WSA-5-VR and WSA-15-VR
Replacement Circuit Breaker
WSA-5-VR and WSA-15-VR
Replacement Circuit Breaker

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THE CIRCUIT BREAKERS DESCRIBED IN THIS BOOK ARE DESIGNED AND TESTED TO OPERATE WITHIN THEIR NAMEPLATE RATINGS. OPERATION OUTSIDE OF THESE RATINGS MAY CAUSE THE EQUIPMENT TO FAIL, RESULTING IN DEATH, BODILY INJURY AND PROPERTY DAMAGE.

ALL SAFETY CODES, SAFETY STANDARDS AND/OR REGULATIONS AS THEY MAY BE APPLIED TO THIS TYPE OF EQUIPMENT MUST BE STRICTLY ADHERED TO.

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This product was manufactured by Eaton at the Power Breaker Center (PBC): 310 Maxwell Avenue, Greenwood, SC 29646.

All possible contingencies which may arise during installation, operation or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding his particular installation, operation or maintenance of particular equipment, contact a Eaton representative.
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SECTION 1: INTRODUCTION

The purpose of this book is to provide instructions for receiving and handling, storage, installation, operation and maintenance of type WSA VR-Series circuit breaker. The Vacuum Replacement Circuit Breakers (also referred to as VR-Series) are designed to be used in existing McGraw-Edison type WSA metal-enclosed switchgear and provide equal or superior electrical and mechanical performance as compared to the design ratings of the original circuit breaker. VR-Series Circuit Breakers provide reliable control, protection and performance, with ease of handling and maintenance. Like ratings are interchangeable with each other.

This book is intended to be used in conjunction with the technical information provided with the original equipment order which includes, but is not limited to electrical control schematics and wiring diagrams, outline diagrams, installation plans, and procedures for installation and maintenance of accessory items.

Satisfactory performance is dependant upon proper application, correct installation, and adequate maintenance. It is strongly recommended that this instruction book be carefully read and followed in order to realize optimum performance and long useful life of the circuit breaker.

1.1 AVAILABLE WSA-VR CIRCUIT BREAKERS

Refer to Table 1.

### Table 1. WSA-VR Availability and Interchangeability

<table>
<thead>
<tr>
<th>Breaker Type</th>
<th>Nominal Voltage Class (kV)</th>
<th>Existing Breaker MVA Rating</th>
<th>Existing Breaker Rated Continuous Current at 60 Hz (Amps)</th>
<th>MVA Designation of VR-Series Breaker</th>
<th>Rated Voltage Factor K</th>
<th>Rated Withstand ANSI Test Voltage Low Freq. kV RMS</th>
<th>Impulse kV Crest</th>
<th>Rated Short-Circuit kA RMS at Rated Max kV</th>
<th>Closing and Latching / Momentary Capabilities kA RMS/Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>WSA-5</td>
<td>4.16</td>
<td>75</td>
<td>1200 / 2000</td>
<td>WSA-5-250</td>
<td>1.24</td>
<td>19</td>
<td>60</td>
<td>29</td>
<td>68 / 97</td>
</tr>
<tr>
<td></td>
<td>13.8</td>
<td>750</td>
<td>1200 / 2000</td>
<td>WSA-15-500XU</td>
<td>1.30</td>
<td>36</td>
<td>95</td>
<td>37</td>
<td>77 / 130</td>
</tr>
</tbody>
</table>
Table 2. WSA-5-VR Dimensions (2000A Shown)

<table>
<thead>
<tr>
<th>Breaker Type</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>WSA-5-VR 250</td>
<td>1200</td>
<td>68.11</td>
<td>20.36</td>
<td>6.81</td>
<td>35.83</td>
<td>10.00</td>
<td>27.13</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>67.60</td>
<td>30.17</td>
<td>10.00</td>
<td>35.62</td>
<td>10.00</td>
<td>27.13</td>
</tr>
</tbody>
</table>
Table 3. WSA-15-VR Dimensions

<table>
<thead>
<tr>
<th>Breaker Type</th>
<th>Existing Breaker</th>
<th>Rated Continuous</th>
<th>Current at 60 Hz</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>WSA-15-VR 500/500U</td>
<td>1200 / 2000</td>
<td>71.75</td>
<td>31.75</td>
<td>10.00</td>
<td>45.10</td>
<td>10.00</td>
<td>27.00</td>
<td>18.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SECTION 2: SAFE PRACTICES

VR-Series breakers are equipped with high speed, high energy operating mechanisms. They are designed with several built-in interlocks and safety features to provide safe and proper operating sequences.

⚠️ WARNING

TO PROTECT THE PERSONNEL ASSOCIATED WITH INSTALLATION, OPERATION, AND MAINTENANCE OF THESE BREAKERS, THE FOLLOWING PRACTICES MUST BE FOLLOWED:

• Only qualified persons, as defined in the National Electrical Safety Code, who are familiar with the installation and maintenance of medium voltage circuits and equipment, should be permitted to work on these breakers.

• Read these instructions carefully before attempting any installation, operation or maintenance of these breakers.

• Always remove the breaker from the enclosure before performing any maintenance. Failure to do so could result in electrical shock leading to death, severe personnel injury or property damage.

• Do not work on a breaker with the secondary test coupler engaged. Failure to disconnect the test coupler could result in an electrical shock leading to death, personnel injury or property damage.

• Do not work on a closed breaker or a breaker with closing springs charged. The closing spring should be discharged and the main contacts open before working on the breaker. Failure to do so could result in cutting or crushing injuries.

• Do not use a circuit breaker by itself as the sole means of isolating a high voltage circuit. Remove the breaker to the Disconnect position and follow all lockout and tagging rules of the National Electrical Code and any and all applicable codes, regulations and work rules.

• Do not leave the breaker in an intermediate position in the cell. Always have the breaker either in the Test or Connected position. Failure to do so could result in a flash over and possible death, personnel injury or property damage.

• Always remove the maintenance tool from the breaker after charging the closing springs.

• Breakers are equipped with safety interlocks. Do not defeat them. This may result in death, bodily injury or equipment damage.
SECTION 3: RECEIVING, HANDLING, AND STORAGE

Type WSA VR-series circuit breakers are subjected to complete factory production tests and inspection before being packed. They are shipped in packages designed to provide maximum protection to the equipment during shipment and storage and at the same time to provide convenient handling. Accessories such as the maintenance tool, cell code plate, (if applicable) etc. are shipped with the breaker (Figure 3.1).

3.1 RECEIVING

Until the breaker is ready to be delivered to the switchgear site for installation, DO NOT remove it from the shipping crate. If the breaker is to be placed in storage, maximum protection can be obtained by keeping it in its crate.

Upon receipt of the equipment, inspect the crates for any signs of damage or rough handling. Open the crates carefully to avoid any damage to the contents. Use a nail puller rather than a crow bar when required.

When opening the crates, be careful that any loose items or hardware are not discarded with the packing material. Check the contents of each package against the packing list.

Examine the breaker for any signs of shipping damage such as broken, missing or loose hardware, damaged or deformed insulation and other components. File claims immediately with the carrier if damaged or loss is detected and notify the nearest Eaton’s Electrical Services & Systems office.

Tools and Accessories

Maintenance Tool: This tool is used to manually charge the closing spring. One maintenance tool is provided with each vacuum unit replacement breaker. (Style# 8064A02G01)

Racking Handle: The racking handle is used to drive the racking mechanism which moves the circuit breaker into and out of the cell. The original OEM racking handle will interface with the VR-Series replacement breaker racking mechanism and is therefore not provided as part of the vacuum replacement breaker.

Secondary Connection Block Extension Cable: The extension cable can be used to connect the circuit breaker to a “test cabinet” or to the switchgear cell’s secondary receptacle block so that the breaker can be electrically operated while not installed in the switchgear cell. This extension cable is the same one provided with the McGraw-Edison breaker and is therefore not included as part of the vacuum replacement breaker.

Cell Rejection Assembly: Eaton provides a cell rejection assembly when the existing circuit breaker compartment requires electrical and/or mechanical modification to accept the new replacement circuit breaker. (Style# 94B6108G27)

Note: Once the required modifications to the existing cell structure are made, it is no longer possible to re-install the original air magnetic circuit breaker.
3.2 HANDLING

**WARNING**

DO NOT USE ANY LIFTING DEVICE AS A PLATFORM FOR PERFORMING MAINTENANCE, REPAIR OR ADJUSTMENT OF THE BREAKER OR FOR OPENING, CLOSING THE CONTACTS OR CHARGING THE SPRINGS. THE BREAKER MAY SLIP OR FALL CAUSING SEVERE PERSONAL INJURY. ALWAYS PERFORM MAINTENANCE, REPAIR AND ADJUSTMENTS ON A WORKBENCH CAPABLE OF SUPPORTING THE BREAKER TYPE.

WSA-VR breaker shipping containers are designed to be handled either by use of a rope sling and overhead lifting device or by a fork lift truck. If containers must be skidded for any distance, it is preferable to use roller conveyors or individual pipe rollers.

Once a breaker has been inspected for shipping damage, it is best to return it to its original shipping crate until it is ready to be installed in the Metal-Clad Switchgear.

When a breaker is ready for installation, a lifting harness in conjunction with an overhead lift or portable floor lift can be used to move a breaker, if this is preferable to rolling the breaker on the floor using self contained wheels. If the breaker is to be lifted, position the lifting device (lifting straps should have at least a 1600 pound capacity) over the breaker and insert the lifting harness hooks into the breaker side openings and secure. Be sure the hooks are firmly attached before lifting the breaker. Stand a safe distance away from the breaker while lifting and moving.

**Figure 3.2. Lifting WSA-VR (WSA-5-VR 250 1200A Shown)**

3.3 STORAGE

If the circuit breaker is to be placed in storage, maximum protection can be obtained by keeping it in the original shipping crate. Before placing it in storage, checks should be made to make sure that the breaker is free from shipping damage and is in satisfactory operating condition.

The breaker is shipped with its contacts open and closing springs discharged. The indicators on the front panel should confirm this. Insert the maintenance tool in the manual charge socket opening (Figure 3.3, 3.5, & 3.7). Charge the closing springs by pumping the handle up and down about 36 times until a crisp metallic “click” is heard. This indicates that the closing springs are charged and is shown by the closing spring “charged” (yellow) indicator. Remove the maintenance tool. Push the “manual close” button. The breaker will close as shown by the breaker contacts “closed” (red) indicator. Push the “manual trip” button. The breaker will trip as shown by the breaker contacts “open” (green) indicator. After completing this initial check, leave the closing springs “discharged” and breaker contacts “open”.

Outdoor storage is NOT recommended. If unavoidable, the outdoor location must be well drained and a temporary shelter from sun, rain, snow, corrosive fumes, dust, dirt, falling objects, excessive moisture, etc. must be provided. Containers should be arranged to permit free circulation of air on all sides and temporary heaters should be used to minimize condensation. Moisture can cause rusting of metal parts and deterioration of high voltage insulation. A heat level of approximately 400 watts for each 100 cubic feet of volume is recommended with the heaters distributed uniformly throughout the structure near the floor.

Indoor storage should be in a building with sufficient heat and circulation to prevent condensation. If the building is not heated, the same general rule for heat as for outdoor storage should be applied.

3.4 WSA-VR APPROXIMATE WEIGHTS

Refer to Table 3.

**Table 4. Maximum Weight by Type**

<table>
<thead>
<tr>
<th>Type</th>
<th>Amperes</th>
<th>LBs</th>
</tr>
</thead>
<tbody>
<tr>
<td>WSA-5-VR 250</td>
<td>1200</td>
<td>710</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>920</td>
</tr>
<tr>
<td>WSA-15-VR 501</td>
<td>1200</td>
<td>800</td>
</tr>
<tr>
<td>WSA-15-VR 502</td>
<td>2000</td>
<td>930</td>
</tr>
</tbody>
</table>
WSA-5-VR and WSA-15-VR
Replacement Circuit Breaker

Figure 3.3. Front External View of WSA-5-VR 250 1200A

Front External View

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Operations Counter</td>
</tr>
<tr>
<td>2</td>
<td>Breaker Contacts Indicator</td>
</tr>
<tr>
<td>3</td>
<td>Push To Close Button</td>
</tr>
<tr>
<td>4</td>
<td>Interlock Handle</td>
</tr>
<tr>
<td>5</td>
<td>Secondary Disconnect Slide</td>
</tr>
<tr>
<td>6</td>
<td>Manual Charging Socket</td>
</tr>
<tr>
<td>7</td>
<td>Spring Charged/Discharged Indicator</td>
</tr>
<tr>
<td>8</td>
<td>Push To Open Button</td>
</tr>
<tr>
<td>9</td>
<td>Racking Mechanism Interlock Shutter</td>
</tr>
</tbody>
</table>
Figure 3.4. Rear External View of WSA-5-VR 250 1200A

### Rear External View

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Primary Disconnects</td>
</tr>
<tr>
<td>2</td>
<td>Guide Rail</td>
</tr>
<tr>
<td>3</td>
<td>TOC Operator</td>
</tr>
<tr>
<td>4</td>
<td>Secondary Disconnect</td>
</tr>
<tr>
<td>5</td>
<td>Code Plate</td>
</tr>
</tbody>
</table>
WSA-5-VR and WSA-15-VR
Replacement Circuit Breaker

Figure 3.5. Front External View of WSA-15-VR 502 2000A

<p>| | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Operations Counter</td>
<td>4</td>
<td>Secondary Disconnect Slide</td>
<td>7</td>
<td>Push To Open Button</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Breaker Contacts Indicator</td>
<td>5</td>
<td>Manual Charging Socket</td>
<td>8</td>
<td>Racking Mechanism Interlock Shutter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Push To Close Button</td>
<td>6</td>
<td>Spring Charged/Discharged Indicator</td>
<td>9</td>
<td>Interlock Handle</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 3.6. Rear External View of WSA-15-VR 502 2000A

Rear External View

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>Guide Rollers</td>
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<tr>
<td>2</td>
<td>SURE CLOSE</td>
<td>4</td>
<td>Secondary Disconnect</td>
</tr>
<tr>
<td>4</td>
<td>Secondary Disconnect</td>
<td>5</td>
<td>Code Plate</td>
</tr>
</tbody>
</table>
WSA-5-VR and WSA-15-VR Replacement Circuit Breaker

Figure 3.7. Front External View of WSA-5-VR 250 2000A

### Front External View

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Operations Counter</td>
</tr>
<tr>
<td>2</td>
<td>Breaker Contacts Indicator</td>
</tr>
<tr>
<td>3</td>
<td>Push To Close Button</td>
</tr>
<tr>
<td>4</td>
<td>Secondary Disconnect Slide</td>
</tr>
<tr>
<td>5</td>
<td>Manual Charging Socket</td>
</tr>
<tr>
<td>6</td>
<td>Spring Charged/Discharged Indicator</td>
</tr>
<tr>
<td>7</td>
<td>Push To Open Button</td>
</tr>
<tr>
<td>8</td>
<td>Push / Pull Handle</td>
</tr>
<tr>
<td>9</td>
<td>Racking Mechanism Interlock Shutter</td>
</tr>
<tr>
<td>10</td>
<td>Lock-Out / Tag-Out</td>
</tr>
<tr>
<td>11</td>
<td>Interlock Handle</td>
</tr>
</tbody>
</table>
Figure 3.8. Rear External View of WSA-5-VR 250 2000A

Rear External View

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Phase Barrier</td>
</tr>
<tr>
<td>2</td>
<td>MOC Operator</td>
</tr>
<tr>
<td>3</td>
<td>SURE CLOSE</td>
</tr>
<tr>
<td>4</td>
<td>Primary Disconnects</td>
</tr>
<tr>
<td>5</td>
<td>Secondary Disconnect</td>
</tr>
<tr>
<td>6</td>
<td>Code Plate</td>
</tr>
<tr>
<td>7</td>
<td>Guide Rail</td>
</tr>
</tbody>
</table>
SECTION 4: DESCRIPTION AND OPERATION

VR-Series vacuum replacement breakers are designed to be used with existing installations of equivalent air-magnetic metal-clad switchgear breaker. The front mounted spring type stored energy mechanism facilitates inspection and provides improved access to components for servicing. The long life characteristics of the vacuum interrupters and proven high reliability of spring-type stored energy mechanisms assure long, trouble-free service with minimum maintenance.

4.1 VACUUM INTERRUPTER

Vacuum interrupters offer the advantages of enclosed arc interruption, small size and weight, longer life, reduced maintenance, minimal mechanical shock, and elimination of contact degradation caused by environmental contamination.

In the closed position, current flows through the interrupter moving and fixed stems and the faces of the main contacts. As the contacts part, an arc is drawn between the contact surfaces. The arc is rapidly moved away from the main contacts to the slotted contact surfaces by self-induced magnetic effects. This minimizes contact erosion and hot spots on the contact surfaces. The arc flows in an ionized metal vapor and as the vapor leaves the contact area, it condenses into the metal shield which surrounds the contacts.

At current zero, the arc extinguishes and vapor production ceases. Very rapid dispersion, cooling, recombination, and deionization of the metal vapor plasma and fast condensation of metal vapor causes the vacuum to be quickly restored and prevents the transient recovery voltage from causing a restrike across the gap of the open contacts.

4.1.1 THE INTERRUPTER ASSEMBLY

Each interrupter is assembled at the factory as a unit to assure correct dimensional relationships between working components. The interrupter assembly consists of a vacuum interrupter, a molded glass polyester stand-off insulator, upper and lower clamps, flexible shunts, bell crank, operating rod, and contact load spring.

The vacuum interrupter is mounted vertically with the fixed stem upward and the moving stem downward. The upper and lower glass polyester stand-off insulator and clamps support the interrupter and are fastened to the breaker’s stored energy mechanism frame. Upper and lower flexible shunts provide electrical connections from each interrupter to the breaker’s primary bushings while providing isolation from mechanical shock and movement of the interrupter’s moving stem. The operating rod, loading spring, and bell crank transfer mechanical motion from the breaker’s operating mechanism to the moving stem of the interrupter. A vacuum interrupter contact erosion indicator is located on the moving stem of the interrupter. It is visible when the breaker is withdrawn and is viewed from the rear of the breaker. (See Figure 6.1 and Figure 6.2)

4.1.2 CONTACT EROSION INDICATOR

The purpose of the contact erosion indicator is to monitor the erosion of the vacuum interrupter contacts, which is very minimal over time with Eaton vacuum interrupters utilizing copper-chrome contact material. A contact erosion indicator mark is located on the moving stem of the interrupter (Figure 6.1 and 6.2).

In order to determine if the contacts have eroded to the extent that the interrupter must be replaced, close the breaker and observe the erosion mark placed on each moving stem from the rear of the breaker. If the mark on the interrupter stem is visible, the interrupter is satisfactory. If the mark is no longer visible, the interrupter assembly must be replaced.

The erosion indicator is easily viewed from the rear on the 7.5 or 15kV designs. Because of the nature of the 5kV 20-WR element inverted design, the erosion indicator is not easily viewed, although it is possible with the use of a light and an inspection type mirror.
WARNING

FAILURE TO REPLACE THE INTERRUPTER ASSEMBLY WHEN INDICATED BY THE CONTACT EROSION INDICATOR COULD CAUSE THE BREAKER TO FAIL, LEADING TO DEATH, PERSONAL INJURY OR PROPERTY DAMAGE.

4.1.3 CONTACT WIPE AND STROKE

Contact wipe is the indication of (1) the force holding the vacuum interrupter contacts closed and (2) the energy available to hammer the contacts open with sufficient speed for interruption.

Stroke is the gap between fixed and moving contacts of a vacuum interrupter with the breaker open.

The circuit breaker mechanism provides a fixed amount of motion to the operating rods. The first portion of the motion is used to close the contacts (i.e. stroke) and the remainder is used to further compress the preloaded wipe spring. This additional compression is called wipe. Wipe and stroke are thus related to each other. As the stroke increases due to the erosion of contacts, the wipe decreases. A great deal of effort and ingenuity has been spent in the design of VR-Series breakers, in order to eliminate any need for field adjustment of wipe or stroke.

WARNING

THERE IS NO PROVISION FOR IN-SERVICE ADJUSTMENTS OF CONTACT WIPE AND STROKE. ALL SUCH ADJUSTMENTS ARE FACTORY SET AND SHOULD NOT BE ATTEMPTED IN THE FIELD.

4.2 PHASE BARRIERS

Phase barriers are sheets of insulation located between the interrupter pole assemblies and on the sides of the breaker frame. The phase barriers are designed to isolate energized conductor components in each phase from the adjacent phase and ground.

WARNING

ALL PHASE BARRIERS MUST BE IN PLACE BEFORE PLACING THE CIRCUIT BREAKER INTO SERVICE. FAILURE TO HAVE THEM IN POSITION CAN CAUSE DEATH, SERIOUS PERSONNEL INJURY AND/OR PROPERTY DAMAGE.

4.3 BUSHINGS AND DISCONNECTING CONTACT ASSEMBLIES

The line and load bushing assemblies, which are the primary circuit terminals of the circuit breaker, consist of six silver plated conductors. Multiple finger type primary disconnecting contacts at the ends of the conductors provide means for connecting and disconnecting the breaker to the bus terminals in the switchgear compartment.

4.4 STORED ENERGY MECHANISM

The spring-type stored energy operating mechanism is mounted on the breaker frame and in the front of the breaker. Manual closing and opening controls are at the front panel (Figure 3.3). They are accessible while the breaker is in any of its four basic positions. (See Section 5 in this manual)

The mechanism stores the closing energy by charging the closing springs. When released, the stored energy closes the breaker, charges the wipe and resets the opening springs. The mechanism may rest in any one of the four positions shown in Figure 4.16 as follows:

- b. Breaker open, closing springs charged.
- d. Breaker closed, closing springs charged.
The mechanism is a mechanically “trip-free” design. Trip-free is defined later in this section.

In normal operation the closing spring is charged by the spring charging motor, and the breaker is closed electrically by the switchgear control circuit signal to energize the spring release coil. Tripping is caused by energizing the trip coil through the control circuit. For maintenance inspection purposes the closing springs can be charged manually by using the maintenance tool and the breaker can be closed and tripped by pushing the “Push to Close” and “Push to Open” buttons on the front panel.

**WARNING**

**KEEP HANDS AND FINGERS AWAY FROM BREAKER’S INTERNAL PARTS WHILE THE BREAKER CONTACTS ARE CLOSED OR THE CLOSING SPRINGS ARE CHARGED. THE BREAKER CONTACTS MAY OPEN OR THE CLOSING SPRINGS DISCHARGE CAUSING CRUSHING INJURY. DISCHARGE THE SPRINGS AND OPEN THE BREAKER BEFORE PERFORMING ANY MAINTENANCE, INSPECTION OR REPAIR ON THE BREAKER.

THE DESIGN OF THIS CIRCUIT BREAKER ALLOWS MECHANICAL CLOSING AND TRIPPING OF THE BREAKER WHILE IT IS IN THE “CONNECT” POSITION. HOWEVER, THE BREAKER SHOULD BE CLOSED MECHANICALLY ONLY IF THERE IS POSITIVE VERIFICATION THAT LOAD SIDE CONDITIONS PERMIT. IT IS RECOMMENDED THAT CLOSING THE BREAKER IN THE “CONNECT” POSITION ALWAYS BE DONE WITH THE CUBICLE DOOR CLOSED. FAILURE TO FOLLOW THESE DIRECTIONS MAY CAUSE DEATH, PERSONAL INJURY, OR PROPERTY DAMAGE.

**ELECTRICAL TRIPPING CAN BE VERIFIED WHEN THE BREAKER IS IN THE “TEST” POSITION.**

### 4.4.1 CLOSING SPRING CHARGING

Figure 4.15 shows schematic section views of the spring charging parts of the stored energy mechanism.

The major component of the mechanism is a cam shaft assembly which consists of a shaft to which are attached two closing spring cranks (one on each end), the closing cam, drive plate, and a free-wheeling ratchet wheel.

The ratchet wheel (6) is actuated by an oscillating ratchet lever (12) and drive pawl (10) driven by the motor eccentric cam. As the ratchet wheel rotates, it pushes the drive plates which in turn rotate the closing spring cranks and the closing cam on the cam shaft.

The motor will continue to run until the limit switch “LS” contacts disconnects the motor.

The closing spring cranks have spring ends connected to them, which in turn coupled to the closing springs. As the cranks rotate, the closing springs get charged.

The closing springs are completely charged, when the spring cranks go over dead center and the closing stop roller (9) comes against the face of the spring release coil (electrically or manually), the upper portion of the cam pushes the spring release latch (1) upward. When the spring release latch moves, the cam shaft assembly is free to rotate. The force of the closing cam (Figure 4.16b, Item 5), moving the main link (2), rotating the pole shaft (4) (which charges the opening spring). This moves the three operating rods (3), closes the main contacts and charges the contact loading springs (not shown). The operational state immediately after the main contacts close but before the spring charging motor recharges the closing springs is illustrated in Figure 4.16c. Interference of the trip “D” shaft with the trip latch prevents the linkage from collapsing, and holds the breaker closed.

Figure 4.16d shows the breaker in the closed state after the closing springs have been recharged. The recharging of the spring rotates the closing cam one half turn. In this position the main link roller rides on the cylindrical portion of the cam, and the main link does not move out of position.

### 4.4.2 CLOSING OPERATION

Figure 4.16 shows the positions of the closing cam and tripping linkage for four different operational states. In Figure 4.16a the breaker is open and the closing springs are discharged. In this state, the trip latch is disengaged from the trip “D” shaft (unlatched). After the closing springs become charged, the trip latch snaps into the fully reset or latched position (Figure 4.16b).

When the spring release clapper (Figure 4.15, Item 13) moves into the face of the spring release coil (electrically or manually), the upper portion of the clapper pushes the spring release latch (1) upward. When the spring release latch moves, the cam shaft assembly is free to rotate. The force of the closing cam (Figure 4.16b, Item 5), moving the main link (2), rotating the pole shaft (4) (which charges the opening spring). This moves the three operating rods (3), closes the main contacts and charges the contact loading springs (not shown). The recharging of the spring rotates the closing cam one half turn. In this position the main link roller rides on the cylindrical portion of the cam, and the main link does not move out of position.

### 4.4.3 TRIPPING OPERATION

When the trip bar “D” shaft (Figure 4.16b, Item 9) is turned by movement of the shunt trip clapper (11), the trip latch will slip past the straight cut portion of the trip bar shaft and will allow the banana link and main link roller to rise. The energy of the opening spring and contact loading springs is released to open the main contacts. The mechanism is in the state illustrated (Figure 4.16a) after the breaker is tripped open.

### 4.4.4 TRIP-FREE OPERATION

When the manual trip button is held depressed, any attempt to close the breaker results in the closing springs discharging without any movement of the pole shaft or vacuum interrupter stem.

### 4.5 CONTROL SCHEMES

There are two basic control schemes for each series of Type VCP-WR breakers, one for DC control and one for AC control voltages (Figure 4.5). Specific wiring schematics and diagrams are included with each breaker.

There may be different control voltages or more than one tripping element, but the principal mode of operation is as follows:

As soon as the control power is applied, the spring charging motor automatically starts charging the closing spring. When the springs are charged, the motor cut off LS1/bb switch turns the motor off. The breaker may be closed by making the control switch close (CS/C) contact. Automatically upon closing of the breaker, the motor starts charging the closing springs. The breaker may be tripped any time by making the control switch (CS/T) contacts.

Note the position switch (PS1) contact in the spring release circuit in the scheme. This contact remains made while the breaker is being levered between the TEST and CONNECTED positions for appropriately retrofitted breakers. Consequently, it prevents the breaker from closing automatically, even though the control close contact may have been made while the breaker is levered to the CONNECTED position.

When the CS/C contact is made, the SR closes the breaker. If the CS/C contact is maintained after the breaker closes, the Y relay is picked up. The Y/a contact seals in Y until CS/C is opened. The Y/b contact opens the SR circuit, so that even though the breaker would subsequently open, it could not be reclosed before CS/C was released and remade. This is the anti-pump function.
VR-Series Circuit Breaker dc Control Schematic

VR-Series Circuit Breaker ac Control Schematic

OPERATION
- LS1: Closed until springs are fully charged
- LS2 (aa): Open until springs are fully charged
- LS2 (bb): Closed until springs are fully charged
- LC: Open until mechanism is reset
- PS1: Open in all except between 'Test' and 'Connect' positions
- PS2: Closed in all except between 'Test' and 'Connect' positions

SWITCH TERMINAL
- 'C' and 'NO' - Brown Switch
- 'C' and 'NC' - Black Switch
- 'C' and 'NO' - Black Switch
- 'C' and 'NC' - Brown Switch
There are several interlocks built into the VR-Series vacuum replacement breakers. Each of these interlocks, though different in form, duplicate or exceed in function that of the original breaker. These interlocks exist to safeguard personnel and equipment. The basic premise behind the interlocking arrangement on the vacuum replacement breaker is that the breaker must not be inserted into or removed from a live circuit while the main contacts are closed. Also considered in the interlocking is that the breaker should pose no greater risk than necessary to the operator in or out of the cell. In addition to the original interlocks, VR-Series breakers provide an anti-close interlock.

### 4.7.1 INTERLOCK HANDLE

When moving the breaker into and out of the cell, the interlock handle must be lifted to allow the linkage to give an open and then trip signal (via the interlock cams) to discharge the internally stored energy of the breaker. The interlock handle controls the interlock plunger which prevents movement of the breaker out of the “connect” or “test” positions without first lifting the interlock handle. The handle positions are labeled “OPERATE,” “RACKING,” and “CELL ENTRY.”

### 4.7.2 ANTI-CLOSE INTERLOCK

The anti-close interlock prevents discharging of the closing springs if the breaker is already closed (Figure 4.15, Item 11). When the breaker is closed, the interlock component moves away from the breaker chassis to a horizontal position. Once the rod is pointing straight out from the breaker, push it manually to the rear until the secondaries are initially engaged. At this point, the small horizontal pin in the handle will have engaged two slots in the lever, which is pivoted immediately above the handle. To insulate complete secondary engagement, push down firmly on the curved end of the lever as far as it will go, using a foot or hand (Figure 5.10). When using a foot, care should be taken not to bend the lever by using excessive force.

To engage the secondary contacts on the 5kV design while the breaker is in the test position, lift the handle on the front left hand side of the breaker chassis to a horizontal position. Once the rod is pointing straight out from the breaker, push it manually to the rear until the secondaries are initially engaged. At this point, initial engagement is achieved, hold the operating rod firmly in that position with one hand, while grasping the secondary engaging handle with the other hand. The secondary engaging handle is located to the right of the operating rod, just inside a rectangular hole. By pulling firmly on the engaging handle, complete secondary engagement will be insured (Figure 5.11).

### 4.7.3 RATCHET & PAWL MECHANISM

The ratchet and pawl mechanism is not required for any ANSI interlocking function. It is provided as an operation convenience to reduce the possibility of an operator inadvertently tripping a closed breaker while attempting to rack the breaker out of position. Any mechanical operating of the breaker should be done using the close and open button on the element itself.

### 4.7.4 INTERLOCK CAMS

The interlock cams function to prevent moving a breaker within the cell except when the primary contacts are open. It also prevents closing primary contacts when the breaker is in an intermediate cell position. The ratchet & pawl mechanism will inhibit cam movement if the breaker is closed.

On an open breaker, lifting the interlock handle forces the interlock cams to rotate under the element and activate the trip linkage of the breaker when moved from the “OPERATE” position and then insert a close signal to discharge the closing springs when lifted to the “CELL ENTRY” position. The interlock cams cause the breaker to remain open between the “test” and “connect” positions. It should be noted that moving the interlock handle to the “RACKING” position will not discharge the closing springs inside the breaker; it will only activate the trip mechanism of the breaker. Also, when the interlock cams are engaged, the breaker cannot be closed.

### Table 4. Time Per Event

<table>
<thead>
<tr>
<th>Event</th>
<th>Milliseconds / Maximum</th>
</tr>
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<tbody>
<tr>
<td>(From Initiation of Close Signal to Contact Make)</td>
<td>75</td>
</tr>
<tr>
<td>(Initiation of Trip Signal to Contact Break)</td>
<td>45</td>
</tr>
<tr>
<td>(Initiation of Trip Signal to Contact Make)</td>
<td>190</td>
</tr>
</tbody>
</table>

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**WARNING**

INTERLOCKS ARE PROTECTIVE DEVICES FOR PERSONNEL AND EQUIPMENT. DO NOT BYPASS, MODIFY, OR MAKE INOPERATIVE ANY INTERLOCKS. DOING SO COULD CAUSE DEATH, SERIOUS PERSONAL INJURY, AND/OR PROPERTY DAMAGE.
4.7.5 SHUTTER INTERLOCK

The grounded aluminum shutters automatically close the opening to the cubicle primary disconnects when the circuit breaker is withdrawn from its connect position. The protective shutters guard against accidental human contact with the cubicle primary disconnect members. They also keep foreign matter from entering the disconnect chambers. Shutters are designed to remain closed until the movable primary disconnects on the breaker are in position to enter the cubicle disconnect chambers.

The two shutter blades operate with a counterbalanced action. One blade moves up while the other moves down. This design requires a minimum of operating forces with smooth shutter operation. Blades are actuated through a common link bar and shutter roller by a guide on the right side of the circuit breaker frame.

⚠️ WARNING

DO NOT FORCE THE BREAKER INTO THE CELL. DOING SO MAY DAMAGE PARTS THEREBY RISKING DEATH, PERSONAL INJURY, AND/OR PROPERTY DAMAGE.

4.8 MISCELLANEOUS ITEMS

4.8.1 MOC OPERATOR (If Equipped)

The MOC switch is external to the circuit breaker and mounted within the confines of the switchgear cubicle. The breaker’s MOC operator interfaces with the cell MOC switch in the same manner as the original breaker being replaced. All Cutler-Hammer VR-Series breakers, which are supplied with MOC operators, are engineered with patented SURE CLOSE Technology. This technology decouples the MOC operator from the main breaker operating mechanism. This prevents the MOC switch from stalling the circuit breaker during a closing operation, preventing damage to the cell MOC components, and extends the life of the MOC switch.

⚠️ NOTICE

ALL 15 KV TYPE WSA-VR BREAKERS UTILIZE THE WSA-VR SURE CLOSE MECHANISM TO CONTROL MOC VELOCITY AND CLOSELY MIMIC THE DYNAMICS AND VELOCITIES OF OLDER BREAKERS. IT IS IMPERATIVE THAT THIS MECHANISM BE ADJUSTED TO MATCH THE NUMBER OF MOC SWITCHES (FROM 0 TO 3) MOUNTED IN THE CELL. ALWAYS MAKE SURE THE MECHANISM IS PROPERLY ADJUSTED BEFORE ANY ATTEMPT IS MADE TO INSERT THE BREAKER INTO THE CELL.

IN ADDITION, THE MOC PANTOGRAPH MUST BE CHECKED BEFORE ANY ATTEMPT IS MADE TO INSERT THE BREAKER INTO THE CELL. DETAILED PROCEDURES FOR EACH TEST ARE OUTLINED IN SECTION 5 OF THIS MANUAL.

4.8.2 TOC OPERATOR

Some McGraw-Edison type WSA cells are equipped with a TOC (Truck Operated Contacts) switch. The right side of the breaker will mate with the cell TOC switch linkage when the breaker is racked into the “connect” position. The TOC switch is located in the switchgear compartment and contains contacts which are used to interlock the circuit breaker with other external devices.

4.8.3 OPERATIONS COUNTER

All WSA-VR breakers are equipped with a mechanical operations counter (Figures 3.3, 3.5, and 3.7). As the breaker opens, the linkage connected to the pole shaft lever advances the counter reading by one.
Figure 4.13. 20WR Vacuum Element - Front Faceplate Removed

20WR Vacuum Element

1. LH Closing Spring
2. Motor Cutoff Switch
3. Latch Check Switch (Rear)
4. Operations Counter
5. Closing Cam
6. Spring Release Assembly
7. Shunt Trip Assembly
8. RH Closing Spring
9. Reset Opening Spring
10. Manual Change Socket
11. Ratchet wheel
12. Charging Motor

WSA-5-VR and WSA-15-VR
Replacement Circuit Breaker
Figure 4.14. 29WR Vacuum Element - Front Faceplate Removed

29WR Vacuum Element

<table>
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<td>Reset Opening Spring</td>
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<td>Motor Cutoff Switch</td>
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<td>Spring Release Assembly</td>
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<td>Manual Charge Socket</td>
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<td>3</td>
<td>Latch Check Switch (Rear)</td>
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<td>Shunt Trip Assembly</td>
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<td>Ratchet wheel</td>
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<td>4</td>
<td>Operations Counter</td>
<td>8</td>
<td>RH Closing Spring</td>
<td>12</td>
<td>Charging Motor</td>
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</table>
WSA-5-VR and WSA-15-VR
Replacement Circuit Breaker

Figure 4.15. Closing Cam and Trip Linkage

Breaker Open, Springs Discharged

Breaker Closed, Springs Charged

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<tr>
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<th>12</th>
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<td>Ratchet Wheel</td>
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<td>Spring Crank</td>
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<td>Cam Shaft</td>
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<td>Spring Release Latch (Close Roller)</td>
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<td>Anti-Close Interlock</td>
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4.16.a. Breaker Open and Closing Spring Not Charged

4.16.b. Breaker Open and Closing Spring Charged

4.16.c. Breaker Closed and Closing Spring Not Charged

4.16.d. Breaker Closed and Closing Spring Charged

### Charging Schematic

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<thead>
<tr>
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<tr>
<td>1</td>
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<td>Main Link</td>
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<td>Operating Rod</td>
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<td>Pole Shaft</td>
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**SECTION 5: INSPECTION & INSTALLATION**

**WARNING**

**BEFORE PLACING THE BREAKER IN SERVICE, CAREFULLY FOLLOW THE INSTALLATION PROCEDURE BELOW AND THE SAFE PRACTICES SET FORTH IN SECTION 2. NOT FOLLOWING THE PROCEDURE MAY RESULT IN INCORRECT BREAKER OPERATION LEADING TO DEATH, BODILY INJURY, AND PROPERTY DAMAGE.**

When the breaker is first commissioned into service and each time the breaker is returned to service, it should be carefully examined and checked to make sure it is operating correctly.

**5.1 EXAMINATION FOR DAMAGE**

Examine the breaker for loose or obviously damaged parts. Never attempt to install nor operate a damaged breaker.

**5.1.1 NAMEPLATE VERIFICATION**

Verify the information on the new VR-Series nameplate matches the information on the purchase order. If any discrepancies exist, notify Eaton’s Electrical Services & Systems for resolution prior to proceeding.

**5.2 SURE CLOSE MECHANISM ADJUSTMENT**

All Type WSA-VR breakers utilize the SURE CLOSE mechanism to control MOC velocity and closely mimic the dynamics and velocities of older breakers. It is imperative that this mechanism be adjusted to match the force of MOC switches mounted in the cell. If the adjustment is made on the WSA-VR breaker to be compatible with one housing with the force of MOC switches, make sure the adjustment is checked and compatible if the breaker is moved to a different housing of the same rating.

The breaker has been factory adjusted to operate one mechanism operated cell (MOC) switch in the cell. This means that for applications with either no MOC switch or one MOC switch, no field adjustments are required.

Finally, the SURE CLOSE mechanism provides an effective way to evaluate the condition of the MOC in the cell. If the SURE CLOSE drive spring is properly adjusted, but the MOC does not fully open or close, it is time to maintain the MOC in the cell. Maintenance usually means cleaning and lubricating the MOC mechanism. If the MOC has seen a large number of cycles, however, worn components may have to be replaced.

To adjust the SURE CLOSE drive spring for more output force, proceed with the following steps:

**Step 1:** Locate the MOC drive spring (Figure 3.3). It is located in the left lower portion of the breaker as viewed from the top rear of the breaker.

**Step 2:** From the factory, the drive spring comes set with adequate force to operate the MOC, however, more force can be generated. Refer to Figure 5.2 to see how that adjustment would look. Notice that there is a nut and a jam nut on the threaded rod to make the adjustment easy.

**Step 3:** Using a spring gauge, measure the force required to operate the MOC to the fully closed position in the cell at the interface with the breaker.

**Step 4:** With the breaker out of the cell, close the breaker and measure the output of the MOC drive with a spring gauge. Open the breaker. The MOC drive force should exceed the MOC cell force requirement by 5%. If not, an adjustment is required.

**Step 5:** Loosen the jam nut on the SURE CLOSE spring and compress the spring an additional .25 inches. Close the breaker.

**WARNING**

**WITH THE BREAKER IN THE OPEN POSITION, THE SPRING COMPRESSION SHOULD NEVER BE SET TO A DIMENSION LESS THAN 3 INCHES AS MEASURED IN FIGURE 5.1.**

**Step 6:** Remeasure the MOC output spring force in the closed position. Repeat until the MOC forces are adequate.

**Step 7:** Inert into the cell.

**Step 8:** Operate the breaker to verify the new setting.

**Step 9:** Repeat steps 3-8 until acceptable operation is achieved.

**Step 10:** Anytime an adjustment is made, make sure the new compressed spring length (measured in the open position) is recorded if different than the dimension in this instruction book.
Step 11: After an adjustment is made, make sure that all nuts are secured in place, prior to returning to service.

5.3 MANUAL OPERATION CHECK

Manual operational checks must be performed before the breaker is connected to a live circuit. Tests must be performed with the breaker withdrawn from the cell or in the disconnect position. While the breaker is withdrawn or in the disconnect position, place the maintenance tool into the manual charge socket opening and charge the closing springs with about 36 up and down strokes of the handle. When charging is complete, the closing crank goes over center with an audible “click” and the springs Charged / Discharged Indicator shows “Charged”. Remove the maintenance tool.

**NOTICE**

IF THE SPRINGS ARE TO BE CHARGED ON A CLOSED BREAKER, NO CLICK IS HEARD AT THE END OF CHARGING OPERATION. DISCONTINUE CHARGING AND REMOVE THE MAINTENANCE TOOL AS SOON AS “CHARGED” FLAG IS FULLY VISIBLE. CONTINUE ATTEMPTS TO FURTHER CHARGE MAY RESULT IN DAMAGE TO THE MECHANISM.

**WARNING**

ALWAYS REMOVE THE MAINTENANCE TOOL AFTER CHARGING THE SPRING. FAILURE TO REMOVE THE MAINTENANCE TOOL FROM THE BREAKER COULD CAUSE INJURY TO PERSONNEL AND/OR EQUIPMENT DAMAGE IF THE BREAKER WAS TO CLOSE.

Close and trip the breaker by pushing the close lever then the trip lever (Figure 3.3).

5.4 VACUUM INTERRUPTER INTEGRITY

Using a dry lint-free cloth or a paper towel, clean all the insulating surfaces of the pole units. Conduct a vacuum interrupter integrity check as described in Section 6.

5.5 INSULATION

Check breaker primary and secondary insulation per Section 6.

5.6 CONTACT EROSION AND WIPE

Manually charge the closing springs and close the breaker. Check contact erosion and wipe as described in Section 6.

5.7 PRIMARY CIRCUIT RESISTANCE

Check the primary circuit resistance as described in Section 6. The resistance should not exceed the values specified. Record the values obtained for future reference.

5.8 ELECTRICAL OPERATIONS CHECK

These checks can be performed with the breaker in its withdrawn or disconnect position and connecting the breaker to a test cabinet or to the switchgear cell’s secondary receptacle using the special extension cable designed for this purpose and described in section 3.

Perform electrical operations checks. Close and trip the circuit breaker electrically several times to verify that the operation is reliable and consistent. Check that the operation of the spring charging motor is reasonably prompt and that the motor makes no unusual noise.

**WARNING**

DO NOT PERFORM ELECTRICAL OPERATION CHECKS WITH THE BREAKER IN THE “CONNECT” POSITION BECAUSE OF THE POSSIBILITY OF CONNECTING DE-ENERGIZED LOAD CIRCUITS TO THE ELECTRICAL POWER SOURCE, RESULTING IN DEATH, PERSONAL INJURY OR EQUIPMENT DAMAGE.

5.9 CELL BREAKER COMPARTMENT MODIFICATIONS

Eaton provides a cell rejection assembly when the existing circuit breaker compartment must be modified electrically and/or mechanically to accept the new replacement circuit breaker. After those modifications, it is no longer possible to re-install the original air magnetic circuit breaker. The cell rejection assembly must be installed in the circuit breaker compartment to prevent accidental installation of the original breaker.

The Eaton WSA-5/15-VR-1200/2000 replacement breaker requires modifications in the circuit breaker control devices mounted in the breaker compartment. After those modifications, the cell rejection assembly (see Figure 5.1c) must be installed in the circuit breaker compartment to block insertion of the original WSA breaker:

1. Perform a complete lock out and tag out of the primary and secondary power circuits of the switchgear compartment (or compartments) that require the cell rejection assembly.
2. Wear Personal Protective Equipment (PPE) according to the local authority having jurisdiction.
3. Holes must be drilled in the circuit breaker compartment flanges on each side of the breaker compartment. Protect all current carrying parts, including stationary primary disconnects, secondary disconnects, and terminals of mechanism operated and truck operated cell switches from metallic dust and shavings produced during the cutting procedure. This could be done using a drop cloth, tarp, or similar product. Make sure the edges of the coverings are sealed with masking or duct tape to seal the components being protected.
4. The cell flanges to be drilled are those that the back side of the breaker front cover approaches in the connect position to isolate the high voltage compartment from the front of the circuit breaker compartment.
5. Position the cell rejection bracket 62 inches (157.4 centimeters) from the bottom of the rejection bracket to the switchgear floor on the front side of the cell flange, making sure it is level. See Figure 5.3. Ensure the cell rejection bracket is centered in the opening between the flanges.

![Figure 5.3. Measuring For Bracket Mounting Holes](image)
WSA-5-VR and WSA-15-VR
Replacement Circuit Breaker

8. Clean a suitable area in the circuit breaker compartment with denatured alcohol near the circuit breaker front cover. Affix the cell conversion label provided as shown in Figure 5.5.

Figure 5.4. Cell Rejection Bracket Detail

Figure 5.5. Cell Rejection Bracket Mounted

⚠️ WARNING
EXAMINE THE INSIDE OF THE CELL BEFORE INSERTING THE BREAKER FOR EXCESSIVE DIRT OR ANYTHING THAT MIGHT INTERFERE WITH THE BREAKER TRAVEL.

⚠️ WARNING
KEEP HANDS OFF THE TOP EDGE OF THE FRONT BARRIER WHEN PUSHING A BREAKER INTO A CELL. FAILURE TO DO SO COULD RESULT IN BODILY INJURY. IF FINGERS BECOME WEDGED BETWEEN THE BREAKER AND THE CELL, USE THE HANDLES PROVIDED ON THE FRONT OF THE BREAKER FACEPLATE, OR USE BOTH FULLY OPENED HANDS FLAT ON THE FRONT OF THE FACEPLATE.

5.10 OPERATIONAL POSITIONS
The breaker has four basic operational positions:

(1) Withdrawn position. In the “withdrawn” position the breaker is out of the cell and the racking handle is not required for this position. The racking system and cell interlocks are functional relative to the cell and interlock handle positions and not the racking mechanism. The breaker can be operated in this position and extreme care should be exercised to avoid inadvertent operation and possible injury or equipment damage.

(2) Disconnect position. In the “disconnect” position the breaker is in the cell and the racking (levering) handle is not required for this position. The front guide rollers and the rear guide rail brackets are straddling the cell guide rail with the interlock plunger against the end of the cell guide rail. The breaker is not held captive in the cell but may be operated manually. The cell interlocks are functional relative to the cell and interlock handle positions, not the racking mechanism. The breaker can be operated in this position rotating the MOC (Figure 5.1) at high rates of speed with great force (if applicable). Extreme care should be exercised to avoid inadvertent operation and possible injury or equipment damage.

(3) Test position. The “test” position is achieved when the interlock handle is lifted to the “cell entry” position and the breaker is pushed into the cell to a position where all four wheels are on the cell floor and the interlock plunger is engaged with the first notch of the cell guide rail with the racking handle removed. The racking lead screw is in its full counterclockwise position and the shutter actuating roller is in the 6 o’clock. Inward travel of the breaker will be halted by the racking mechanism engaging with the cell. When the interlock handle is released, the interlock plunger will engage the cell floor to hold the breaker captive in the cell, release the trip mechanism, and allow the racking interlock flag to block insertion of the racking handle. The test position can be verified by the inability to move the breaker in or out, the racking interlock flag is blocking the lead screw, the high voltage shutters are shut, and the interlock handle is in the “OPERATE” position (fully downward). Manual testing may be performed in this position and electrical testing may be performed by sliding the secondary connection block rearward to engage the cell’s corresponding receptacle.

(4) Breaker in the connect position. The “connect” position is achieved by lifting the interlock handle to the “racking” position, inserting and rotating the racking handle clockwise (from the “test” position) to achieve about 8.25 inches for WSA-5 and 12 inches for WSA-15 of travel until a mechanical stop is reached. As the breaker is advanced into the cell, the primary voltage source shutters will open allowing the breaker stabs to engage with the source. This is the fully engaged or connected position. The connect position can be verified by observing that the racking interlock flag blocks the lead screw when the racking handle is removed, the high voltage shutters indicate open, the interlock handle is in the “OPERATE” position (fully downward), and both trip and close linkages are released. The breaker is now ready for service.
5.11 RACKING BREAKER INTO CELL

a. Place the breaker in the withdrawn position out of the cell. The cell interlocks are functional relative to the cell and interlock handle positions, not the racking mechanism. The breaker can be operated in this position rotating the MOC operator at high rates of speed with great force (if applicable). Extreme care should be exercised to avoid inadvertent operation and possible injury or equipment damage.

**WARNING**

*THE BREAKER CAN BE OPERATED WHEN WITHDRAWN FROM THE CELL AND EXTREME CARE SHOULD BE EXERISED TO AVOID INADVERTENT OPERATION AND POSSIBLE INJURY OR EQUIPMENT DAMAGE.*

b. Check that the closing spring status indicator reads “DISCHARGED” and that the main contact status indicator reads “OPEN”. Manually trip, close, and trip the breaker as needed to obtain this status.

c. From the “withdrawn” position, lift the interlock handle to the “RACKING” position (horizontal). This interlock handle movement will engage the trip mechanism and raise the interlock flag to allow access to the racking mechanism. Insert the racking handle and rotate the racking mechanism to the fully counterclockwise position to set the shutter actuating roller on the end of the racking mechanism to the 6 o’clock position. Remove the racking handle and align the guide rail rollers of the breaker with the guide rail of the cell.

d. Push the circuit breaker into the cell until all the wheels are on the cell floor and the interlock plunger strikes the cell guide rail and halts inward travel of the breaker (Figure 5.3). This is the “disconnect” position. In this position the breaker is not held captive in the cell and can be operated because there is no interface of the cell floor and breaker interlocks. Cell labeling may not be provided to verify this position.

e. To advance the breaker from the “disconnect” position to the “test” position, lift the interlock handle completely to the “CELL ENTRY” position and push the breaker into the cell. While holding the interlock handle in the upright position, insert the racking handle and rotate several turns clockwise (Figure 5.7).

f. Once movement has started, the interlock handle may be released. When the breakers are new the handle will remain in the up position until the levering handle is removed and the interlock handle is pushed down. An audible click of the interlock plunger engaging the guide rail will be observed at approximately 1.25 in. for WSA-5 and 2.5 in. for WSA-15 of inward travel. The engagement of the interlock plunger with the guide rail will be accompanied by the racking mechanism bottoming out in its associated cell receptacle, the open interlock cam releasing its linkages, the interlock flag blocking access to the racking mechanism, and the interlock handle dropping completely to the “OPERATE” position. The breaker is now in the “test” position. Remove the racking handle.

**Note:** The movement of the interlock handle provides a trip signal when lifted half way to the “RACKING” position that remains throughout all intermediate breaker positions and the remaining upward movement of the handle will be required during the 1.25 in. for WSA-5 and 2.5 in. for WSA-15 of inward travel. The engagement of the interlock plunger with the guide rail will be accompanied by the racking mechanism bottoming out in its associated cell receptacle, the open interlock cam releasing its linkages, the interlock flag blocking access to the racking mechanism, and the interlock handle dropping completely to the “OPERATE” position. The breaker is now in the “test” position.

The spring charging motor will begin to run and charge the closing spring as the secondary connection is made as long as control power is available. The breaker is now in the “test” position, with control voltage applied, and ready for electrical or manual testing.

g. The “test” position can be verified by the inability to move the breaker in or out, the interlock handle in the “OPERATE” position (fully down), the close and trip signals are released, and the interlock flag is blocking access to the racking mechanism. In the “test” position, the breaker can be operated manually and electrically, thus allowing maintenance tests or checks. The breaker may be operated electrically by pulling the slide handle (Figure 5.8) completely out, rotating the slide handle

**Figure 5.7. Lifting Interlock Handle (WSA-15-VR Shown)**

**Figure 5.8. Operating Secondary Slide (WSA-15-VR Shown)**
h. To advance from the “test” position, lift the interlock handle to the “RACKING” position to expose the racking mechanism and insert the racking handle (Figure 5.9). At this point any attempt to mechanically close the breaker will cause a trip-free operation. Rotate the racking handle clockwise to open the primary shutters and induce inward movement of the breaker.

Note: On the first one-third (1/3) turn of the racking handle, the shutter actuating roller on the end of the racking mechanism rotates in the keyhole at the back of the cell and opens the primary shutters. Shutter indication is on the right side of the cell for verification.

Figure 5.9. Racking Into Cell (WSA-15-VR Shown)

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>DO NOT ATTEMPT TO REMOVE A CLOSED CIRCUIT BREAKER. VERIFY THE BREAKER IS IN THE OPEN POSITION PRIOR TO PROCEEDING.</td>
</tr>
</tbody>
</table>

5.12 REMOVING BREAKER FROM CELL

a. After ensuring the breaker is open, lift the interlock handle to the “RACKING” position (horizontal), and engage the racking handle (Figure 5.5).

b. Rotate the racking handle counterclockwise and observe the outward travel of the breaker. After the breaker moves outward about one-half (1/2”) inches, the interlock handle may be released and the plunger allowed to ride on the guide rail. The breaker will start coming out of the cell before the main stabs are disconnected and will be in a non-operable mode.

Note: The secondary disconnect slide is held stationary relative to the breaker when the secondary slide handle is fully inserted into the breaker. The secondary disconnect will automatically disengage from the cell when the breaker is racked out of the “connect” position when the aforementioned slide handle criteria is met.

Although the closing springs are still charged, the breaker will go through a trip-free operation if any attempt to close it is made in the intermediate position. The shutters will close after the main stabs have cleared, isolating the breaker from its source as the “test” position is entered.

c. Continue rotating the racking handle counterclockwise until the shutter position indicator on the right side of the cell rises completely to show “closed”, and the outward travel of the breaker is halted by the interlock plunger mating with the guide rail.

d. Remove the racking handle.

The breaker is in the “test” position and the trip mechanism is released, allowing the breaker to be operated either electrically or mechanically.

e. Lift the interlock handle to the “CELL ENTRY” (fully raised) position to clear the cell guide rail and pull the breaker out (Figure 5.7). Once movement has started, the interlock handle may be released.

When the interlock handle is fully raised to the “CELL ENTRY” position, a close signal will combine with the trip signal from the interlock cam. This will cause the charging springs to discharge (if charged) leaving the breaker in the open position and the closing springs discharged. The breaker travels outward about 1.25 in. for WSA-5 and 2.5 in. for WSA-15 from the “test” to the “disconnect” position where the interlock plunger will drop to the floor and release the breaker from the cell. Once the breaker is withdrawn free of the guide rail area, it is in the “withdrawn” position.

Release the interlock handle and rotate the racking mechanism clockwise to achieve about 8.25 in. for WSA-5 and 12 in. for WSA-15 of inward breaker travel until the interlock plunger drops into its slot in the guide rail. The closing springs may be in the charged state but the internal PS switch will open circuit the close spring release coil (preventing an electrical close). As the breaker is advanced into the cell, the breaker stabs engage with the source. Remove the racking handle. Position the secondary slide handle in the 6 o’clock position and push inward completely if secondary block was engaged in step 4.3g.

This is the fully engaged or “connect” position. The “connect” position can be verified by the inability to move the breaker in or out, the interlock handle is in the “OPERATE” position (fully down), the trip mechanism and has been released, and the interlock flag is blocking access to the racking mechanism. Cell labeling may not be available for breaker position verification. The breaker is now ready for service.
SECTION 6: INSPECTION & MAINTENANCE

⚠️ WARNING
DO NOT WORK ON A BREAKER IN THE "CONNECTED" POSITION.
DO NOT WORK ON A BREAKER WITH SECONDARY DISCONNECTS ENGAGED.
DO NOT WORK ON A BREAKER WITH SPRINGS CHARGED OR CONTACTS CLOSED.
DO NOT DEFECT ANY SAFETY INTERLOCKS.
DO NOT LEAVE MAINTENANCE TOOL IN THE SOCKET AFTER CHARGING THE CLOSING SPRINGS.

6.2 INSPECTION AND MAINTENANCE PROCEDURES

<table>
<thead>
<tr>
<th>NO. / SECTION</th>
<th>INSPECTION ITEM</th>
<th>CRITERIA</th>
<th>INSPECTION METHOD</th>
<th>CORRECTIVE ACTION IF NECESSARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Insulation</td>
<td>Stand Off Insulators, Operating Rods, Tie-Bars and Barriers</td>
<td>No Dirt</td>
<td>Visual Check</td>
<td>Clean WithLint-Free Cloth</td>
</tr>
<tr>
<td></td>
<td>No Cracking</td>
<td>Visual Check</td>
<td>Replace Cracked Unit</td>
<td></td>
</tr>
<tr>
<td>Vacuum Integrity</td>
<td>Between Main Circuit With Terminals Ungrounded</td>
<td>Withstand 27k 60Hz For 1 Minute</td>
<td>Hipot Tester</td>
<td>Clean And Retest Or Replace</td>
</tr>
<tr>
<td>Insulation Integrity</td>
<td>Main Circuit To Ground</td>
<td>Withstand 15kV, 60Hz For 1 Minute (15kV Rating) 27kV, 60Hz For 1 Minute (15kV Ratings)</td>
<td>Hipot Tester</td>
<td>Clean And Retest Or Replace</td>
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<tr>
<td></td>
<td>Control Circuit To Ground (Charging Motor Disconnected)</td>
<td>Withstand 1125V, 60Hz For 1 Minute</td>
<td>Hipot Tester</td>
<td>Clean And Retest Or Replace</td>
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<tr>
<td>2. Power Element</td>
<td>Vacuum Interrupters</td>
<td>Contact Erosion Visibility Of Mark</td>
<td>Visual - Close The Breaker And Look For Green Mark On Moving Stem From The Rear Of The Breaker (See Figure 6.1 and 6.2)</td>
<td>If Mark Is Not Visible, Replace Interrupter Assembly</td>
</tr>
<tr>
<td></td>
<td>Contact Wipe Visible</td>
<td>Visual (Figure 6.3 and 6.4)</td>
<td>Replace VI Assembly</td>
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<td></td>
<td>Adequate Vacuum</td>
<td>See Section 6.3</td>
<td>Replace Interrupter Assembly If Vacuum Is Not Adequate</td>
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<tr>
<td></td>
<td>Dirt On Ceramic Body</td>
<td>Visual Check</td>
<td>Clean With Dry Lint-Free Cloth</td>
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<td>Primary Disconnects</td>
<td>No Burning Or Damage</td>
<td>Visual Check</td>
<td>Replace If Burned, Damaged Or Eroded</td>
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<tr>
<td>3. Control Circuit Parts</td>
<td>Closing And Tripping Devices Including Disconnects</td>
<td>Smooth And Correct Operation By Control Power</td>
<td>Test Closing And Tripping Of The Breaker Twice</td>
<td>Replace Any Defective Device-Identify Per Trouble-Shooting Chart</td>
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<tr>
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<td>Wiring</td>
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<td>Terminals</td>
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<tr>
<td></td>
<td>Motor</td>
<td>Smooth And Correct Operation By Control Power</td>
<td>Test Closing And Tripping Of The Breaker Twice</td>
<td>Replace Brushes Or Motor</td>
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<td>Tightness Of Hardware</td>
<td>No Loose Or Missing Parts</td>
<td>Visual And Tightening With Appropriate Tools</td>
<td>Tighten Or Reinstate If Necessary</td>
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<td>4. Operating Mechanism</td>
<td>Dust Or Foreign Matter</td>
<td>No Dust Or Foreign Matter</td>
<td>Visual Check</td>
<td>Clean As Necessary</td>
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<td>Lubrication</td>
<td>Smooth Operation And No Excessive Wear</td>
<td>Sight And Feel</td>
<td>Lubricate Very Sparingly With Light Machine Oil</td>
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<td>Deformation Or Excessive Wear</td>
<td>No Excessive Deformation Or Wear</td>
<td>Visual And Operational</td>
<td>Remove Cause And Replace Parts</td>
</tr>
<tr>
<td></td>
<td>Manual Operation</td>
<td>Smooth Operation</td>
<td>Manual Charging Closing And Tripping</td>
<td>Correct Per Trouble-Shooting Chart If Necessary</td>
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<td>CloSure Test</td>
<td>≥ 0.6 Inch Over Travel</td>
<td>CloSure Test 8-9.1</td>
<td>If &lt; 0.6 Contact PB.C. At 1-877-276-9379</td>
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BOLT SIZE

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<tr>
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</tbody>
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TORQUE Lb. In.
6.3 VACUUM INTERRUPTER INTEGRITY TEST

Vacuum interrupters used in Type VR-Series circuit breakers are highly reliable interrupting elements. Satisfactory performance of these devices is dependent upon the integrity of the vacuum in the interrupter and the internal dielectric strength. Both of these parameters can be readily checked by a one minute AC high potential test. (See Table 6.1 for appropriate test voltage.) During this test, the following warning must be observed:

⚠️ WARNING

APPLYING ABNORMALLY HIGH VOLTAGE ACROSS A PAIR OF CONTACTS IN VACUUM MAY PRODUCE X-RADIATION. THE RADIATION MAY INCREASE WITH THE INCREASE IN VOLTAGE AND/OR DECREASE IN CONTACT SPACING. X-RADIATION PRODUCED DURING THIS TEST WITH RECOMMENDED VOLTAGE AND NORMAL CONTACT SPACING IS EXTREMELY LOW AND WELL BELOW MAXIMUM PERMITTED BY STANDARDS. HOWEVER, AS A PRECAUTIONARY MEASURE AGAINST POSSIBILITY OF APPLICATION OF HIGHER THAN RECOMMENDED VOLTAGE AND/OR BELOW NORMAL CONTACT SPACING, IT IS RECOMMENDED THAT ALL OPERATING PERSONNEL STAND AT LEAST ONE METER AWAY IN FRONT OF THE BREAKER.

With the breaker open and securely sitting on the floor, connect all top/front primary studs (bars) together and the high potential machine lead. Connect all bottom/rear studs together and the high potential return lead. Do not ground them to the breaker frame. Start the machine at zero potential, increase to appropriate test voltage and maintain for one minute.

Successful withstand indicates that all interrupters have satisfactory vacuum level. If there is a breakdown, the defective interrupter or interrupters should be identified by an individual test and replaced before placing the breaker in service.

After the high potential is removed, discharge any electrical charge that may be retained, particularly from the center shield of vacuum interrupters. To avoid any ambiguity in the AC high potential test due to leakage or displacement (capacitive) current, the test unit should have sufficient volt-ampere capacity. It is recommended that the equipment be capable of delivering 25 milliamperes for one minute.

Although an AC high potential test is recommended, a DC test may be performed if only a DC test unit is available, but is not recommended.

In this case the equipment must be capable of delivering 5 milliamperes for one minute to avoid ambiguity due to field emission or leakage currents and the test voltage shall be as shown in Table 6.1.

The current delivery capability of 25 mA AC and 5 mA DC apply when all three VI’s are tested in parallel. If individual VI’s are tested, current capability may be one third of these values.

⚠️ WARNING

SOME DC HIGH POTENTIAL UNITS, OPERATING AS UNFILTERED HALF-WAVE RECTIFIERS, ARE NOT SUITABLE FOR USE TO TEST VACUUM INTERRUPTERS BECAUSE THE PEAK VOLTAGE APPEARING ACROSS THE INTERRUPTERS CAN BE SUBSTANTIALLY GREATER THAN THE VALUE READ ON THE METER.

### Vacuum Interrupter Integrity Test Voltage

<table>
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<tr>
<th>Breaker Rated Maximum Voltage</th>
<th>AC 60Hz</th>
<th>DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to and including 15.0 kV</td>
<td>27 kV</td>
<td>40 kV</td>
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</table>

6.4 CONTACT EROSION AND WIPE

Since the contacts are contained inside the interrupter, they remain clean and require no maintenance. However, during high current interruptions there may be a minimal amount of erosion from the contact surfaces. To determine contact erosion, close the breaker and observe the vacuum interrupter moving stem from the rear of the breaker. If the mark on each stem is visible, erosion has not reached maximum value thus indicating satisfactory contact surface of the interrupter. If the mark is not visible, the vacuum interrupter assembly must be replaced (Figure 6.1 and 6.2).

The adequacy of contact wipe can be determined by simply observing the vacuum interrupter side of the operating rod assembly on a closed breaker. Figures 6.3 and 6.4 show the procedure for determining the contact wipe. It maybe necessary to use a small mirror and flashlight to clearly see the “T” shape indicator. If the wipe is not adequate, the vacuum interrupter assembly (Pole Unit) must be replaced. Field adjustment is not possible.

⚠️ WARNING

FAILURE TO REPLACE A VACUUM INTERRUPTER ASSEMBLY WHEN CONTACT EROSION MARK IS NOT VISIBLE OR WIPE IS UNSATISFACTORY, WILL CAUSE THE BREAKER TO FAIL TO INTERRUPT AND THEREBY CAUSE PROPERTY DAMAGE OR PERSONNEL INJURY.

Figure 6.1. Vacuum Interrupter Showing Contact Erosion Indicator With Breaker Open
(Shown here for clarity purposes only)

Figure 6.2. Vacuum Interrupter Showing Contact Erosion Indicator With Breaker Closed
(Indicators are checked only when breaker is closed.)
6.5 INSULATION

In VR-Series breakers, insulation maintenance primarily consists of keeping all insulating surfaces clean. This can be done by wiping off all insulating surfaces with a dry lint free cloth or dry paper towel. In case there is any tightly adhering dirt that will not come off by wiping, it can be removed with a mild solvent or distilled water. But be sure that the surfaces are dry before placing the breaker in service. If a solvent is required to cut dirt, use Isopropyl Alcohol or commercial equivalent. Secondary control wiring requires inspection for tightness of all connections and damage to insulation.

6.6 INSULATION INTEGRITY CHECK

PRIMARY CIRCUIT:

The integrity of primary insulation may be checked by the AC high potential test. The test voltage depends upon the maximum rated voltage of the breaker. For the breakers rated 4.76 kV, 8.25 kV and 15 kV the test voltages are 15 kV, 27 kV and 27 kV RMS, 60 Hz respectively. Conduct the test as follows:

Close the breaker. Connect the high potential lead of the test machine to one of the poles of the breaker. Connect the remaining poles and breaker frame to ground. Start the machine with output potential at zero and increase to the test voltage. Maintain the test voltage for one minute. Repeat for the remaining poles. Successful withstand indicates satisfactory insulation strength of the primary circuit.

Open the breaker. Connect the high potential lead of the test machine to one of the poles of the breaker. Connect the remaining poles and breaker frame to ground. Start the machine with output potential at zero and increase to the test voltage. Maintain the test voltage for one minute. Repeat for the remaining poles. Successful withstand indicates satisfactory insulation strength of the primary circuit.

If a DC high potential machine is used, make certain that the peak voltage does not exceed the peak of the corresponding AC RMS test voltage.

SECONDARY CIRCUIT:

Isolate the motor by disconnecting the two motor leads from the terminal block. Connect all points of the secondary disconnect pins with a shooting wire. Connect this wire to the high potential lead of the test machine. Ground the breaker frame. Starting with zero, increase the voltage to 1125 RMS, 60 Hz. Maintain the voltage for one minute. Successful withstand indicates satisfactory insulation strength of the secondary control circuit. Remove the shooting wire and reconnect the motor leads.
6.7 PRIMARY CIRCUIT RESISTANCE CHECK

The main contacts of the VR-Series circuit breaker are inside the vacuum chamber where they remain clean and require no maintenance at any time. Unlike most typical circuit breaker designs, the VR-Series design uses a highly reliable and unique flexible clamp design that eliminates the need for lubrication and inspection for wear.

The DC electrical resistance of the primary circuit may be calculated by measuring the voltage drop across the circuit. This test should be performed with a low voltage, direct current (DC) power supply capable of delivering no less 100A DC.

- To check the primary circuit resistance:
  - Remove the circuit breaker from the switchgear
  - Close the breaker
  - Pass at least 100A DC from terminal to terminal of each pole unit in the closed position
  - Measure the voltage drop across the terminals.

The resistance can be calculated from Ohm’s Law and is expressed in micro-ohms. Repeat for the remaining two poles.

The resistance should not exceed the factory test levels more than 200%. Factory test levels are recorded on the circuit breaker test form, which is included with the breaker. If measurements exceeds 200%, contact the manufacturer.

\[
R_{\text{conversion}} = R_{\text{Factory}}(1 + (T_{\text{Field}} - T_{\text{Factory}})\rho)
\]

- \( R_{\text{conversion}} \) = Resistance correction for temperature based from the factory resistance measurement.
- \( R_{\text{Factory}} \) = Resistance measurement from the factory.
- \( T_{\text{Field}} \) = Temperature measurement in the field.
- \( T_{\text{Factory}} \) = Temperature measurement from the factory.
- \( \rho \) = Copper resistivity temperature coefficient.

\[
\rho = 0.0039 \text{ Copper Resistivity Temperature Coefficient / Deg C}
\]

\[
\rho = 0.002167 \text{ Copper Resistivity Temperature Coefficient / Deg F}
\]

6.8 MECHANISM CHECK

Make a careful visual inspection of the mechanism for any loose parts such as bolts, nuts, pins, rings, etc. Check for excessive wear or damage to the breaker components. Operate the breaker several times manually and electrically. Check the closing and opening times to verify that they are in accordance with the limits in Table 4.1.

6.8.1 CLOSURE™ TEST

Introduction: The CloSure™ Test is a simple yet extremely effective means to determine and monitor the ability of the mechanism to close the breaker contacts fully. It provides a quantitative measure of the extra energy available in terms of over travel in inches to close the breaker contacts to their full extent. It may be used periodically to monitor the health of the mechanism.

General Information: The CloSure™ Test can be performed on all VR-Series circuit breakers. (Refer to Table 6.1.) If the CloSure™ travel obtained is as specified, the mechanism performance is satisfactory. If the CloSure™ travel does not conform as shown in Figure 6.15, contact Eaton’s Electrical Services & Systems for further information. (See Step 13.)

**WARNING**

DO NOT ATTEMPT TO INSTALL OR PERFORM MAINTENANCE OR TESTS ON THE EQUIPMENT WHILE IT IS ENERGIZED. NEVER PUT YOUR HANDS NEAR THE MECHANISM WHEN THE CIRCUIT BREAKER IS IN THE CHARGED OR CLOSED POSITION. DEATH OR SEVERE PERSONAL INJURY CAN RESULT FROM CONTACT WITH ENERGIZED EQUIPMENT. ALWAYS VERIFY THAT NO VOLTAGE IS PRESENT BEFORE PROCEEDING WITH THE TASK, AND ALWAYS FOLLOW GENERALLY ACCEPTED SAFETY PROCEDURES.
Step 5 - Clean the far left cam with a mild solvent such as alcohol. Place the tape around the cam starting from the bottom up. Make certain that the tape adheres well to the cam surface. (Figure 6.6).

Step 6 - Mount the transparent CloSure™ Test Tool (Figure 6.7b) with two bolts and washers. Refer to Figure 6.7a and Table 6.1 for approximate mounting holes. Hand tighten the bolts.

Step 7 - Using a red Sanford® Sharpie® fine point permanent marker (or equivalent), place the marker tip in the proper hole (“C”) located over the cam and make a heavy mark on the tape by moving the marker as described in Figures 6.9, 6.11, and 6.12. Remove the marker from the hole.

Step 8 - Charge the closing springs with the maintenance tool (Charging handle). Continue charging the closing springs until a “click” is heard and the status indicator shows “CHARGED” (Figure 6.8).

Step 9 - Place the marker back in the hole. While holding the marker tip against the tape, close the breaker (Figure 6.10). Remove the marker from the hole.

Step 10 - While closely observing the pole shaft at the right side of the circuit breaker (Figure 6.11), recharge the closing springs with the maintenance tool. As the circuit breaker is recharged, there should be no movement of the pole shaft. If there is movement of the pole shaft while recharging, this indicates a problem with the circuit breaker - stop the test and consult the factory.

Step 11 - Open the circuit breaker, then close it, then reopen it. Verify that the mark made in Step 7 is aligned with the pen opening. If it is not aligned, this indicates a problem with the circuit breaker - stop the test and consult the factory.

Step 12 - Inspect the circuit breaker to assure it is in the open position and the closing springs are discharged. Alternately depress the Open and Close clappers a few times to ensure the circuit breaker is completely discharged. Remove the transparent CloSure™ Tool.

Step 13 - Remove the tape from the cam and place it on a sheet of paper that can be kept as a record of the test. Record the date of the test, person conducting the test, circuit breaker serial number, and the operations counter on the tap or paper (Figures 6.14 and 6.15).

Step 14 - Evaluate the CloSure™ performance by comparing the test tape with the illustration in Figure 6.16. Measure the over travel “X”. If “X” is not greater than or equal to 0.6”, this indicates a problem with the circuit breaker - consult the factory.

Step 15 - Reassemble the front cover onto the circuit breaker. Return the circuit breaker to its original configuration and setup.

Table 6.1. CloSure™ Tool Mounting/Testing Locations by Circuit Breaker Type

<table>
<thead>
<tr>
<th>BREAKER LINE</th>
<th>APPROXIMATE MECHANISM CABINET WIDTH (INCH)</th>
<th>UPPER MOUNTING HOLE</th>
<th>LOWER MOUNTING HOLE</th>
<th>MARKER PLACEMENT HOLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>18WR</td>
<td>18</td>
<td>A1</td>
<td>B2</td>
<td>C1</td>
</tr>
<tr>
<td>20WR</td>
<td>20</td>
<td>A1</td>
<td>B2</td>
<td>C2</td>
</tr>
<tr>
<td>29WR</td>
<td>27</td>
<td>A1</td>
<td>B2</td>
<td>C5</td>
</tr>
</tbody>
</table>

Figure 6.7a. Attaching CloSure™ Test Tool at Hole “A” & “B”
WSA-5-VR and WSA-15-VR
Replacement Circuit Breaker

Figure 6.8. Manually Charging Closing Springs

Figure 6.9. Make a Clear and Heavy Mark

Figure 6.10. With Marker in Hole “C”, While Closing Breaker

Figure 6.11. Pole Shaft Located On Right Side Of Circuit Breaker

Figure 6.12. Move the Sharpie® 15° Left and Right

Figure 6.13. Top view of Cam and Marker Interface
6.9 LUBRICATION

All parts that require lubrication have been lubricated during the assembly with molybdenum disulphide grease. Eaton No. 53701QB. Over a period of time, this lubricant may be pushed out of the way or degrade. Proper lubrication at regular intervals is essential for maintaining the reliable performance of the mechanism. The breaker should be relubricated once a year or per the operations table (Table 6.2), whichever comes first. The locations shown in Figure 6.17 should be lubricated with a drop of light machine oil. After lubrication, operate the breaker several times manually and electrically.

Roller bearings are used on the pole shaft, the cam shaft, the main link and the motor eccentric. These bearings are packed at the factory with a top grade slow oxidizing grease which normally should be effective for many years. They should not be disturbed unless there is definite evidence of sluggishness, dirt or parts are dismantled for some reason.

If it becomes necessary to disassemble the mechanism, the bearings and related parts should be thoroughly cleaned, remove old grease in a good grease solvent. Do not use carbon tetrachloride. They should then be washed in light machine oil until the cleaner is removed. After the oil has been drawn off, the bearings should be packed with Eaton Grease 53701 QB or equivalent.

Table 6.2. Lubrication Per Number of Operations

<table>
<thead>
<tr>
<th>RATINGS OPERATIONS</th>
<th>OPERATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>29kA and below</td>
<td>750</td>
</tr>
<tr>
<td>Above 29kA</td>
<td>400</td>
</tr>
<tr>
<td>3000 Amp</td>
<td>400</td>
</tr>
</tbody>
</table>

Figure 6.17. General Lubrication Areas

- Apply one drop of non-synthetic light machine oil at locations shown.
### Table 6.3. Troubleshooting Chart

<table>
<thead>
<tr>
<th>SYMPTOM</th>
<th>INSPECTION AREA</th>
<th>PROBABLE DEFECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FAILS TO CLOSE</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Closing Springs Not Charged | Control Circuit | • Control Power (Fuse Blown Or Switch Off)  
• Secondary Disconnects  
• Motor Cut-off Switch (Poor Or Burned Contacts, Lever Not Operational)  
• Terminals And Connectors (Poor Or Burned Contacts)  
• Motor (Brushes Worn Or Commutator Segment Open) |
| | Mechanism | • Pawls (Slipping Or Broken)  
• Ratchet Wheel (Teeth Worn Or Broken)  
• Cam Shaft Assembly (Sluggish Or Jammed)  
• Oscillator (Reset Spring Off Or Broken) |
| Closing Springs Not Charged | Control Circuit (Close Coil Does Not Pick Up) | • Control Power (Fuse Blown Or Switch Off)  
• Secondary Disconnects  
• Anti Pump Relay (Y Relay N.C. Contact Open Or Burned Or Relay Picks Up)  
• Close Coil (Open Or Burned)  
• Latch Check Switch (Contact Open - Bad Switch Or Trip Bar Not Reset)  
• Auxiliary Switch (B Contact Open Or Burned)  
• Motor Cut-Off (Contacts Open Or Burned)  
• Trip Coil Assembly (Clapper Fails To Reset) |
| | | Closing Sound But No Close  
• Pole Shaft (Not Open Fully)  
• Trip Latch Reset Spring (Damaged Or Missing)  
• Trip Bar-D Shaft (Fail To Remain Reset)  
• Trip Latch-Hatchet (Fails To Remain Reset)  
• Trip Floor Tripper (Fails To Remain Reset)  
• Close Latch (Binding)  
• Close Latch Roller (Binding)  
• Trip Circuit Energized |
| **UNDESIRABLY CLOSES** | Control Circuit | • Close Circuit (CS/C Getting shorted) |
| | Mechanism | • Close Release Latch (Fails To Reset)  
• Close Floor Tripper (Fails To Reset) |
| **FAILS TO CLOSE** | Control Circuit | • Control Power (Fuse Blown Or Switch Off)  
• Secondary Disconnects  
• Auxiliary Switch (A Contact Not Making Poor Or Burned)  
• Trip Coil (Burned Or Open)  
• Terminals And Connections (Poor Or Burned Or Open)  
• Trip Clapper (Jammed) |
| Trip Mechanism | Trip Sound But No Trip | • Trip Bar, Trip Latch (Jammed)  
• Pole Shaft (Jammed)  
• Operating Rod Assembly (Broken Or Pins Out)  
• Vacuum Interrupter (One Or More Welded) |
| **UNDESIRABLY TRIPS** | Control Circuit | • Control Power (CS/T Switch, remains made) |
| | Mechanism | • Trip Coil Clapper (Not Resetting)  
• Trip Bar Or Trip Latch (Poor Engagement Of Mating Or Worm Surfaces)  
• Trip Bar Reset Spring (Loss Of Torque) |
SECTION 7: REPLACEMENT PARTS

7.1 GENERAL

In order to minimize production downtime, it is recommended that an adequate quantity of spare parts be carried in stock. The quantity will vary from customer to customer, depending upon the service severity and continuity requirements. Each customer should develop his own level based on operating experience. However, when establishing a new operating record, it is a good practice to stock one set of control components for every six circuit breakers of the same control voltage. This quantity should be adjusted with time and frequency of operation of the circuit breakers.

7.2 ORDERING INSTRUCTIONS

a. The style numbers in Table 7.1 should be sufficient to purchase control components for most applications. Some breakers have special control schemes. Supply complete nameplate information for verification or if additional components are needed.

b. Specify the method of shipping desired.

c. Send all orders or correspondence to the nearest Eaton sales office or contact the PBC direct at 1-877-276-9379.

d. Include negotiation number with order when applicable.

<table>
<thead>
<tr>
<th>#</th>
<th>Description</th>
<th>Style Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ANTI-PUMP (Y) RELAY</td>
<td>94C9525H01, 94C9525H02, 94C9525H03, 94C9525H04, 94C9525H05</td>
</tr>
<tr>
<td>2</td>
<td>RECTIFIER</td>
<td>94C9525G09</td>
</tr>
<tr>
<td>3</td>
<td>SPRING CHARGING MOTOR</td>
<td>94C9525G10, 94C9525G11, 94C9525G12</td>
</tr>
<tr>
<td>4</td>
<td>BREAKER AUXILIARY SWITCH</td>
<td>94C9525G13</td>
</tr>
<tr>
<td>5</td>
<td>BREAKER POSITION SWITCH</td>
<td>94C9525H06</td>
</tr>
<tr>
<td>6</td>
<td>BREAKER POSITION SWITCH</td>
<td>Breaker Position Switch PS2, 94C9525H07</td>
</tr>
<tr>
<td>7</td>
<td>LATCH CHECK SWITCH</td>
<td>Latch Check Switch (LC), 94C9525H08</td>
</tr>
<tr>
<td>8</td>
<td>MOTOR CUTOFF SWITCHES (LS) (20WR/29WR) (LS) (18WR)</td>
<td>94C9525G14, 94C9525G15</td>
</tr>
<tr>
<td>9</td>
<td>SPRING RELEASE COILS / SHUNT TRIPS</td>
<td>24vDC, 94C9525G16, 48vDC, 94C9525G17, 125vDC / 120vAC, 94C9525G18, 250vDC / 240vAC, 94C9525G19</td>
</tr>
<tr>
<td>10</td>
<td>CONTROL COMPONENTS KIT</td>
<td>48vDC, 94C9525G01, 125vDC, 94C9525G02, 250vDC, 94C9525G03, 120vAC-C/M 48vDC-T, 94C9525G04, 240vAC-C/M 48vDC-T, 94C9525G05, 120vAC-C/M 120vAC-CT, 94C9525G06, 240vAC-C/M 240vAC-CT, 94C9525G07</td>
</tr>
</tbody>
</table>