Instructions for installation, operation, and maintenance of type MVS/MVS2, MEB, and MSB metal-enclosed switchgear assemblies: 4.76 kV or 15.0 kV class

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Indoor MVS Switchgear Assembly

Outdoor MVS Switchgear Assembly
Instructions for installation, operation, and maintenance of type MVS/MVS2, MEB, and MSB metal-enclosed switchgear assemblies: 4.76 kV or 15.0 kV class
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Instructions for installation, operation, and maintenance of type MVS/MVS2, MEB, and MSB metal-enclosed switchgear assemblies: 4.76 kV or 15.0 kV class

Section 1: Introduction

1.1 Purpose

This instruction book is expressly intended to cover the installation, operation, and maintenance of Medium Voltage Switch (type MVS/MVS2) metal enclosed switchgear, Metal Enclosed Switch and Breaker (type MSB) metal enclosed switchgear, and Metal Enclosed Switchgear (type MEB). It is not encompassing of all possible contingencies, variations, and details that may arise during installation, operation, or maintenance of this equipment.

If further information is desired by the purchaser regarding this particular installation or application information, contact the local Eaton sales office, see the appropriate section of Eaton consulting application guide, and review the appropriate industry standards.

1.2 Description and application

The type MVS/MVS2 metal enclosed switchgear assemblies consists of one or more vertical sections of metal enclosed switchgear as defined in industry standard American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) C37.20.3. Typically, each vertical section contains an air insulated, three-pole, gang-operated, quick-make, quick-break, load interrupter switch. It can be applied in combination with power fuses or a vacuum circuit breaker (type MSB switchgear) and many other protective devices to provide safe, economical switching and overcurrent protection where infrequent disconnecting means is required. Also, a drawout-mounted circuit breaker can be provided without the load interrupter switch in the vertical section (MEB type switchgear).

1.3 Documentation references

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

Refer to the customer drawing package for order specific information.

For further information on installation and application, refer to the applicable descriptive bulletins and/or industry standards publications. Download Eaton electric information from www.eaton.com.

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 Terminology

Metal-enclosed load interrupter switchgear: This is an assembly of metal vertical sections as defined in industry standard ANSI/IEEE C37.20.3.

Load interrupter switch: The basic switching and fault-closing device used in metal enclosed load interrupter switchgear.

Fuse: A device used in conjunction with a load interrupter switch to provide overcurrent and short-circuit protection.

Circuit breaker: A device used in metal-enclosed switchgear assemblies to provide switching and overcurrent protection in conjunction with associated protective and control devices.
1.6 Safety precautions

**WARNING**

ONLY QUALIFIED ELECTRICAL WORKERS WITH TRAINING AND EXPERIENCE ON HIGH VOLTAGE CIRCUITS SHOULD BE PERMITTED TO WORK ON THIS EQUIPMENT. THEY SHOULD BE FAMILIAR WITH THE WORK TO BE PERFORMED, THE SAFETY EQUIPMENT REQUIRED, AND HAZARDS INVOLVED.

1. Read and understand these instructions before attempting any assembly, operation, or maintenance of a MVS/MVS2, MSB, or MEB switchgear assembly.

2. Disconnect all low voltage and medium voltage power sources before working on the equipment per Occupational Safety and Health Act (OSHA) and local lockout and tag out procedures. Verify voltages have been removed, both ground load and line side connections. Observe the National Fire Protection Association’s (NFPA) Publication #70 that is commonly known as the National Electrical Code (NEC), OSHA, and local procedures and standards. This includes visual inspections while the vertical section door is open, making any adjustments inside or outside the switchgear vertical section, performing maintenance, or installing replacement parts.

3. The vertical section door cannot be opened with the switch in the CLOSED position. In addition, the switch cannot be closed with the vertical section door open.

4. Before opening the door of the vertical section, look through the window on the door to ensure that all three main blades and flicker blades are OPEN. If necessary, use an additional suitable light source.

**WARNING**

DEFEATING OR DISENGAGING SAFETY INTERLOCKS ON A MVS/MVS2 SWITCH THAT IS PROPERLY INSTALLED IN A MVS/MVS2 SWITCHGEAR ASSEMBLY AND CONNECTED TO A POWER SOURCE MAY RESULT IN PROPERTY DAMAGE, BODILY INJURY, OR DEATH.

DO NOT DEFEND OR DISENGAGE ANY SAFETY INTERLOCKS WHEN THE SWITCHGEAR IS IN SERVICE.

Before energizing the switchgear assembly:

5. Make sure the MVS/MVS2 switchgear assembly is securely fastened to a true and level surface according to the floor plan of the customer drawings.

6. Always be sure that all hardware is in place and secured by tightening or using safety fasteners before putting an MVS/MVS2 switch into operation (see Section 7).

7. Confirm that all arc chutes and barriers are installed.

8. Confirm that no tools or other objects are left inside the vertical section.

9. Confirm that all devices, doors, and covers 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.**

<table>
<thead>
<tr>
<th>Rated Maximum Voltage (kV)</th>
<th>Power-Frequency Withstand (rms) (kV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.76</td>
<td>14.25</td>
</tr>
<tr>
<td>8.25</td>
<td>27</td>
</tr>
<tr>
<td>15.0</td>
<td>27</td>
</tr>
<tr>
<td>27.0</td>
<td>45</td>
</tr>
<tr>
<td>38.0</td>
<td>60</td>
</tr>
</tbody>
</table>

11. For additional safety information and safe-use practices for the VCP-TR circuit breaker, refer to IB131016EN. For the VCP-W circuit breaker, refer to IB131006EN.

1.7 Switchgear identification

A nameplate is located inside the small access door of each type MVS/MVS2 switchgear vertical section (see Figure 1). Contained on this nameplate are the Eaton master parts list number and all the necessary switchgear ratings. This information should be given to the Eaton sales office if a question should arise concerning the switchgear or if renewal parts are required. This information is sufficient for Eaton to find the manufacturing information for the switchgear.

**Table 1. Power Frequency Withstand Test Voltages.**

<table>
<thead>
<tr>
<th>Type:</th>
<th>Medium Voltage Metal Enclosed Switchgear Assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enclosure Type:</td>
<td>GO &amp; RI</td>
</tr>
<tr>
<td>Enclosure Category:</td>
<td>Section No. 0f</td>
</tr>
<tr>
<td>MIV:</td>
<td>3 Phase 60 Hz</td>
</tr>
<tr>
<td>Maximum Continuous Current</td>
<td>1200 A</td>
</tr>
<tr>
<td>Operating Voltages</td>
<td>4.75 kV</td>
</tr>
<tr>
<td>Main Circuit Breaker Current Rating</td>
<td>2000 A</td>
</tr>
<tr>
<td>Continuous:</td>
<td></td>
</tr>
<tr>
<td>Momentary RMS Value</td>
<td>3000 A</td>
</tr>
<tr>
<td>Short Time (2 Sec, 5%) Value</td>
<td>3000 A</td>
</tr>
<tr>
<td>Type</td>
<td>Switchgear assemblies meet the requirements of industry standards IEC 62271-20.3 and ANSI C37.57</td>
</tr>
<tr>
<td>This switchgear vertical section is suitable for use on a circuit capable of delivering not more than 5 RMS symmetrical amperes with maximum See separate label inside for fuse continuous current ratings when fuses are mounted in this vertical section.</td>
<td></td>
</tr>
</tbody>
</table>

**WARNING**

EXCEEDING NAMEPLATE RATINGS OF MVS/MVS2 SWITCHGEAR COULD CAUSE PROPERTY DAMAGE, SEVERE INJURY, OR DEATH.

MVS/MVS2 SWITCHGEAR MUST BE OPERATED WITHIN ITS NAMEPLATE RATINGS.

1.8 Safety features

Type MVS/MVS2 load interrupter switchgear has several built-in features to reduce hazards and to provide proper operating sequences.

1. A door interlock prevents opening the enclosure’s front door while the load interrupter switch is in the closed position.

2. A switch interlock prevents manual operation of the switch’s operating mechanism with the door open.

3. A viewing window is provided to visually verify the switch contact position.

4. Provisions are provided for padlocking the switch in the open or closed position.

5. Provisions are provided for padlocking the door handles closed.

6. Mechanical indicators show whether the switch mechanism is open or closed.

7. Key interlocks, when provided, force a sequence of operation.
Operating a MVS/MVS2 Switch with a Key Interlock Bolt Extended Will Result in Equipment Damage and May Also Expose a Person to Bodily Injury or Death.

The key must be inserted into the interlock and rotated to retract the locking bolt before operating a MVS/MVS2 switch.

### 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 Joining type MVS/MVS2 enclosures

#### 2.2.1 Access to MVS/MVS2 switchgear vertical sections containing switches

Each MVS2 switch is shipped from the factory in the closed position to maintain alignment during shipping and handling. When handling MVS/MVS2 switchgear, be sure the switches are in the closed position. The safety interlocking prevents opening of the door of the vertical section when the switch is closed.

In order to gain access to the interior, be sure the switchgear is on a true and level surface according to the floor plan of the customer drawings. To open a manually operated MVS2, switch insert the operating handle and push down. When the switch opens the door may be opened.

Do not operate MVS2 switches unless the switchgear assembly is setting on a true and level surface.

#### 2.2.2 Identification of shipping splits

Refer to the front view on the switchgear assembly drawing supplied with the switchgear. Beneath this view, shipping splits will be identified in relation to group numbers for each vertical section. Normally, shipping sections will not exceed 92 in. (2336.8 mm) in width.

### 2.2.3 Procedures for joining MVS/MVS2 enclosures at shipping splits

During the following steps, please refer to Figure 2.

![Figure 2. Joining the MVS/MVS2 Enclosures.](image-url)
Instructions for installation, operation, and maintenance of type MVS/MVS2, MEB, and MSB metal-enclosed switchgear assemblies: 4.76 kV or 15.0 kV class

Step 1: Position the shipping sections next to each other. In some cases, it may be necessary to use an aligning tool such as a punch to move the structures into alignment.

Step 2: Bolt the side sheets together using the tie-bolt kit found in the detail box.

Step 3: Make the main and ground bus connections using the links and hardware furnished. The bus bar is tin or silver-plated. To insure a proper electrical connection, care should be taken to protect the plating from damage. **DO NOT** use joint compound.

**CAUTION**

CLEANING BUS JOINTS WITH ABRASIVE OR CHEMICAL CLEANSERS MAY REMOVE PLATING, WHICH MAY CAUSE JOINT OVERHEATING.

TO CLEAN THE SURFACES, WIPE THEM WITH CLEAN, DRY CLOTH.

Step 4: Bolted connections should be tightened to the torque values given in Section 8.

2.3 Installation of roof caps on outdoor units.

Roof caps are necessary to complete the roof of all outdoor MVS/MVS2 switchgear assemblies. Those not factory installed are shipped on the switchgear in a “shipping” position or cartons that are shipped separately.

The following procedure and accompanying figures detail the work to be done to install each cap.

Step 1: Remove the bolts securing the lifting lugs to the MVS/MVS2 switchgear assembly. Remove the lifting lugs and reinstall the bolts.

Step 2: Place a roof cap (intermediate or end) in position. Install the hardware on vertical end surfaces to hold the roof cap in place.

Figure 3. Installation of Roof Caps on Outdoor Units.

Step 3: Continue this procedure until all roof caps have been installed.

2.4 Connection of type MVS/MVS2 switchgear to the transformer

2.4.1 Physical connection

2.4.1.1 Indoor assemblies, dry type, cast coil type, or liquid filled type transformers

Holes are predrilled in the side of the MVS/MVS2 structure to match the holes provided in the transformer case. Hardware is provided in the MVS/MVS2 switchgear where it will be connected to the transformer. Remove this hardware and retain it for fastening the switchgear to the transformer.

Move the MVS/MVS2 switchgear to match the holes on the side that will face the transformer to the matching holes in the transformer case. Minor misalignment may be corrected with a tapered guiding rod of some kind. Insert the hardware and tighten. Use extreme caution in moving the MVS/MVS2 switchgear to prevent damage.

2.4.1.2 Outdoor throat connection, liquid filled transformers

During the following steps, please refer to Figure 4.

Step 1: Remove the sealing ring flange from MVS/MVS2 switchgear throat and set it aside.

Step 2: The switchgear and transformer should be brought together to give a spacing of approximately 0.5 in. (12.7 mm) between throat flanges.

Step 3: Apply the double adhesive tape supplied with MVS/MVS2 switchgear to outside surfaces of both flanges.

Step 4: Press felt supplied with MVS/MVS2 switchgear into place on adhesive tape.

Step 5: Reinstall sealing ring removed in Step 1.

2.4.2 Medium Voltage Electrical Connections

2.4.2.1 Connection by cables supplied with type MVS/MVS2 switchgear or transformer

- The supplied cables are NOT factory pre-cut to the proper length. The installer MUST cut the cables to fit.
- Factory cables are unshielded. For all applications, they must be properly separated from each other, from all grounded metal parts, and from the transformer bushings/terminals of other phases.

Figure 4. Transformer Connection to MVS/MVS2 Switchgear.

- Phasing of main conductors in type MVS/MVS2 switchgear conforms to industry standards, which is 1, 2, 3, front to rear, top to bottom, and left to right at connection points unless otherwise noted on the drawings. The installer is responsible for maintaining continuity of phasing throughout the system.
- Lugs are provided with the switchgear for terminating the cables to the transformer bushings/terminals or to the MVS/MVS2 switchgear terminals.
2.4.2.2 Connection by bus bar

- Splice plates and hardware are furnished with the MVS/MVS2 switchgear. The transformer manufacturer supplies a flexible connector if the transformer is a dry type or cast coil. If the transformer is liquid filled type, MVS/MVS2 provides the flexible connector.
- Bus bar is tin or silver-plated. To insure a proper electrical connection, care should be taken to protect the plating from damage. Refer to Section 2.2.3, Step 3.
- All copper connections should be tightened according to the specifications given in Section 8.

2.5 Connections to AMPGARD medium voltage motor control center (MCC)

Step 1: Holes are pre-drilled in the side of the MVS/MVS2 switchgear structure to match holes provided in the AMPGARD MCC. Bolt the units together using hardware furnished with the MVS/MVS2 switchgear.

Step 2: Make the bus connections as detailed in Section 2.4.2.2.

2.6 Connections to a MVA metal clad switchgear assembly

2.6.1 Indoor switchgear

Follow the same procedure as given in Section 2.5.

2.6.2 Outdoor switchgear

Step 1: Position the units side by side. The holes in MVS/MVS2 side sheet around the bus cutout will match the holes in metal clad switchgear flange.

Step 2: Press the sponge neoprene gasketing tape, supplied with MVS/MVS2 switchgear, onto the flange to form a weather-tight seal.

Step 3: Join the enclosures using the bolts supplied with the MVS/MVS2 switchgear. The opposite side of the metal clad switchgear flange has nuts in place for ease of connection.

Step 4: Make the bus connections as detailed in Section 2.4.2.2.

2.7 Connection of customer power cables

Figures 5 through 14 show the suggested means for connection of the incoming or exiting cables (maximum of two per phase, 500 kcmil) in MVS/MVS2 switchgear. The letters in each figure apply to the itemized subjects following. All necessary materials to perform the cable installation are to be provided by others unless specifically noted otherwise in the detailed instructions below, or where specifically purchased with the switchgear assembly. To install the incoming and exiting cables, follow these instructions.

A. The switchgear terminals

For incoming power, the terminals are usually located at the top of the switch in a vertical section. For outgoing circuits, the terminals are beneath the switch if unfused, or on the fuse mounting if fused. Each terminal pad has a 2-hole pattern suitable for either a single-hole terminal or a terminal with a 2-hole National Electrical Manufacturers Association (NEMA) drilling pattern. The terminal lugs for the cable, if purchased with the switchgear, will be bolted to the switchgear terminals. If the terminal lugs are not there, then they are to be provided by others. The terminals of the switchgear are not suitable to support the weight of the cable. It will be necessary to support the weight of the cable with the cable support angle discussed in C.

B. Cable electrical stress relief devices

The design of MVS/MVS2 switchgear is based upon the use of “pre-formed” type electrical stress relief devices such as 3-M Quickterm-II, Raychem” heat shrink termination systems, etc. The stress relief devices are to be provided by others.
Instructions for installation, operation, and maintenance of type MVS/MVS2, MEB, and MSB metal-enclosed switchgear assemblies: 4.76 kV or 15.0 kV class

Figure 5. Bottom Cable Entrance (Energy Source), Rear Access.

Figure 6. Top Cable Entrance (Energy Source), Rear Access.

Figure 7. Bottom Cable Exit (to Load), Rear Access.

Figure 8. Top Cable Exit (to Load), Rear Access.
Instructions for installation, operation, and maintenance of type MVS/MVS2, MEB, and MSB metal-enclosed switchgear assemblies: 4.76 kV or 15.0 kV class

Figure 9. Bottom Cable Entrance (Energy Source) Front Access Pull Section.

Figure 10. Top Cable Entrance (Energy Source) Front Access.

Figure 11. Top Cable Entrance (Energy Source) Front Access.

Figure 12. Bottom Cable Exit (to Load of Fuse) Front Access or Cable in Front.
WARNING

USE OF SOLVENTS, OILS, JOINT COMPONDS, OR GREASE ON OR NEAR NORYL® INSULATION WILL DESTROY IT.

2.8 Securing MVS/MVS2, MSB, and MEB switchgear assemblies to foundations

All anchoring hardware and necessary devices are supplied by Eaton. If the switchgear assembly was purchased for seismic applications, follow the instructions on the specific drawings provided for the switchgear assembly that address the anchoring details. Another drawing addresses the load bearing requirements. Indoor or outdoor vertical sections are secured using clips and foundation bolts. Anchors and lag screws may be used in place of J-bolts if desired.
**Section 3: Switchgear assembly inspection before startup**

Each switch is properly adjusted at the factory before shipment. However, vibration and mechanical stresses imposed by transit and installation can adversely affect switch adjustment. Therefore, a final inspection is essential before energizing. If this inspection reveals any defects in adjustment, they should be corrected according to alignment procedures in IB02102002E.

**Step 1:** Check the bolted bus connections for proper tightness, referring to Section 8 for torque values.

**Step 2:** If non-disconnect type mounted fuses are supplied, check the plastic knobs that hold the fuses in place. They should be hand tight or ideally 62 in.-lbs (7.0 N•m).

**Step 3:** If disconnect fuses are supplied, check to see that they are completely latched closed.

**Step 4:** For units fitted with expulsion-type, boric acid fuses, check the discharge filters on the lower end of the fuses are securely hand tight.

**Step 5:** Check to see if the space heaters, if supplied, are energized.

**Step 6:** Wipe away any dust or dirt that may have accumulated in compartment(s), paying particular attention to insulators and insulating material.

---

**WARNING**

**USE OF SOLVENTS, OILS, JOINT COMPOUNDS, OR GREASES ON OR NEAR NORYL® INSULATION WILL DESTROY IT.**

CLEAN ONLY WITH WATER OR ISOPROPYL ALCOHOL.

---

**WARNING**

NORYL® INSULATED EQUIPMENT: ELECTRICAL JOINT COMPOUNDS MUST NOT BE USED ON CONNECTIONS OR TERMINATIONS TO OR FROM THIS EQUIPMENT.

DO NOT USE SOLVENTS, OILS, OR GREASES ON OR NEAR THIS EQUIPMENT. WATER AND ISOPROPYL ARE THE ONLY APPROVED CLEANERS FOR THIS EQUIPMENT.

---

**CAUTION**

ISOPROPYL ALCOHOL IS FLAMMABLE. PROVIDE ADEQUATE VENTILATION AND KEEP AWAY FROM FLAMES AND OTHER IGNITION SOURCES.

CONSULT YOUR SAFETY DEPARTMENT BEFORE USING.

**Step 7:** A final thorough inspection should be made to ensure that no tools or other objects are accidentally left inside the enclosure.

---

**WARNING**

DEFEATING OR DISENGAGING SAFETY INTERLOCKS ON A MVS OR MVS2 SWITCH THAT IS CONNECTED TO A POWER SOURCE MAY RESULT IN PROPERTY DAMAGE, BODILY INJURY OR DEATH.

DO NOT DEFEAT OR DISENGAGE ANY SAFETY INTERLOCKS.
**Section 4: Operation**

**4.1 Mechanical safety interlocks**

The MVS or MVS2 manually operated switch is equipped with switch interlocks and door interlocks as well as provisions for pad-locking in either the open or closed position. See IB02102002E for details of the interlocks and their functions.

**4.2 Key interlocking**

Key interlocks are supplied when specified, but certain MVS/MVS2 switchgear configurations require key interlocks and they are therefore included. Standard schemes are available for locking the switch in the open position or the closed position, as well as locking the main door closed. Numerous other schemes are available for special requirements that must coordinate with upstream or downstream devices supplied by Eaton or other equipment.
Periodic high potential tests are not required after initial start-up and are recommended only after repair of high voltage live parts or insulation, or when the trend of “MEGGER” readings indicates it to be advisable. This field test should be made before the main cables are connected and should not exceed the values in the Table 8.

Table 8. Field Dielectric Test Values.

<table>
<thead>
<tr>
<th>kV Class</th>
<th>Test Voltage, 60Hz AC, Applied for One (1) Minute.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>14.25</td>
</tr>
<tr>
<td>15</td>
<td>27</td>
</tr>
</tbody>
</table>

The intent of the cleaning procedure is to remove as much dirt, dust, and other foreign material as possible from the insulation with minimum exposure to any solvents. The recommended cleaning procedure is to use a lint-free cloth. In most cases this will be sufficient. For accumulations that cannot be removed by the above procedure, a lint-free cloth, slightly dampened with water, can be used. Allow the apparatus to dry for at least four hours at room temperature before energizing or testing. If a lint-free, water dampened cloth does not produce satisfactory results, use a lint-free cloth dampened with isopropyl alcohol. Dry the same as when using a water-dampened cloth.

⚠️ CAUTION

ISOPROPYL ALCOHOL IS FLAMMABLE. PROVIDE ADEQUATE VENTILATION AND KEEP AWAY FROM FLAMES AND OTHER IGNITION SOURCES.

CONSULT YOUR SAFETY DEPARTMENT BEFORE USING.

5.4 Fuse replacement

⚠️ WARNING

FAILURE TO COMPLETELY DISCONNECT THE MVS/MVS2 SWITCHGEAR ASSEMBLY FROM ALL POWER SOURCES PRIOR TO INSPECTION MAY RESULT IN SEVERE INJURY OR DEATH.

THE SWITCHGEAR ASSEMBLY MUST BE COMPLETELY DISCONNECTED FROM ALL POWER SOURCES AND GROUNDED BEFORE PERFORMING ANY INSPECTION.

⚠️ WARNING

WHEN ACCESSING FUSES, FAILURE TO ASSURE THAT THE FUSES ARE DE-ENERGIZED MAY RESULT IN EQUIPMENT DAMAGE, BODILY INJURY, OR DEATH.

MAKE SURE THAT ALL POWER SOURCES ARE DE-ENERGIZED BEFORE ATTEMPTING TO ACCESS THE FUSES.

Step 6:

a. Ferrell type fuses: Fuses are removed by loosening the plastic hand knobs and removing the locking bars. Fuses are then free to be removed. When the fuses are re-installed, the hand knobs should be retightened hand tight or ideally 62 in.-lb (70 N•m).

b. Bolt-in type fuses: Remove the two bolts at the top of the fuse along with the two bolts at the bottom of the fuse. Fuses are then free to be removed. Re-install the new fuse using the same hardware and torque to proper value listed in Section 8.

c. Disconnect type fuses: To remove the fuse, lift up on the latch on top of the fuse and pull the fuse towards the front of the enclosure. This will allow the fuse to rotate on the bottom fuse-mounting bracket. Lift the fuse out of the bottom fuse-mounting bracket. To re-install the new fuse, place the fuse in the bottom fuse mounting bracket and rotate the fuse inward until it is fully latched in place.

5.5 Lubrication

Lubrication should be done during routine maintenance. All excess lubrication must be removed with a clean cloth to prevent any accumulation of dust or dirt. Avoid any lubrication on the insulation. Care must be taken to prevent any non-conductive lubricant from reaching any current carrying contact surface. See IB02102002E for the MVS2 switch lubrication requirements, and see IB2102003E for MVS/MVS2 selector switch lubrication requirements. For other components see the appropriate instruction documents for those components, for their lubrication requirements.
Section 6: Duplex switchgear configuration

When supplied, the duplex configuration consists of two vertical sections containing MVS or MVS2 switches connected together by a common bus on the hinge terminals of each switch. This, in turn, is connected to one set of fuses located in one of the switch compartments. This arrangement allows the selection of either of two incoming lines.

Figure 16. Duplex Selective Switch Operation.

This arrangement is always supplied with key interlocking for safe operation. Key interlocking consists of a lock on each switch to lock the switch in the open position and a lock on each door to lock each door closed. Each of the locks is keyed alike and only one key must be available to operating personnel. Since the key is retained in its lock when a switch is closed or when a door is opened, two things are assured:

- Only one switch may be closed at a time to prevent paralleling of incoming lines.
- Both switches must be locked in the open position to unlock either main door, preventing access to energized load side bus or fuses.

⚠️ WARNING

ONLY ONE KEY SHOULD BE AVAILABLE TO OPERATING PERSONNEL FOR THIS INTERLOCK SCHEME. WHEN SHIPPED FROM THE FACTORY, EACH LOCK WILL HAVE A SEPARATE KEY.

ALL EXTRA KEYS MUST BE DESTROYED OR OTHERWISE MADE INACCESSIBLE TO OPERATING PERSONNEL. FAILURE TO DO SO COULD RESULT IN SEVERE INJURY OR DEATH.

Section 7: MSB and MEB switchgear assemblies

Note: Detailed VCP-W circuit breaker information is provided in instruction book IB131006EN.

Note: Detailed VCP-TR circuit breaker information is provided in IB131016EN.

7.1 Description and application

MSB switchgear is an integrated assembly of a visible MVS or MVS2 disconnect switch, bus, a fixed mounted type VCP-TR vacuum circuit breaker, and control devices which are coordinated electrically and mechanically for high voltage circuit protection. The MSB switchgear assembly provides economic and reliable circuit interruption and fault protection for high voltage circuits 2.4 kV through 15 kV.

MEB switchgear is an integrated assembly of bus, a drawout mounted type VCP-W vacuum circuit breaker, and control devices coordinated electrically and mechanically for high voltage circuit protection. The MEB switchgear assembly provides economic and reliable circuit interruption and fault protection for high voltage circuits 2.4 kV through 15 kV.

7.2 Safety features

The seven safety features outlined in Section 1.8 of this document also apply to MSB switchgear. In addition, the following features apply to reduce hazards and to provide proper operating sequences. The following features also apply to MEB switchgear assemblies.

1. For electrically operated circuit breakers, an external control switch is provided to allow customer to open or close the vacuum circuit breaker with the full height main door closed.
2. For electrically operated circuit breakers, red and green indicating lights are provided to give visual indication of circuit breaker status (open/close positions).
3. Semi-flush fixed mounted relay and metering devices are mounted on the front hinged door in a protective relay cabinet for convenient access.
4. The breaker function indicators and controls are accessible and visible when the full height door is opened.
5. The breaker function indicators are:
   - Breaker-open/close;
   - Closing spring-charged/discharged;
   - Close and trip buttons;
   - Operation counter breaker latch; and
   - Manual spring charging access.
6. The stored energy mechanism is vertically mounted on the front of the breaker for easy access. It is available for either DC or AC operation. The VCP-TR circuit breaker can also be equipped with integral protective functions that do not require external control power to trip the circuit breaker during an overcurrent condition.
7. The vacuum interrupter contact wear indicator is clearly visible, and the wear-gap (contact erosion) indicators require only an occasional check.

7.3 Receiving, handling, and storage

The VCP-TR breaker comes installed within the MSB assembly. The VCP-W circuit breaker may come in a separate shipping carton and will have to be installed once the switchgear assembly is installed.

7.4 Installation

Refer to IB022014EN: Instructions for receiving, handling, storing, and installation of medium voltage switchgear, for type MVS/MVS2, MEB, and MSB switchgear assembly installation.
Instructions for installation, operation, and maintenance of type MVS/MVS2, MEB, and MSB metal-enclosed switchgear assemblies: 4.76 kV or 15.0 kV class

7.6.2 Breaker insertion and removal for MEB switchgear, VCP-W circuit breaker

**WARNING**

FAILURE TO FOLLOW THE STEPS BELOW TO ACCESS OR REMOVE A VCP-W CIRCUIT BREAKER COULD RESULT IN SEVERE INJURY OR DEATH.

**FOLLOW THESE STEPS TO SAFELY ACCESS OR REMOVE THE CIRCUIT BREAKER.**

7.6.2.1 Inserting and removing the VCP-W circuit breaker

Step 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.

Step 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.

Step 3: In this position, the breaker can be inserted or removed from the breaker compartment (see Figures 17 and 18).

**Figure 17. Insertion of the Drawout Extension Rails.**
Figure 18. Lifting the Breaker On and Off of the Extension Rails.

7.6.2.2 Checking the pan operation.

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

**Manual Secondary:** For a manually engaged secondary harness, pull the secondary plug handle forward until the secondary receptacle located on the compartment levering pan fully mates with the secondary breaker wiring plug.

**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.)

B. 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 red indicator on the levering system can be seen through the window on the front of the levering system, or until the breaker cover plate aligns with the connect position location given on the BPI label (item 7) if so equipped.

C. 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.

D. Test the breaker and cell interface per the circuit breaker instruction booklet IB131006EN.
Section 8: MVS/MVS2 switchgear bolt tightness for bus connections

Use the following torque value for tightening bus joints.

Table 9. Bus Joint Hardware Tightness Values.

<table>
<thead>
<tr>
<th>Bolt Diameter Decimal Size in. (mm)</th>
<th>Bolt Diameter Standard</th>
<th>Nominal Torque ft-lb (N•m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.250 (6.35)</td>
<td>1/4-20</td>
<td>5 (6.78)</td>
</tr>
<tr>
<td>0.312 (7.93)</td>
<td>5/16-18</td>
<td>12 (16.27)</td>
</tr>
<tr>
<td>0.375 (9.53)</td>
<td>3/8-16</td>
<td>25 (33.90)</td>
</tr>
<tr>
<td>0.500 (12.70)</td>
<td>1/2-13</td>
<td>50 (67.79)</td>
</tr>
<tr>
<td>0.625 (15.88)</td>
<td>5/8-11</td>
<td>95 (128.82)</td>
</tr>
</tbody>
</table>

Section 9: MVS/MVS2, MEB, and MSB switchgear field taping procedure (5/15 kV)

9.1 Busbar taping

Materials for taping

Reference Figures 19 and 20 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.

9.2 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.

9.2.1 Factory installed NORYL insulation

Factory installed insulation may be NORYL, a high-performance engineering thermoplastic. It can be irreversibly damaged if it comes in contact with certain chemicals. See Section 5.3.2 for cleaning procedures.

⚠️ WARNING

USE OF SOLVENTS, OILS, JOINT COMPOUNDS, OR GREASES ON OR NEAR NORYL® INSULATION WILL DESTROY IT.

CLEAN ONLY WITH WATER OR ISOPROPYL ALCOHOL.

⚠️ CAUTION

ISOPROPYL ALCOHOL IS FLAMMABLE. PROVIDE ADEQUATE VENTILATION AND KEEP AWAY FROM FLAMES AND OTHER IGNITION SOURCES.

CONSULT YOUR SAFETY DEPARTMENT BEFORE USING.

9.3 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.
THRU-JOINTS, WITH-HARDWARE

1. CLEAN AREA OF DIRT AND FOREIGN MATTER
2. WIPE PREINSULATION WITH ISOPROPYL ALCOHOL IF NECESSARY
3. APPLY FILLER OVER BARE CONDUCTOR AND HARDWARE TO COVER AND SMOOTH OUT SURFACE. CONTOUR INTO PREINSULATION SURFACES. TRY TO PREVENT AIR POCKETS. COVER CONDUCTORS AND HARDWARE WITH AT LEAST .12 INCH OF FILLER PER FIG. 5.
4. APPLY 6.0X.030 THICK PAD #1 OVER JOINT WITH MINIMUM OF 1.0 INCH OVERLAP ON FLUIDIZE (1 1/4 LAPS). APPLY 6.0X.030 THICK PAD #2 OVER PAD #1 BUT STARTING ON RIGHT SIDE WITH 1.0 INCH OVERLAP ON PREINSULATION SEE FIG. 6
5. APPLY 6.0X.030 THICK PAD #3 OVER PADS #1 & #2 AND CENTERED ON JOINT PER FIG. 7
6. APPLY ONE LAYER OF 1.00X.030 INSULATING TAPE USING 2/3 LAP AND EXTENDING 0.75 INCH MINIMUM BEYOND THE PADS ON THE PREINSULATION PER FIG. 8.

Figure 19. T-Joint Field Taping Methods.
Instructions for installation, operation, and maintenance of type MVS/MVS2, MEB, and MSB metal-enclosed switchgear assemblies: 4.76 kV or 15.0 kV class

9.4 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, connecting to a transformer, or to an AMPGARD MCC, or to an MVA 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, the cable connections, or bus connections to other apparatus, insulation of these connections must be made.

Table 10. Taping chart.

<table>
<thead>
<tr>
<th>Switchgear Voltage</th>
<th>Pre-insulation or Pad Overlap Minimum</th>
<th>Insulating Tape</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>in. (mm)</td>
<td>Lap of Tape</td>
</tr>
<tr>
<td>Up to 5</td>
<td>1.50 (38.1)</td>
<td>0.5</td>
</tr>
<tr>
<td>75 and 15</td>
<td>1.50 (38.1)</td>
<td>0.66</td>
</tr>
</tbody>
</table>

Figure 20. Thru-joint Field Taping Methods.

**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.
Instructions for installation, operation, and maintenance of type MVS/MVS2, MEB, and MSB metal-enclosed switchgear assemblies: 4.76 kV or 15.0 kV class

Figure 21. Zero Sequence Current Transformer Connections.

All connections to ground (Such as shielding) must be carried through the current transformer and solidly grounded on the load side of the CT as shown. Use #6 wire with 600V insulation.

Lead, armor, conduit, and so on

Power Cables

Insulated pothead bushing

Insulated pothead mounting

Pothead ground lead must be carried through the Zero Sequence current transformer and solidly grounded on the load side of the ct as shown. Use #6 wire with 600V insulation.

Power Cables

Conduit, when used

Electrical joint required between pothead and lead covered or armored power cables.

Zero Sequence transformer

Conduit must be terminated and solidly grounded on the load side of the current transformer.

To Load

Cable connections to switchgear terminals when used with Insulated Pothead.
Instructions for installation, operation, and maintenance of type MVS/MVS2, MEB, and MSB metal-enclosed switchgear assemblies: 4.76 kV or 15.0 kV class
Instructions for installation, operation, and maintenance of type MVS/MVS2, MEB, and MSB metal-enclosed switchgear assemblies: 4.76 kV or 15.0 kV class

Notes:
Instructions for installation, operation, and maintenance of type MVS/MVS2, MEB, and MSB metal-enclosed switchgear assemblies: 4.76 kV or 15.0 kV class