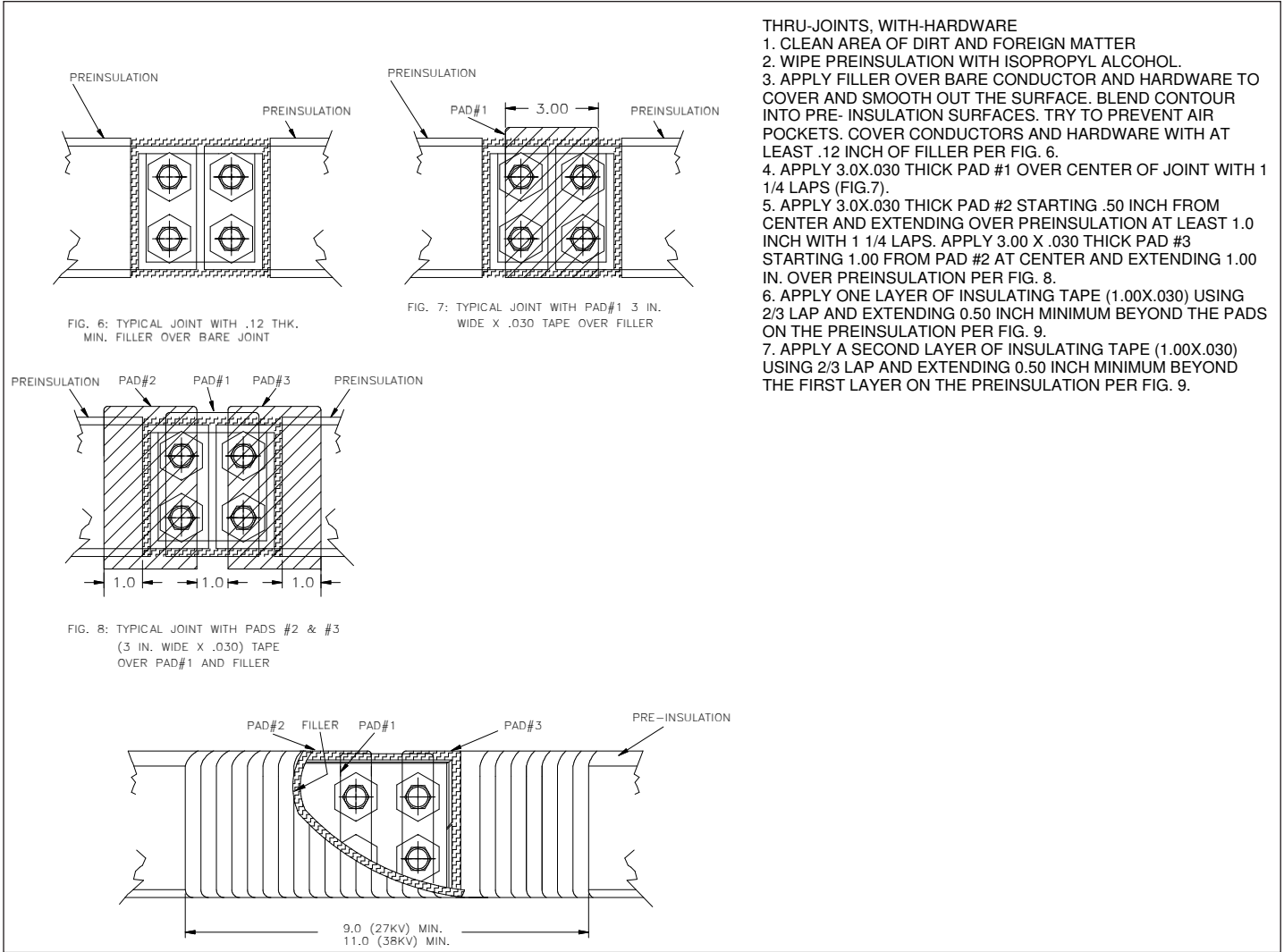


Figure 38. Thru-joint Field Taping Methods.

Table 5. Taping Chart.

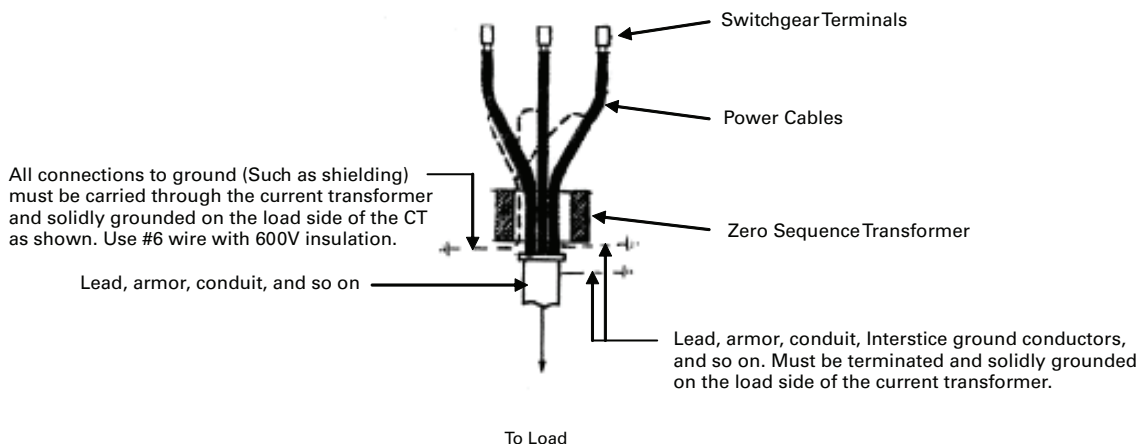
Switchgear Voltage	Pre-insulation or Pad Overlap Minimum		Insulating Tape	
kV	in (mm)	Lap of Tape	Layers	Number of Pads
38	1.50 (38.1)	0.66	2	4

10.4 Responsibility of installer

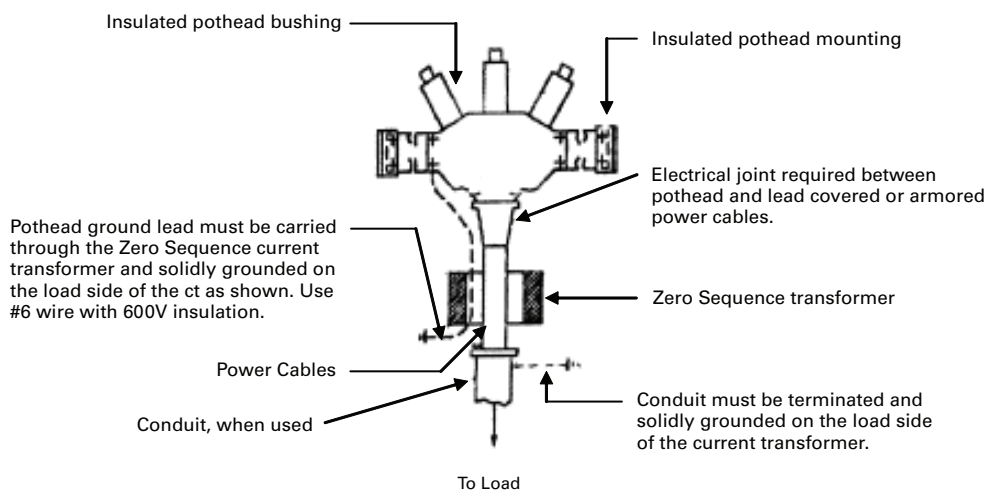
- For incoming or outgoing terminations, these approved materials are not supplied by Eaton and must be obtained and installed by others as identified above in the definitions.
- For connections involving shipping splits within an assembly, or connecting to a transformer, or to an AMPGARD MCC, or to 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 39. Zero Sequence Current Transformer Connections.

**Notes:**

Notes:



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