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Indoor MVS Switchgear Assembly

Outdoor MVS Switchgear Assembly
Section 1: Introduction

Read and understand these instructions before attempting any installation, operation, or maintenance of this switchgear.

1.1 Purpose

This instruction book is expressly intended to cover the installation, operation, and maintenance of Medium Voltage Switch (type MVS) metal enclosed switchgear, Metal Enclosed Switch and Breaker (type MSB) metal enclosed switchgear, and Metal Enclosed Breaker (type MEB) metal enclose switchgear. It does not purport to cover 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 Electrical, Inc. sales office, see the appropriate section of Eaton Electrical, Inc. Consulting Application Guide, and review the appropriate industry standards.

1.2 Description and Application

The type MVS 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 Revision Level

Revision level is 1. This is a new document.

1.4 Documentation References

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

1.5 Eaton Electrical, Inc. Contact Information

For the location of the nearest Eaton Electrical, Inc. sales office or distributor, call toll free 1-800-525-2000 or log onto www.eatonelectrical.com.

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

1.6 Terminology

Metal Enclosed Load Interrupter Switchgear: This is an assembly of metal vertical sections as defined in 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.

1.7 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, 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.

For more information visit: www.eatonelectrical.com
Before energizing the switchgear assembly:
5. Make sure the MVS switchgear assembly is securely fastened to a surface that is level within ± 0.0125 in. in 36 in. (0.318 mm in 914.4 mm) front to rear, left to right, and diagonally.
6. Always be sure that all hardware is in place and secured by tightening or using safety fasteners before putting an 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.

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

---

**WARNING**

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

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

---

**WARNING**

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

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**WARNING**

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DO NOT DEFEAT OR DISENGAGE ANY SAFETY INTERLOCKS WHEN THE SWITCHGEAR IS IN SERVICE.
1.10 Ratings and Standards

Table 1. MVS/MSB/MEB Switchgear Voltage and Frequency Ratings, RMS Values.

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>4.76 kV CLASS</th>
<th>15 kV CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Maximum Design Voltage</td>
<td>4.76 kV</td>
<td>15 kV</td>
</tr>
<tr>
<td>Impulse Withstand Voltage, BIL*</td>
<td>60 kV</td>
<td>95 kV</td>
</tr>
<tr>
<td>Low Frequency Withstand Voltage</td>
<td>19 kV</td>
<td>36 kV</td>
</tr>
<tr>
<td>Rated Frequency</td>
<td>60 Hz</td>
<td>60 Hz</td>
</tr>
</tbody>
</table>

*Basis Impulse Level (BIL)*

Table 2. MVS/MSB/MEB Switchgear Main Bus Current Rating for Short-circuit Capability of 63.8 kA Peak for 10 Cycles.

FOR THE MAIN BUS CONTINUOUS CURRENT RATING

<table>
<thead>
<tr>
<th>Related Capability</th>
<th>Rating</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Momentary Current Rating, kA Peak</td>
<td>63.8</td>
<td>63.8</td>
</tr>
<tr>
<td>Short Time Current rating, 2 Seconds, kA Symmetrical</td>
<td>25</td>
<td>25</td>
</tr>
</tbody>
</table>

Table 3. MVS/MSB/MEB Switchgear Main Bus Current Rating for Short-circuit Capability of 97 kA Peak for 10 Cycles.

FOR THE MAIN BUS CONTINUOUS CURRENT RATING

<table>
<thead>
<tr>
<th>Related Capability</th>
<th>Rating</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Momentary Current Rating, kA Peak</td>
<td>97</td>
<td>97</td>
</tr>
<tr>
<td>Short Time Current rating, 2 Seconds, kA Symmetrical</td>
<td>38</td>
<td>38</td>
</tr>
</tbody>
</table>

Table 4. MVS/MSB/MEB Switchgear Main Bus Current Rating for Short-circuit Capability of 127.5 kA Peak for 10 Cycles.

FOR THE MAIN BUS CONTINUOUS CURRENT RATING

<table>
<thead>
<tr>
<th>Related Capability</th>
<th>Rating</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Momentary Current Rating, kA Peak</td>
<td>127.5</td>
<td>127.5</td>
</tr>
<tr>
<td>Short Time Current rating, 2 Seconds, kA Symmetrical</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

Table 5. MVS/MSB/MEB Switchgear Main Bus Current Rating for Short-circuit Capability of 160.6 kA Peak for 10 Cycles.

FOR THE MAIN BUS CONTINUOUS CURRENT RATING

<table>
<thead>
<tr>
<th>Related Capability</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Momentary Current Rating, kA Peak</td>
<td>160.6</td>
</tr>
<tr>
<td>Short Time Current rating, 2 Seconds, kA Symmetrical</td>
<td>63</td>
</tr>
</tbody>
</table>

Table 6. MVS2 Switch Standards.

<table>
<thead>
<tr>
<th>STANDARDS DOCUMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underwriters Laboratory (UL) or Canadian Standards Association (CSA) Listing to:</td>
</tr>
<tr>
<td>ANSI/IEEE C37.20.3</td>
</tr>
<tr>
<td>ANSI C37.57</td>
</tr>
<tr>
<td>CSA Listing Only to:</td>
</tr>
<tr>
<td>CAN/CSA C22.2 No 31</td>
</tr>
</tbody>
</table>

WARNING

OPERATING A MVS OR 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 OR MVS2 SWITCH.
Section 2: Receiving, Handling, and Storage

2.1 Receiving
A visual inspection - inside and out - should be performed immediately upon receipt of the switchgear assembly before removing it from the truck. Shipping papers should be checked to be sure all boxes or other accompanying pieces have been received. If any damage or shortages are evident, a claim should be filed at once with the carrier and the nearest Eaton Electrical, Inc. office notified.

The data nameplate for each switchgear assembly is located inside the mechanism access door. The master parts list number is located on this nameplate and should be given to the Eaton Electrical, Inc. representative whenever identification of the assembly is required.

2.2 Handling
Removable lifting lugs are provided on the top of the MVS structure for insertion of hooks to lift the complete structure. This is the only recommended method of moving the MVS structure. Extreme care should be used not to damage or deform the switchgear if other moving methods are employed.

2.3 Storage
If it is necessary to store the equipment before installation, keep it in a clean, dry location with ample air circulation and heat to prevent condensation. Like all electrical apparatus, these units contain insulation that must be protected against dirt and moisture. Outdoor assemblies may be stored outside only if the roof caps are installed, the space heaters energized, and any openings are enclosed.

Section 3: Installation
Refer to shipping list for location of the bus, hardware, and all other joining and installation material.

3.1 Joining Type MVS Enclosures

3.1.1 Access to MVS Switchgear Vertical Sections Containing Switches
Each MVS2 switch is shipped from the factory in the closed position to maintain alignment during shipping and handling. 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 (defined as \( \pm 0.0125 \) in. in 36 in. [0.318 mm in 914.4 mm] front to rear, left to right, and diagonally beneath the supporting framework of the switchgear assembly). To open a manually operated MVS2 switch insert the operating handle and push down. When the switch opens the door may be opened.

When handling MVS switchgear, be sure the switches are in the closed position. Do not operate MVS2 switches unless the switchgear assembly is setting on a true and level surface. True and level is defined as level within \( \pm 0.0125 \) in. in 36 in. (0.318 mm in 914.4 mm) front to rear, left to right, and diagonally, measured at any point beneath the supporting framework of the MVS switchgear.

3.1.2 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.

3.1.3 Procedures for Joining MVS Enclosures at Shipping Splits
During the following steps, please refer to Figure 2.
Step 1: Remove the eight (8) 0.375-16 in. bolts from each side sheet.

Step 2: Position the shipping sections next to each other. The four (4) holes will match holes in adjacent side sheets. In some cases, it may be necessary to use of an aligning tool such as a punch to move the structures into alignment.

Step 3: Bolt the side sheets together using the eight (8) bolts removed from one side sheet in Step 1.

Step 4: 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.

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

3.3 Connection of Type MVS Switchgear to the Transformer

3.3.1 Physical Connection

3.3.1.1 Indoor Assemblies, Dry Type, Cast Coil Type, or Liquid Filled Type Transformers

Holes are predrilled in the side of the MVS structure to match the holes provided in the transformer case. Hardware is provided in the MVS 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 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 switchgear to prevent damage.

3.3.1.2 Outdoor Throat Connection, Liquid Filled Transformers

During the following steps, please refer to Figure 4.

Step 1: Remove the sealing ring flange from MVS 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 switchgear to outside surfaces of both flanges.

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

Step 5: Reinstall sealing ring removed in Step 1.

3.3.2 Medium Voltage Electrical Connections

3.3.2.1 Connection by Cables Supplied with Type MVS 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 15 kV applications, they must be properly separated from each other, from all grounded metal parts, and from the transformer bushings/terminals of other phases. For 4.76 kV applications, it is only necessary to install cables so they will not be damaged from sharp edges, points, etc.

**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.

Figure 3. Installation of Roof Caps on Outdoor Units.
Instructions for Installation, Operation, and Maintenance of Type MVS, MEB, and MSB Metal Enclosed Switchgear Assemblies: 4.76 kV or 15.0 kV Class

3.5 Connections to a MVA Metal Clad Switchgear Assembly

3.5.1 Indoor Switchgear
Follow the same procedure as given in Section 3.4.

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

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

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

Step 4: Make the bus connections as detailed in Section 3.3.2.2.

3.6 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 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 below.

B. Cable Electrical Stress Relief Devices
The design of MVS 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.
C. Cable Support Channel(s).
The cable support devices are supplied by the installer unless specifically purchased with the MVS switchgear. MVS cable supports, when supplied, are made of structural framing channel. The cable supports must be mounted to suit the geometry of the installation. The means to fasten the cable to the cable supporting devices are to be provided by others.

There are a large number of commercially available cable support devices that can be fastened to the structural framing channel to support the cable so the cable weight is not hanging on the switchgear terminals.

E. Current Transformer(s)
The current transformers are to be mounted on the side of the cable support that will physically support the current transformers so they will not slide down onto the stress relief devices. The high voltage cable is to be routed through the current transformer.

The H1 side of each current transformer is to be towards the normal source of electric power. Each current transformer secondary wiring is terminated at a plug. This plug is to be placed in the terminal block receptacle to match the phase on which the current transformer is mounted. The switchgear terminals will have phase labeling. The secondary wires are to be fastened to the support channel so they cannot fall into high voltage parts.

WARNING
FAILURE TO INSTALL THE CABLE SUPPORT MAY RESULT IN DAMAGE TO THE SWITCHGEAR TERMINALS, WHICH IN TURN MAY RESULT IN MAJOR EQUIPMENT DAMAGE AND CAUSE SEVERE PERSONAL INJURY OR DEATH.

THE CABLE SUPPORT MUST BE INSTALLED AS INSTRUCTED IN THIS DOCUMENT.

D. Lacing Cord or Other Equivalent Materials/Means
The cables must be lashed together to restrain the cables if a short circuit should occur. This material is to be provided by others. For large cables and/or cable reverse loops, it may also be necessary to lash the cable bundle(s) to the support channel. The views show this suggested fastening of the cable bundles.

WARNING
FAILURE TO LASH THE CABLES TOGETHER MAY RESULT IN DAMAGE TO THE SWITCHGEAR, WHICH IN TURN MAY RESULT IN MAJOR EQUIPMENT DAMAGE AND CAUSE SEVERE PERSONAL INJURY OR DEATH.

THE CABLE MUST BE LASHED TOGETHER AS INSTRUCTED IN THIS DOCUMENT.
Figure 7. Unfused Bottom Cable Exit (to Load), Rear Access.

Figure 8. Unfused Top Cable Exit (to Load), Rear Access.

Figure 9. Top Cable Entrance (Energy Source), Front Access.

Figure 10. Bottom Cable Entrance (Energy Source), Front Access.
Figure 11. Unfused Top Cable Exit (to Load), Front Access.

Figure 12. Unfused Bottom Cable Exit (to Load), Front Access.

Figure 13. Unfused bottom cable exit (to load), front access.

Figure 14. Fused Bottom Cable Exit (to Load), Front Access.
3.7 Field Taping of Electrical Connections

During the following procedures, please refer to Figure 15.

Figure 15. Field Taping of Electrical Connections.

3.7.1 Definitions and Eaton Electrical, Inc. Approved Materials for Field Insulation

**Filler:** Nashua No. 102 Duct Sealer® or 3M Co. Scotch-fil® or Neer® Duct Seal.

**Insulating Tape and Pad:** Either 3M Co. Scotch 23® or Scotch 130C®.

**Insulating Boot:** Molded plastic cover that is put over a joint and fastened in place with wire ties.

**Joint:** An area to be insulated. This consists of the bare conductor and 1.5 in. (38.1 mm) of any pre-insulation next to the bare conductor.

**Layer:** Insulating tape, 1.0-in. (25.4-mm) wide, wrapped from one end of the joint to the other (or to a pad) so each succeeding turn laps the previous turn by the amount specified in the taping chart.

**Overlap:** A specified distance measured along the pre-insulation starting from the point where the pre-insulation ends and the exposed conductor begins.

**Pad:** Any insulating tape applied which is wider than 1.0 in. (25.4 mm). Includes a band of tape consisting of one or more turns wrapped directly on top of each other.

**Pre-insulation:** Any insulation covering (sleeving materials such as NORYL®, Raychem®, Scotch-tite®, and fluidized epoxy coating) adjacent to an exposed conductor prior to insulating.

3.7.2 Responsibility of Installer

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

Table 7. Minimum Clearance Chart.

<p>| KV RATING OF THE PHASE-TO-PHASE |</p>
<table>
<thead>
<tr>
<th>MVS SWITCHGEAR</th>
<th>IN. (MM)</th>
<th>PHASE-TO-GROUND</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>3.5 (88.9)</td>
<td>3.5 (88.9)</td>
</tr>
<tr>
<td>15</td>
<td>6 (152.4)</td>
<td>6 (152.4)</td>
</tr>
</tbody>
</table>

* Example: If the phase-to-phase clearances above for a given rating do not exist, then it is only necessary to insulate the center phase.

**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.

3.7.3 Field Insulation Methods

3.7.3.1 Method 1 - 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.

3.7.3.2 Method 2 - Using Insulating Tape and Filler:

3.7.3.2.1 General

**Step 1:** Elongate the insulating tape 10 to 25 % during application to insure a smooth, tight fit. On pads, elongate the corners only.

**Step 2:** Should a tape roll expire during application, start the new role by overlapping the previous end by 1/2 turn.

**WARNING**

USE OF SOLVENTS, OILS, JOINT COMPOUNDS, OR GREASE ON OR NEAR NORYL® INSULATION WILL DESTROY IT.
3.7.3.2.2 Joint - No Hardware

**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:** Apply one turn of 1.0 in. (25.4 mm) tape so 1/2 of the tape is on the conductor and 1/2 is on the pre-insulation. Overlap the tape ends 1.5 in. (38.1 mm).

**Step 3:** Apply one layer of insulating tape, lapping as specified in the taping chart below, overlapping any pre-insulation by 1.5 in. (38.1 mm).

3.7.3.2.3 Joint - with Hardware

**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:** Apply the filler over the bare conductor and hardware to cover and smooth out the surface. Blend the contour into pre-insulation surfaces. Cover the conductors and hardware with at least 0.125 in. (3.18 mm) inch of filler.

**Step 3:** Apply pad(s) of insulating tape of sufficient width to overlap the pre-insulation by 1.0 in. (25.4 mm) or more.

**Step 4:** Apply one layer of insulating tape, lapping as specified in the taping chart, overlapping any pre-insulation or pads by 1.5 in. (38.1 mm).

### Table 8: Taping Chart

<table>
<thead>
<tr>
<th>MVS kV Rating</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>5</td>
<td>1.5 (38.1)</td>
<td>1/2</td>
</tr>
<tr>
<td>Over 5</td>
<td>1.5 (38.1)</td>
<td>2/3</td>
</tr>
</tbody>
</table>

3.7.4 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 6.3.2 for cleaning procedures.
Figure 16. Floor Plan of a Typical Non-seismic MVS 4.76 kV and 15 kV Switchgear Installation.

Figure 17. Floor Plan of a Seismic MVS 4.76 kV and 15 kV Switchgear Installation.
3.9 Connection of Space Heaters to Customers Source
Space heaters, when supplied, must be energized to prevent condensation. Heaters are supplied for 120- or 240-volt sources as shown on the drawings. For switchgear assemblies with or without heater control devices, heaters will be internally wired and brought to a terminal block. A wiring diagram will be furnished with the drawings showing connection points for power.

Section 4: 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, Section 5.3.

Step 1: Check the bolted bus connections for proper tightness, referring to Section 9 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.

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. If bus is insulated, see Section 6.3.2 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.

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

4.1 Inspection Before Startup

Each MVS/MSB/MEB switchgear assembly is functioning properly at the factory before shipment. However, vibration and mechanical stresses imposed by transit and installation can adversely affect the switchgear assembly and its component devices. Therefore, an inspection is essential before energizing. If this inspection reveals the switchgear assembly or any component device has come out of adjustment, the switchgear or its component device should be readjusted according to this instruction bulletin and the associated instruction documents for the component.

Inspection procedures require closing and opening the switch with the main door open. This requires override of the switch safety interlocks. This is described in the switch instruction bulletin IB02102002E, Section 5.3.1. For circuit breaker instructions when the switchgear is type MSB, refer to IB69C3067H06. For circuit breaker instructions when the switchgear is type MEB, refer to IB 32-255-1.

- When fuse mountings are supplied, check to ensure the fuse mountings are securely fastened and the fuses are securely clamped in place.
- When Eaton Electrical, Inc. type RBA fuses are provided, check to ensure the discharge filters or condensers on the fuses have been securely hand tightened.
- Perform the recommended procedures in Section 6.3 to assure the insulation integrity of the switchgear assembly.
- A final, thorough inspection should be made to ensure that no tools or other objects are accidentally left inside the enclosure.

Section 5: Operation

5.1 Mechanical Safety Interlocks

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

5.2 Key Interlocking

Key interlocks are supplied when specified, but certain MVS 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 Electrical, Inc. or other equipment.

5.3 Fuse Replacement

- When fuse mountings are supplied, check to ensure the fuse mountings are securely fastened and the fuses are securely clamped in place.
- When Eaton Electrical, Inc. type RBA fuses are provided, check to ensure the discharge filters or condensers on the fuses have been securely hand tightened.
- Perform the recommended procedures in Section 6.3 to assure the insulation integrity of the switchgear assembly.
- A final, thorough inspection should be made to ensure that no tools or other objects are accidentally left inside the enclosure.

CAUTION

ISOPROPYL ALCOHOL IS FLAMMABLE. PROVIDE ADE-QUATE VENTILATION AND KEEP AWAY FROM FLAMES AND OTHER IGNITION SOURCES.

CONSULT YOUR SAFETY DEPARTMENT BEFORE USING.

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.

CAUTION

failure to completely disconnect the mvs 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 1: All devices that could energize the fuse should be opened, padlocked, and tagged so that inadvertent closure cannot create a hazard.

Step 2: The MVS or MVS2 switch should be opened by rotating the handle downward.

Step 3: Before opening the door, look through a window to visually verify that all blades are disengaged from their break jaws.

Step 4: After opening the door, an appropriate medium voltage-sensing device should be used to determine if voltage is present.
Step 5: If no voltage is present, a suitable grounding device should be attached to the fuse terminals to discharge any static charge and assure that the fuse terminals remain at ground potential.

Fuses are removed by loosening the plastic hand knobs and removing the locking bars. Fuses are then free to be removed. When fuses are re-installed, the hand knobs should be retightened hand tight.

Section 6: Maintenance

**WARNING**

FAILURE TO COMPLETELY DISCONNECT THE MVS 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.

6.1 Inspection Schedule

The switchgear should be inspected on a regular periodic basis to ensure all components are functioning correctly and the insulation system integrity is being maintained. See the appropriate instruction documents for the component devices.

6.2 Inspection Procedure

Wipe away any dust or dirt that may have accumulated inside each switchgear vertical section, paying close attention to insulators and insulating material. If the bus is insulated, see Section 6.3.2 for cleaning procedures.

6.3 Insulation and Conductor Maintenance

6.3.1 Insulated Bus Coverings Made from NORYL®

Insulated bus coverings are made from NORYL®, a high-performance engineering thermoplastic. NORYL® can be irreversibly damaged if it comes in contact with certain chemicals. Such petroleum containing products as solvents, oils, greases, and electrical joint compounds are especially harmful. Non-metallic materials, not specifically approved by Eaton Electrical, Inc. Engineering, should not come in contact with the NORYL®. Only specified tapes and fillers should be used when insulating bus bar joints. See Section 3.7 for details.

6.3.2 Electrical Parts and Insulation Check and Cleaning

De-energize primary circuits before removing any enclosure parts. Before cleaning, take “MEGGER” readings between live parts and to ground. Inspect for signs of overheating or weakened insulation. Remove dust from conductors, live parts, insulators, component insulation, live parts, and enclosure surfaces. An industrial grade vacuum cleaner would assist this procedure. Wipe clean with isopropyl alcohol or distilled water only, then wipe dry.
After the live parts, insulators, and drive rod links have been dusted and wiped clean, take “MEGGER” readings again between the live parts 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 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 9.

Table 9. 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.

### 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.

6.4 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 insulation. Care must be taken to prevent any non-conductive lubricant from reaching any current carrying contact surface. Use conductive grease (Eaton Electrical part number 7274A48H02) on moving and sliding contacts of the voltage transformer trays and other similar components. Use mechanical lubricating grease (Eaton Electrical part number 53701AI) on moving parts that are not electrical contacts. See IB02102002E for the MVS2 switch lubrication requirements, and see IB2102003E for MVS selector switch lubrication requirements. For other components see the appropriate instruction documents for those components, for their lubrication requirements.

### CAUTION

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

CONSULT YOUR SAFETY DEPARTMENT BEFORE USING.
Section 7: 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 18. 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 8: MSB and MEB Switchgear Assemblies

8.1 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.

8.2 Identification

See Section 1.8 of this bulletin.

8.3 Safety Features

The seven safety features outlined in Section 1.9 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.

8.4 Receiving, Handling, and Storage
The VCP-TR breaker comes installed within the MSB assembly. See Section 2 of this document for 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.

8.5 Installation
Refer to Section 3 of this document for MSB or MEB switchgear assembly installation.

For a VCP-W circuit breaker or a VCP-TR circuit breaker before startup, refer to the appropriate section in the applicable instruction book for this information.

8.5.1 Electromechanical or Solid State Relays and Devices - Before Startup.

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**WARNING**

**ELECTROMECHANICAL RELAYS ARE MECHANICALLY "BLOCKED" FOR SHIPMENT PURPOSES.**

**REMOVE ALL SHIPPING BLOCKS PRIOR TO THE SETTING OF RELAYS.**

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**Step 1:** Set all protective relays in accordance with system protection coordination study data. All operation indicators on the protective relays are factory set for the control voltage utilized.

**Step 2:** Set or "program" all electronic devices in accordance with system protection coordination study data or other applicable data. Refer to those devices' instructions for specific procedures.

8.6 Operation
Refer to the applicable circuit breaker instruction book for circuit breaker operation.

8.7 Maintenance
Refer to the applicable circuit breaker instruction book for maintenance of the circuit breaker. For switchgear maintenance, refer to Section 6 of this document.

---

8.7.1 Breaker Removal, VCP-TR Circuit Breaker

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**WARNING**

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

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

**Step 1:** All upstream devices that could energize the circuit breaker should be opened, padlocked, and tagged so that inadvertent closure cannot create a hazard.

**Step 2:** The MVS switch must be opened by rotating the handle downward.

**Step 3:** Before opening the door, look through the window to visually verify that all blades are disengaged from their stationary contacts. Use a flashlight if necessary.

**Step 4:** After opening the door, a medium voltage-sensing device should be used to determine if voltage is present.

**Step 5:** If no voltage is present, a suitable grounding device should be attached to the bus connections to discharge any static charge and ensure that the bus connections remain at ground potential.

Although the VCP-TR circuit breaker is a fixed mounted device in a MSB switchgear vertical section, it can be removed for maintenance purposes.
Section 9: MVS Switchgear Bolt Tightness for Bus Connections

Use the following torque value for tightening bus joints.

Table 10. Bus Joint Hardware Tightness Values.

<table>
<thead>
<tr>
<th>BOLT DIAMETER DECIMAL SIZE</th>
<th>BOLT DIAMETER STANDARD</th>
<th>NOMINAL TORQUE</th>
<th>FT-LB (N-M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.250 (6.35)</td>
<td>1/4-20</td>
<td>4</td>
<td>5.42</td>
</tr>
<tr>
<td>0.312 (7.93)</td>
<td>5/16-18</td>
<td>8</td>
<td>10.85</td>
</tr>
<tr>
<td>0.375 (9.53)</td>
<td>3/8-16</td>
<td>25</td>
<td>33.90</td>
</tr>
<tr>
<td>0.500 (12.70)</td>
<td>1/2-13</td>
<td>50</td>
<td>67.80</td>
</tr>
<tr>
<td>0.625 (15.88)</td>
<td>5/8-11</td>
<td>65</td>
<td>88.13</td>
</tr>
</tbody>
</table>

Section 10: Renewal Parts

Table 11. Common Renewal Parts

<table>
<thead>
<tr>
<th>PART DESCRIPTION</th>
<th>STYLE NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulator, Glass Polyester, 4.76 kV</td>
<td>4892A97H01</td>
</tr>
<tr>
<td>Insulator, Glass Polyester, 15 kV</td>
<td>4892A97H02</td>
</tr>
<tr>
<td>Insulator, epoxy, 4.76 kV</td>
<td>4892A97H07</td>
</tr>
<tr>
<td>Insulator, epoxy, 15 kV</td>
<td>4892A97H08</td>
</tr>
<tr>
<td>Bus Support Polyester/Nylon, 8 in. Centers</td>
<td>260C003H01</td>
</tr>
<tr>
<td>Bus Support Polyester/Epoxy, 8 in. Centers</td>
<td>260C265H01</td>
</tr>
<tr>
<td>Bus Brace, 3 Conductor Polyester/Nylon, 8 in. Centers</td>
<td>260C005H01</td>
</tr>
<tr>
<td>Bus Brace, 3 Conductor Polyester/Epoxy, 8 in. Centers</td>
<td>260C266H01</td>
</tr>
<tr>
<td>Bus Brace, 2 Conductor Polyester/Nylon, 8 in. Centers</td>
<td>260C005H03</td>
</tr>
<tr>
<td>Bus Brace, 2 Conductor Polyester/Epoxy, 8 in. Centers</td>
<td>260C266H03</td>
</tr>
<tr>
<td>Bus Brace, 3 Conductor Polyester/Nylon, 8 in. Centers</td>
<td>260C005H01</td>
</tr>
<tr>
<td>Bus Brace, 3 Conductor Polyester/Epoxy, 8 in. Centers</td>
<td>260C266H01</td>
</tr>
<tr>
<td>Bus Brace, 3 Conductor Polyester/Nylon, 8 in. Centers</td>
<td>260C005H01</td>
</tr>
<tr>
<td>Bus Brace, 3 Conductor Polyester/Epoxy, 8 in. Centers</td>
<td>260C266H01</td>
</tr>
<tr>
<td>Fuse Live Parts Kit, RBA200 4.76 kV</td>
<td>98A1125G22</td>
</tr>
<tr>
<td>Fuse Live Parts Kit, RBA200 15 kV</td>
<td>98A1125G23</td>
</tr>
<tr>
<td>Fuse Live Parts Kit, RBA400 4.76 kV</td>
<td>98A1125G24</td>
</tr>
<tr>
<td>Fuse Live Parts Kit, RBA400 15 kV</td>
<td>98A1125G25</td>
</tr>
<tr>
<td>Space Heater, 125 V 250 W</td>
<td>3614A50H01</td>
</tr>
<tr>
<td>Space Heater, 250 V 250 W</td>
<td>3614A50H02</td>
</tr>
<tr>
<td>Set of Fuse Barriers (15 kV Class)</td>
<td>7278A27G43</td>
</tr>
<tr>
<td>Fuse Live Parts Kit, RBA800 4.76 kV</td>
<td>98A1125G26</td>
</tr>
<tr>
<td>Fuse Live Parts Kit, RBA800 15 kV</td>
<td>98A1125G27</td>
</tr>
<tr>
<td>Fuse Live Parts Kit, CLE, 3 in. Diameter, Ferrule Single Barrel, 4.76 kV</td>
<td>98A1125G03</td>
</tr>
<tr>
<td>Fuse Live Parts Kit, CLE, 3 in. Diameter, Ferrule Single Barrel, 15 kV</td>
<td>98A1125G04</td>
</tr>
<tr>
<td>Fuse Live Parts Kit, CLE, 3 in. Diameter, Ferrule Double Barrel, 4.76 kV</td>
<td>98A1125G05</td>
</tr>
<tr>
<td>Fuse Live Parts Kit, CLE, 3 in. Diameter, Ferrule Double Barrel, 15 kV</td>
<td>98A1125G06</td>
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</tbody>
</table>
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