DST-2-VR⁺
VR-Series⁺ Replacement Circuit Breaker

DST-2-15-VR⁺ 500 2000A Shown
DST-2-VR+
VR-Series+ Replacement Circuit Breaker

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⚠️ DANGER

IMPROPERLY INSTALLING OR MAINTAINING THESE PRODUCTS MAY CAUSE THE EQUIPMENT TO FAIL, RESULTING IN DEATH, SEVERE PERSONAL INJURY, EQUIPMENT DAMAGE AND/OR IMPROPER OPERATION.

READ AND UNDERSTAND THESE INSTRUCTIONS BEFORE ATTEMPTING ANY UNPACKING, ASSEMBLY, OPERATION OR MAINTENANCE OF THE CIRCUIT BREAKERS.

INSTALLATION OR MAINTENANCE SHOULD BE ATTEMPTED ONLY BY QUALIFIED PERSONNEL. THIS INSTRUCTION BOOKLET SHOULD NOT BE CONSIDERED ALL INCLUSIVE REGARDING INSTALLATION OR MAINTENANCE PROCEDURES. IF FURTHER INFORMATION IS REQUIRED, YOU SHOULD CONSULT EATON’S ELECTRICAL SERVICES & SYSTEMS.

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

THESE VACUUM REPLACEMENT CIRCUIT BREAKERS ARE DESIGNED TO BE INSTALLED PURSUANT TO THE AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI), SERIOUS INJURY, INCLUDING DEATH, SEVERE PERSONAL INJURY, EQUIPMENT DAMAGE AND/OR IMPROPER OPERATION.
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SECTION 1: INTRODUCTION

This instruction booklet provides information on receiving and handling, storage, installation, operation and maintenance of the DST-2 VR-Series+ vacuum replacement circuit breaker. The Vacuum Replacement circuit breakers (also referred to as VR-Series+) are designed to be used in existing Federal Pacific type DST-2 metal-clad switchgear. The VR-Series+ circuit breakers provide 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 of the VR-Series+ circuit breakers are interchangeable with each other.

The VR-Series+ circuit breaker element offers:

- **10-year or 10,000 operation scheduled maintenance intervals.** When applied in “usual service conditions” as defined by IEEE C37.04-1999, the VR-Series+ circuit breaker element requires maintenance only once every ten years or ten thousand operations, which ever comes first.
  
  Note: See Inspection & Maintenance section in this booklet for details.

- **Increased mechanical endurance.** Circuit breakers in repetitive duty applications offer 50% more operations over conventional vacuum circuit breaker elements before parts replacement may be needed.

- **Increased short circuit capability.** The VR-Series+ circuit breaker short circuit capability can be increased to 41 kA, provided a bus bracing study is performed and the switchgear is adequately braced to meet the requirements per IEEE C37.59.

Use this instruction bulletin in conjunction with the technical information provided with the original equipment order which includes electrical control schematic and wiring diagrams, outline diagrams, installations plans, and procedures for installation and maintenance of accessory items.

Satisfactory performance is dependent on proper application, correct installation, and adequate maintenance. It is very important that this installation and maintenance instruction booklet be read and followed closely to achieve optimum performance and a long useful circuit breaker life in its application.

### 1.1 VISUAL INSTRUCTION BOOKLET ESSENTIALS

Eaton provides additional documentation designed to enhance the technical information provided in this instruction booklet for the VR-Series+ circuit breakers. The Visual Instruction Booklet Essentials (VIBE) is a digital supplemental booklet featuring user interactive content and informative videos intended to assist with the maintenance of the VR-Series+ circuit breaker. The VIBE document is available for immediate download at www.eaton.com/VR-Series.

### 1.2 QUICK RESPONSE CODE

VR-Series+ circuit breakers have a quick response code (QR Code) on the escutcheon of the circuit breaker front cover. This QR Code is a matrix barcode that provides direct access to download VR-Series+ specific documentation, such as product instruction booklets and the VIBE documentation. See Figure 1.1 for the featured VR-Series+ QR Code.

Note: A smart phone with an adequate QR Code Scanner application must be used. Downloading content may incur data charges from the mobile service provider.

### WARNING

SATISFACTORY PERFORMANCE OF THESE CIRCUIT BREAKERS IS CONTINGENT UPON PROPER APPLICATION, CORRECT INSTALLATION AND ADEQUATE MAINTENANCE. THIS INSTRUCTION BOOKLET MUST BE CAREFULLY READ AND FOLLOWED IN ORDER TO OBTAIN OPTIMUM PERFORMANCE FOR LONG USEFUL LIFE OF THE CIRCUIT BREAKERS. IT IS FURTHER RECOMMENDED THAT THE INSTALLATION BE PERFORMED BY AN EATON TRAINED ENGINEER OR TECHNICIAN.

VR-SERIES+ CIRCUIT BREAKERS ARE PROTECTIVE DEVICES, AS SUCH, THEY ARE MAXIMUM RATED DEVICES. THEREFORE, THEY SHOULD NOT UNDER ANY CIRCUMSTANCE BE APPLIED OUTSIDE THEIR NAMEPLATE RATINGS.

ALL POSSIBLE CONTINGENCIES WHICH MIGHT ARISE DURING INSTALLATION, OPERATION, OR MAINTENANCE, AND ALL DETAILS AND VARIATIONS OF THIS EQUIPMENT ARE NOT COVERED BY THESE INSTRUCTIONS. IF FURTHER INFORMATION IS DESIRED BY THE PURCHASER REGARDING A PARTICULAR INSTALLATION, OPERATION, OR MAINTENANCE OF THIS EQUIPMENT, THE LOCAL EATON REPRESENTATIVE SHOULD BE CONTACTED.

### 1.3 AVAILABLE DST-2-VR+ CIRCUIT BREAKERS

Refer to Table 1.
Table 1. DST-2-VR+ Availability and Interchangeability

<table>
<thead>
<tr>
<th>Existing DST-2 Circuit Breaker Type</th>
<th>DST-2-VR+ Circuit Breaker Type</th>
<th>Maximum Voltage</th>
<th>Nominal 3-Phase MVA Class</th>
<th>Existing Circuit Breaker Rated Continuous Current at 60 Hz</th>
<th>Rated Voltage Factor</th>
<th>Rated Withstand ANSI Test Voltage</th>
<th>Rated Short-Circuit</th>
<th>Maximum Sym. Interrupting Capability</th>
<th>Closing and Latching / Momentary Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>DST-2-5-250</td>
<td>DST-2-5-VR+250</td>
<td>4.76</td>
<td>250</td>
<td>1.24</td>
<td>19</td>
<td>60</td>
<td>29</td>
<td>36</td>
<td>58 / 97</td>
</tr>
<tr>
<td>DST-2-5-250</td>
<td>DST-2-5-VR+41 ① ② ③</td>
<td>4.76</td>
<td>④</td>
<td>1.0</td>
<td>19</td>
<td>60</td>
<td>41</td>
<td>⑤</td>
<td>78 / 132</td>
</tr>
<tr>
<td>DST-2-7.5-500</td>
<td>DST-2-7.5-VR+500</td>
<td>8.25</td>
<td>500</td>
<td>1.25</td>
<td>36</td>
<td>95</td>
<td>33</td>
<td>41</td>
<td>66 / 111</td>
</tr>
<tr>
<td>DST-2-15-500</td>
<td>DST-2-15-VR+500</td>
<td>15.0</td>
<td>500</td>
<td>1.30</td>
<td>36</td>
<td>95</td>
<td>18</td>
<td>23</td>
<td>37 / 62</td>
</tr>
<tr>
<td>DST-2-15-500U</td>
<td>DST-2-15-VR+500U(3)</td>
<td>15.0</td>
<td>500</td>
<td>1.30</td>
<td>36</td>
<td>95</td>
<td>28</td>
<td>36</td>
<td>58 / 97</td>
</tr>
<tr>
<td>DST-2-15-750</td>
<td>DST-2-15-VR+750</td>
<td>15.0</td>
<td>750</td>
<td>1.30</td>
<td>36</td>
<td>95</td>
<td>28</td>
<td>36</td>
<td>58 / 97</td>
</tr>
<tr>
<td>DST-2-15-500/750</td>
<td>DST-2-15-VR+41 ① ② ③</td>
<td>15.0</td>
<td>④</td>
<td>1.0</td>
<td>36</td>
<td>95</td>
<td>⑥</td>
<td>⑦</td>
<td>77 / 130</td>
</tr>
</tbody>
</table>

① All circuit breakers have a 3 second short-time and 3-cycle interrupting ratings.
② Non-standard rating.
③ Requires bus bracing study and additional switchgear bracing.
Table 2. DST-2-VR+ Dimensions

<table>
<thead>
<tr>
<th>Circuit Breaker Type</th>
<th>Existing Circuit Breaker Rated</th>
<th>Continuous Current at 60 Hz (Amps)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>DST-2-15-VR+</td>
<td>1200 / 2000</td>
<td>65.38</td>
<td>25.75</td>
<td>7.88</td>
<td>34.18</td>
<td>11.00</td>
<td>19.81</td>
<td></td>
</tr>
<tr>
<td>DST-2-5-VR+</td>
<td>1200 / 2000</td>
<td>57.13</td>
<td>18.50</td>
<td>5.50</td>
<td>32.44</td>
<td>11.00</td>
<td>19.87</td>
<td></td>
</tr>
</tbody>
</table>
SECTION 2: SAFE PRACTICES

VR-Series+ circuit 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.

⚠️ DANGER

TO PROTECT THE PERSONNEL ASSOCIATED WITH INSTALLATION, OPERATION, AND MAINTENANCE OF THESE CIRCUIT 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 circuit breakers.
- Read these instructions carefully before attempting any installation, operation or maintenance of these circuit breakers.
- Always remove the circuit breaker from the enclosure before performing any maintenance. Failure to do so could result in electrical shock leading equipment failure, resulting in death, severe personal injury, equipment damage and/or improper operation.
- Do not work on a circuit breaker with the secondary test coupler engaged. Failure to disconnect the test coupler could result in an electrical shock leading to death, severe personal injury, equipment damage and/or improper operation.
- Do not work on a closed circuit breaker or a circuit breaker with closing springs charged. The closing spring should be discharged and the main contacts open before working on the circuit 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 circuit 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 circuit breaker in an intermediate position in the circuit breaker compartment. Always have the circuit breaker either in the ‘Test’ or ‘Connect’ position. Failure to do so could result in a flash over causing the equipment to fail, resulting in death, severe personal injury, equipment damage and/or improper operation.
- Always remove the maintenance tool from the circuit breaker after charging the closing springs.
- Circuit breakers are equipped with safety interlocks. Do not defeat them. This may result in equipment failure, resulting in death, severe personal injury, equipment damage and/or improper operation.
SECTION 3: RECEIVING, HANDLING, AND STORAGE

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, code plate, (if applicable) etc. are shipped with the circuit breaker.

3.1 RECEIVING

Until the circuit breaker is ready to be delivered to the switchgear site for installation, DO NOT remove it from the shipping crate. If the circuit 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 circuit breaker for any signs of shipping damage such as broken, missing or loose hardware, damaged or deformed insulation and other components. If damaged or loss is detected, file claims immediately with the carrier and notify an Eaton representative.

Tools and Accessories

Maintenance Tool (Style# 94C9506G01): This tool is used to manually charge the closing springs. One maintenance tool is provided with each vacuum replacement circuit breaker.

Rotary Racking Handle (Style# 94B4102G21): Rotary racking is possible utilizing a speed-handle, suitable extensions and a standard 3/4" socket. One rotary racking handle is provided per order. If necessary, additional racking handles may be purchased directly from Eaton. This handle is used with the rotary racking system for insertion and removal.

Levering Handle: The original DST-2 levering handle is used to assist in moving the circuit breaker into and out of the cell. However, it cannot be used with the rotary racking system. Its use is illustrated in section 5 of this manual.

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 original Federal Pacific breaker and is therefore not included as part of the vacuum replacement breaker.

Lifting Strap (Style# 94B1194G01): Optional item recommended for lifting the DST-2-VR+ circuit breaker.
3.2 HANDLING

⚠️ WARNING

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

VR-Series+ circuit breaker shipping containers are designed to be handled either by use of an 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 circuit 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 the circuit breaker is ready for installation, a lifting harness in conjunction with an overhead lift or portable floor lift can be used to move the circuit breaker. If the circuit breaker is to be lifted, position the lifting device over the circuit breaker and insert the lifting harness hooks into the circuit breaker side lifting points and secure (lifting straps should have at least a 1000lbs lift capacity). Be sure the hooks are firmly attached before lifting the circuit breaker. Stand a safe distance away from the circuit breaker while lifting and moving.

Figure 3.2. Lifting DST-2-VR+

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. Confirm that the circuit breaker is free from shipping damage and is in satisfactory operating condition before placing it in to storage.

The circuit breaker is shipped with its contacts open and closing springs discharged. The indicators on the front cover should confirm this. Insert the end of the maintenance tool into the manual charge socket opening and charge the closing springs by moving the handle up and down the full range of motion. When charging is complete the ratchet will no longer advance and the spring charged / discharged indicator displays ‘Charged’. (Figure Set 3.3). Remove the maintenance tool. Push the “manual close” operator. The circuit breaker will trip as shown by the circuit breaker contacts ‘Open’ indicator. After completing this initial check, leave the closing springs ‘Discharged’ and circuit 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 APPROXIMATE WEIGHT BY TYPE

Table 3. Approximate Weight by Type

<table>
<thead>
<tr>
<th>Type</th>
<th>Amperes</th>
<th>LBs</th>
</tr>
</thead>
<tbody>
<tr>
<td>DST-2-15-VR+</td>
<td>500</td>
<td>650*</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>750*</td>
</tr>
<tr>
<td>DST-2-15-VR+</td>
<td>750</td>
<td>630*</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>750*</td>
</tr>
<tr>
<td>DST-2-5-VR+</td>
<td>250</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>670</td>
</tr>
</tbody>
</table>

Note: * = An additional 75# is added with the optional internal Rotary Racking system.
DST-2-VR+
VR-Series+ Replacement Circuit Breaker

Figure 3.3.a. Front External View of DST-2-15-VR+

Front External View

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lock Out / Tag Out</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Levering Point</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>Terminal Block Access</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>Handle</td>
<td>9</td>
</tr>
<tr>
<td>5</td>
<td>Main Contact Status Indicator</td>
<td>10</td>
</tr>
</tbody>
</table>
Figure 3.3.b. Rear External View of DST-2-15-VR+

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lifting Points</td>
</tr>
<tr>
<td>2</td>
<td>Secondary Disconnects</td>
</tr>
<tr>
<td>3</td>
<td>Primary Disconnects</td>
</tr>
<tr>
<td>4</td>
<td>Anti Rotation Self Adjuster (Optional)</td>
</tr>
<tr>
<td>5</td>
<td>Ground Contact</td>
</tr>
</tbody>
</table>
Figure 3.3.c. Front External View of DST-2-5-VR+
Figure 3.3.d. Rear External View of DST-2-5-VR+

Rear External View

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lifting Points</td>
</tr>
<tr>
<td>2</td>
<td>Secondary Disconnects</td>
</tr>
<tr>
<td>3</td>
<td>Primary Disconnects</td>
</tr>
<tr>
<td>4</td>
<td>Ground Contact</td>
</tr>
</tbody>
</table>
SECTION 4: DESCRIPTION AND OPERATION

VR-Series® vacuum replacement circuit breakers are designed to be used with existing installations of equivalent air-magnetic metal-clad switchgear circuit breakers. 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 if the vapor leaves the contact area, it would condense into the metal shield which surrounds the contacts.

At current zero, the arc extinguishes and vapor production ceases. Very rapid dispersion, cooling, recombinaton, 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 VACUUM INTERRUPTER ASSEMBLY

Each vacuum interrupter assembly (also referred to as pole unit) is assembled at the factory as a unit to assure correct dimensional relationships between working components. Three interrupter assemblies are used per circuit breaker. Each vacuum interrupter assembly consists of a molded insulator frame and includes the vacuum interrupter, its lead assembly, bell crank, operating rod, stand-off insulator, and contact load spring. The vacuum interrupter is mounted vertically with the stationary vacuum interrupter stem upward and the moving interrupter stem downward. The pole units are fastened to the circuit breaker's stored energy mechanism frame. Silver-plated copper laminated shunts transfer current from the moving interrupter stem to the upper primary bushings via a Holm-free, non-sliding conical current transfer. A silver-plated copper casting is attached to the stationary stem, completing the primary circuit to the lower disconnect assemblies. The operating rod, loading spring, and bell crank transfer the mechanical motion from the circuit breaker's stored energy mechanism to the moving stem of the vacuum interrupter.

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. The VR-Series® vacuum interrupter assembly incorporates both the original vacuum interrupter erosion indicator and the contact-spring wipe into one all-encompassing indicator. The adequacy of the remaining contact erosion and wipe can easily be determined by observing the moving end of the vacuum interrupter assembly on a closed circuit breaker. The procedure to determine the adequacy of the “T” cutout on the vacuum interrupter assembly is depicted in Figures 6.1 and 6.2. If the wipe is inadequate (no part of the “T” cutout is visible) then the vacuum interrupter assembly must be replaced. Field adjustment is not possible.
4.1.3 CONTACT WIPE AND STROKE

The circuit breaker mechanism provides a fixed amount of motion to the operating rods connected to the moving stem of the vacuum interrupter. The first portion of the motion, the stroke, is used to close the vacuum interrupter contacts; the remainder of that motion, the wipe, is used to further compress the pre-loaded wipe spring. Contact stroke and wipe are related; contact wipe is the indication of the force holding the vacuum interrupter contacts closed as well as the energy available to hammer the contacts open with sufficient speed for interruption. Stroke is the gap between the stationary and moving contact of the vacuum interrupter when the circuit breaker is open. As the stroke increases due to contact erosion inside the vacuum interrupter, the wipe decreases. Although these changes are taking place as operations accumulate on the vacuum interrupter, field adjustment of the wipe or stroke are not necessary during the lifetime of the vacuum interrupter.

4.2 LINE AND LOAD CONDUCTOR ASSEMBLIES

Multiple finger type primary disconnecting contacts at the ends of the conductors provide means for connecting and disconnecting the circuit breaker to the bus terminals in the circuit breaker compartment of the metal-clad switchgear.

4.3 STORED ENERGY MECHANISM

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

The mechanism stores the closing energy by charging the closing springs. Spring charging is automatically accomplished when control power is applied to the circuit breaker secondary disconnect contact. When released, the stored energy closes the circuit breaker, charges the wipe and resets the opening springs. The mechanism may rest in any one of the four positions shown in Figure 4.8 as follows:

b. Circuit Breaker open, closing springs charged.
c. Circuit Breaker closed, closing springs discharged.
d. Circuit Breaker closed, closing springs charged.

The mechanism is a mechanically “trip-free” design. Trip-free is defined in Section 4.3.4 (Trip-Free Operation).

In normal operation the closing spring is charged by the spring charging motor, and the circuit 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 circuit breaker can be closed and tripped by pushing the “Push to Close” and “Push to Open” operators on the front cover.

4.3.1 CLOSING SPRING CHARGING

Figure 4.7 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” contact disconnects the motor.

The closing spring cranks have spring ends connected to them, which are 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 spring release latch (1). The closing springs are now held in the fully charged position.

The closing springs may also be charged manually as follows: Insert the end of the maintenance tool into the manual charge socket opening and charge the closing springs by moving the handle up and down the full range of motion. When charging is complete the ratchet will no longer advance and the spring charged / discharged indicator displays ‘Charged’. (Figure Set 3.3). Any further motion of the maintenance tool will not result into advance of charging.

4.3.2 CLOSING OPERATION

Figure 4.8 shows the positions of the closing cam and tripping linkage for four different operational states. In Figure 4.8.a the circuit breaker is open and the closing springs are not charged. In this state, the trip latch (8) is disengaged from the trip “D” shaft (9) (unlatched). After the closing springs become charged, the trip latch snaps into the fully reset or latched position (Figure 4.8.b) When the spring release clapper (Figure 4.7, Item 13) moves into the face of the spring release coil (electrically or manually), the lower portion of the clapper pushes the spring release latch (1) downward. When the spring release latch moves, the cam shaft assembly is free to rotate. The force of the closing cam (Figure 4.8.b, 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 4.8.c. Interference of the trip “D” shaft with the trip latch prevents the linkage from collapsing, and holds the circuit breaker closed.
Figure 4.8.d shows the circuit 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.

4.3.3 TRIPPING OPERATION
When the trip bar “D” shaft (Figure 4.8.b, 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 lower. 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 4.8.b) after the circuit breaker is tripped open.

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

4.4 CONTROL SCHEMES
There are two basic control schemes for the VR-Series+ circuit breaker elements, one for dc control and one for ac control voltages (Figure 4.3). Specific customer order wiring schematics and diagrams are included with each circuit breaker.

There may be different control voltages or more than one tripping device, 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 circuit breaker may be closed by closing the control switch close (CS/C) contact. Automatically upon closing of the circuit breaker, the motor starts charging the closing springs. The circuit breaker may be tripped any time by closing the control switch (CS/T) contacts.
Note the position switch (PS1) contact in the spring release circuit in the scheme. This contact remains closed while the circuit breaker is being racked between the ‘test’ and ‘connect’ positions for VR-Series+ circuit breakers. Consequently, it prevents the circuit breaker from closing automatically, even though the control close contact may have been closed while the circuit breaker is racked to the ‘connect’ position.
When the CS/C contact is closed, the SR closes the circuit breaker. If the CS/C contact is maintained after the circuit 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 circuit breaker would subsequently open, it could not be reclosed before CS/C was released and remade. This is the anti-pump function.

4.4.1 TIMING
The opening and closing times for the circuit breakers vary depending upon the control voltage, power rating, environment and test equipment. Differences in timing are expected between initial factory measurements and field inspections. Circuit breaker timing can be measured by service personnel using available equipment before installation and in conjunction with regular maintenance periods to assist in tracking the general health of the circuit breaker. Typical ranges as observed using nominal control voltages are listed in Table 4.

<table>
<thead>
<tr>
<th>Event</th>
<th>Milliseconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closing Time (From Initiation of Close Signal to Contact Make)</td>
<td>45 - 60</td>
</tr>
<tr>
<td>Opening Time (Initiation of Trip Signal to Contact Break)</td>
<td>30 - 38</td>
</tr>
<tr>
<td>Reclosing Time (Initiation of Trip Signal to Contact Make)</td>
<td>140 - 165</td>
</tr>
</tbody>
</table>

Note: Values are typical at nominal rated control voltage(s).

4.5 SECONDARY CONNECTION BLOCK
The breaker control circuit is connected to the switchgear control through secondary connection block (Figure 3.3.b). The contacts engage automatically when the breaker is racked into the “test” and “connect” positions. The socket half of the connection is located in the cubicle and a jumper of multiconductor cable can complete the control connections (for testing) when the breaker is withdrawn from the cell.

4.6 INTERLOCKS

\[\text{WARNING}\]
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.

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.

4.6.1 ANTI-CLOSE INTERLOCK
The anti-close interlock prevents discharging of the closing springs if the breaker is already closed (Figure 4.5, Item 11). When the breaker is closed, the interlock component moves away from the spring release clapper so that it cannot lift the spring release latch (8).

4.6.2 SHUTTER OPERATING MECHANISM
Each breaker cell is equipped with a shutter to shield the high voltage stabs in the cubicle when the breaker is not in the cubicle. The shutter is regulated by the shutter operating mechanism located on the right side of the breaker. This mechanism opens the shutter as the breaker is racked into the cell and closes the shutter as the breaker is racked out of the cell.

Table 4. Time Per Event
**VR-Series+ Circuit Breaker dc Control Schematic**

- **Operation**: Closed until springs are fully charged.
- **Switch Terminal**: ‘C’ and ‘NO’ Brown Switch

**VR-Series+ Circuit Breaker ac Control Schematic**

- **Operation**: 1. Open until springs are fully charged. 2. Closed until mechanism is reset. 3. Open in all except between ‘Test’ and ‘Connect’ positions. 4. Closed in all except between ‘Test’ and ‘Connect’ positions.
- **Switch Terminal**: ‘C’ and ‘NO’ Black Switch

---

**Legend**

- CS - Circuit Breaker Control Switch - close
- LS1 - Spring Released Coil (Close Coil)
- PS1 - Position Switch 1
- Y - Anti Pump Relay
- SR - Spring Release Coil (Close Coil)
- M - Spring Charging Motor
- ST - Shunt Trip Coil
- PR - Protective Relay
- O - Terminal Block or Accessible Terminal
- PS2 - Position Switch 2
4.6.3 RACKING SYSTEM TRIP AND SPRING RELEASE INTERLOCKS

4.6.3.1 INTERNAL ROTARY RACKING
An active interlock is provided to keep the breaker in a trip free position when the breaker is between the test and fully connected position; no adjustments are necessary. In addition to the active interlock, two passive interlocks are provided; one to prevent engaging the rotary racking handle into the breaker when the breaker is closed, and one to prevent turning the rotary shaft in the breaker when the breaker is closed.

4.6.3.2 LEVERING HANDLE RACKING (FLOOR TRIP / INTERLOCK PEDAL)
The levering interlock prevents engaging a shut breaker with live cell buss work or removing a breaker from the cell with charging springs. The basic premise of this interlock is that no breaker should be connected to or removed from cell primary circuitry when shut. The levering interlock accomplishes this by providing a trip signal to the breaker automatically from the floor trip whenever the Interlock Pedal is depressed.

4.7 RACKING MECHANISM

4.7.1 LEVERING SYSTEM TRIP AND SPRING RELEASE INTERLOCKS
The levering system tripping and spring release interlocks perform the following:

a. Set the breaker mechanically trip-free during the first 4 inches of travel into the cell and whenever the breaker receives a close signal in an intermediate or the disconnect position.

b. Set the breaker in a safe condition (breaker open, springs discharged) when removed from the cell.

c. Insert a mechanical trip signal to open a position switch preventing energizing of the spring release coil whenever the breaker is in an intermediate position.

d. Prevent inadvertent cycling (pumping) of the breaker between the test and connect positions.

e. Prevent insertion of a closed breaker into the cell.

⚠️ 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 GROUNDING CONTACT
The grounding contact is an assembly of spring loaded fingers which ground the breaker frame (static ground) by engaging the switchgear cell grounding bus when the breaker is racked into the cell. The ground contact is located at the rear of the breaker near the floor and visible from the back of the breaker when out of the cell.

4.9 MISCELLANEOUS ITEMS

4.9.1 OPERATIONS COUNTER
All DST-2-VR+ breakers are equipped with a mechanical operations counter (Figures 3.3). As the breaker opens, the linkage connected to the pole shaft lever advances the counter reading by one.
**Figure 4.6. VR-Series+ Circuit Breaker Element Mechanism - Front Cover Removed**

<table>
<thead>
<tr>
<th>#</th>
<th>Component Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LH Closing Spring</td>
</tr>
<tr>
<td>2</td>
<td>Latch Check Switch (To Rear of Motor Cutoff Switch)</td>
</tr>
<tr>
<td>3</td>
<td>Motor Cutoff Switch</td>
</tr>
<tr>
<td>4</td>
<td>Closing Cam</td>
</tr>
<tr>
<td>5</td>
<td>Spring Release Assembly</td>
</tr>
<tr>
<td>6</td>
<td>RH Closing Spring</td>
</tr>
<tr>
<td>7</td>
<td>Reset / Opening Spring</td>
</tr>
<tr>
<td>8</td>
<td>Manual Charge Socket</td>
</tr>
<tr>
<td>9</td>
<td>Shunt Trip Assembly</td>
</tr>
<tr>
<td>10</td>
<td>Ratchet wheel</td>
</tr>
<tr>
<td>11</td>
<td>Operations Counter</td>
</tr>
<tr>
<td>12</td>
<td>Charging Motor</td>
</tr>
</tbody>
</table>
Circuit Breaker Open, Springs Discharged

Circuit Breaker Closed, Springs Charged

### Closing Cam and Trip Linkage

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Spring Release (Close) Latch</td>
</tr>
<tr>
<td>2</td>
<td>Pole Shaft</td>
</tr>
<tr>
<td>3</td>
<td>Closing Spring Fixed End</td>
</tr>
<tr>
<td>4</td>
<td>Closing Spring</td>
</tr>
<tr>
<td>5</td>
<td>Holding Pawl</td>
</tr>
<tr>
<td>6</td>
<td>Ratchet Wheel</td>
</tr>
<tr>
<td>7</td>
<td>Spring Crank</td>
</tr>
<tr>
<td>8</td>
<td>Cam Shaft</td>
</tr>
<tr>
<td>9</td>
<td>Spring Release Latch (Close Roller)</td>
</tr>
<tr>
<td>10</td>
<td>Spring Release Latch (Close Roller)</td>
</tr>
<tr>
<td>11</td>
<td>Anti-Close Interlock</td>
</tr>
<tr>
<td>12</td>
<td>Motor Ratchet Lever</td>
</tr>
<tr>
<td>13</td>
<td>Spring Release (Close) Clapper</td>
</tr>
<tr>
<td>14</td>
<td>Spring Release (Close) Coil</td>
</tr>
</tbody>
</table>
Figure 4.8. Charging Schematic

4.8.a. Circuit Breaker Open and Closing Spring Not Charged

4.8.b. Circuit Breaker Open and Closing Spring Charged

4.8.c. Circuit Breaker Closed and Closing Spring Not Charged

4.8.d. Circuit Breaker Closed and Closing Spring Charged

<table>
<thead>
<tr>
<th>Charging Schematic</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Main Link Roller</td>
<td>5</td>
<td>Closing Cam</td>
</tr>
<tr>
<td>2</td>
<td>Main Link</td>
<td>6</td>
<td>Cam Shaft</td>
</tr>
<tr>
<td>3</td>
<td>Operating Rod</td>
<td>7</td>
<td>Banana Link</td>
</tr>
<tr>
<td>4</td>
<td>Pole Shaft</td>
<td>8</td>
<td>Trip latch</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Trip Bar “D” Shaft</td>
<td>10</td>
<td>Trip Latch Reset Spring</td>
</tr>
<tr>
<td>11</td>
<td>Shunt Trip Lever</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Shunt Trip Coil</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SECTION 5: INSPECTION & INSTALLATION

**WARNING**

BEFORE PLACING THE CIRCUIT 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 CIRCUIT BREAKER OPERATION LEADING TO DEATH, BODILY INJURY, AND PROPERTY DAMAGE.

When the circuit breaker is first commissioned into service and each time the circuit 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 circuit breaker for loose or obviously damaged parts. Never attempt to install nor operate a damaged circuit 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.

**WARNING**

Always de-energize/isolate the power source feeding the circuit breakers/switchgear and lock-out/tag-out the power source prior to insertion or removal of any circuit breaker. Never attempt to maintain or modify a circuit breaker while inserted in a switchgear cell structure. Always remove the circuit breaker and move it to a suitable area for maintenance or repair.

Follow all lockout and tag-out requirements of the National Electric Code, OSHA and any other applicable local codes, regulations and procedures.

5.2 SURE CLOSE MECHANISM ADJUSTMENT

**WARNING**

For all type circuit breaker housings equipped with mechanism operated cell (MOC) switches, the steps outlined in this section must be performed before installing a replacement VR-Series+ circuit breaker. Failure to comply could cause severe personal injury, death, equipment damage and/or improper operation.

All type DST-2-VR+ circuit breakers with MOC operators utilize the SURE CLOSE mechanism to control kinetic energy transfer and closely mimic the dynamics and velocities of older circuit breakers. It is imperative that this mechanism be adjusted to compensate for the force of the MOC switch mounted in the cell.

The circuit breaker SURE CLOSE MOC operator is factory adjusted to a force of 37-52 lbf. This force has been proven to successfully operate a well-maintained Federal Pacific 8-9 stage MOC switch provided it does not have excessive pitting or arcing on its contacts. The parameters for the existing MOC switch should be verified and adjustments made to the cell switch mounting location. Do not attempt to insert or operate a DST-2-VR+ replacement circuit breaker in a cell containing an MOC until after the switch has been properly adjusted.

Figure 5.1. SURE CLOSE Spring Compression Setting

![SURE CLOSE Spring Compression Setting](300x570 to 562x721)

Locate the cell mounted MOC. Two functional versions of the MOC interface are known to exist. One operates the MOC switch in the connected position only and the other will operate in either the “TEST” or “CONNECTED” positions. Figures 5.3.a shows the MOC switch that can operate in the “TEST” or “CONNECTED” positions.

To insure the proper operation of the SURE CLOSE mechanism, the MOC assembly should be cleaned and inspected for worn parts, lubricated and properly secured in the cell before proceeding. A spring force gauge should be used to measure the forces needed to move the switch to the fully closed position prior to inserting the circuit breaker.

**Step 1:** Attach a spring force gauge to the round operating rod as shown (Figure 5.3.c) and pull vertically until the switch contacts have all changed state. Do not “over-pull” on the gauge. Measure and record the force. It should be approximately 27-32 lbf for a properly maintained and adjusted Federal Pacific MOC switch with 8-9 stages. The force will be higher for switches with more stages or if improperly maintained.

**Step 2:** Place the circuit breaker at a safe distance from the cell structure and on a level surface. If the cell structure is energized, be sure the circuit breaker is beyond the Arc Flash Boundary. Chock the wells to prevent movement. Use the maintenance tool to charge the stored energy mechanism and manually press the “PRESS TO CLOSE” device to close the circuit breaker.

**Step 3:** Attach the spring force gauge as shown in Figure 5.14 and pull down vertically (approximately .125 - .25”) to measure the SURE CLOSE MOC operator force. It should measure between 37-52 lbf. This provides a minimum margin/differential of approximately 10 lbf to operate the MOC switch. If the differential force between the SURE CLOSE MOC operator and the MOC switch is less than 10 lbf, then the SURE CLOSE MOC operator force should be increased to obtain a 10 lbf differential between the force measure in the cell and the output force of the circuit breaker with the circuit breaker being the greater of the two forces. Proceed with the following steps to increase the circuit breaker SURE CLOSE MOC operator force:

**Step 4:** Open the circuit breaker by depressing the “PUSH TO OPEN” operator. Locate the SURE CLOSE MOC drive spring (Figure 3.4). It is located in the lower left portion of the circuit
breaker as viewed from the primary bushing side of the circuit breaker.

Step 5: Loosen the outer jam nut on the **SURE CLOSE** spring and turn the inner nut clockwise to compress the spring an additional 25 inch. Measure and record the length of the compressed length of the spring. It should never be compressed to less than 3.00 inches. Charge the circuit breaker’s stored energy mechanism using the “maintenance tool” and close the circuit breaker by depressing the “PUSH TO CLOSE” operator.

Step 6: With the circuit breaker still out of the cell and in the closed position, measure the output of the MOC drive as described in Step 3. The MOC drive force should exceed the MOC cell force requirement by a minimum of 10 lbf. If not, repeat Steps 4 - 6 until the required margin is achieved. Do not compress the spring beyond 3.00 inches as referenced in Figure 5.1 and Step 5.

Step 7: Manually charge and close the circuit breaker 2-3 times to stabilize the reactions of the circuit breaker components. Close the circuit breaker and measure the MOC output force as described in Step 3. If the force margin remains adequate, proceed to the next step. If not, repeat adjustment Steps 4 - 6. Tighten the jam nut (Figure 5.1) when adjustments are completed.

Step 8: Insert into the cell following the instructions for the correct vintage (See Section 4).

Step 9: Operate the circuit breaker to verify the MOC operator force is sufficient when driving all the MOC system components.

Step 10: Repeat Steps 3 - 8 until acceptable operation is achieved.

Step 11: Anytime an adjustment is made, make sure the new compressed spring length (measured in the open position) is recorded if different from the dimension as received from the factory.

Step 12: After an adjustment is made, always verify 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 an energized 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 Set 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 LOW FREQUENCY WITHSTAND TEST (INSULATION CHECK)

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

After going through the above steps, the breaker is now ready to be operated electrically. It is preferred that this check be made with the breaker in the Test position in the breaker compartment. Since the Type DST-2-VR+ Circuit Breaker is for use in existing DST-2 Metal-Clad Switchgear, installation procedures are similar. If it is necessary to reference anything in the breaker compartment, refer to the original instruction books supplied with the assembly.

#### 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.**

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.

### 5.9 MECHANICAL INTERLOCK (FLOOR TRIP) OPERATIONAL CHECKS

Check the operation of the mechanical interlock (floor trip) by observing the main contact status and closing spring status as the breaker is moved between the disconnect and test position. The breaker should discharge its closing springs when moved between...
the disconnect and test positions and remain open between the test and connect positions. (Refer to Section 4.7 for information concerning correct operation of these components).

5.10 OPERATION, INSERTION AND REMOVAL (LEVERING-IN VERSION)

5.10.1 OPERATIONAL POSITIONS (LEVERING-IN VERSION)

The breaker has four basic operational positions:

1. Breaker withdrawn from cell. In the “withdrawn” position the breaker is out of the cell. The levering handle is not required for this position. 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. Breaker in the cell in the disconnect position. (Figure 5.1) As the breaker is pushed into the cell it will reach a position where all four wheels are on the cell floor guide rails and the floor spring discharge interlock has not activated. (For Canadian breakers the interlock plunger will rest in the first cell position.) This is the “disconnect” position and the breaker can be manually operated because there is no interface of the cell floor interlocks with breaker interlock linkage. No cell labeling is provided to verify this position.

3. Breaker in the test position. (Figure 5.2) The “test” position is achieved when the breaker has advanced into the cell from the disconnect position and the audible click of the lock engaging the interlock rail has been observed. (For Canadian breakers, the interlock plunger will rest in the second cell position.) The test position can be verified by the inability to move the breaker in or out, the Interlock Pedal is in the up position, and the cell label “test” is visible on the floor of the cell in front of the breaker’s left front wheel.

4. Breaker in the connect position. (Figure 5.4) The “connect” position is achieved by moving the breaker into the cell using the levering handle until a mechanical stop is reached. As the breaker is advanced from the test position, 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 the inability to move the breaker in or out, and the cell label “operating” is visible on the floor of the cell in front of the breaker’s left front wheel. The breaker is now ready for service.

**WARNING**

DO NOT USE ANY TOOL TO LEVER THE BREAKER FROM TEST OR CONNECTED POSITION OTHER THAN THE LEVERING HANDLE.

5.10.2 INSERTION PROCEDURE (LEVERING-IN VERSION)

a. Place the breaker in the withdrawn position. In the “withdrawn” position the breaker is out of the cell. The levering handle is not required for this position. The breaker can be operated in this position and extreme care should be exercised to avoid inadvertent operation and possible injury or equipment damage.

**WARNING**

THE BREAKER CAN BE OPERATED IN THE WITHDRAWN POSITION AND EXTREME CARE SHOULD BE EXERCISED TO AVOID INADVERTENT OPERATION AND POSSIBLE INJURY OR EQUIPMENT DAMAGE.

b. From the withdrawn position, align the center groove of the breaker wheels with the guide rails of the cell.

c. 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.
d. Push the circuit breaker into the cell until all the wheels are on the guide rails and the spring discharge linkage has not cycled. (For Canadian breakers, the interlock plunger will rest in the first cell position.) No mechanical stop will be reached. This is the “disconnect” position and the breaker can still be operated because there is no interface of the cell floor interlocks with breaker interlock linkage. No cell labeling is provided to verify this position.

e. Depress the pedal and push or lever the breaker further into the cell. (Figure 5.3)

Note: Depressing of the Interlock Pedal automatically positions the motor cutoff switch to “off”.

f. Once movement has started, the Interlock Pedal should be released if depressed. The levering handle may be required to move the breaker completely into the test position and its use is illustrated in Figure 5.3. An audible click of the interlock plunger engaging the interlock rail will be observed when moving from the disconnect position. The Interlock Pedal will travel down at the beginning of movement and rapidly rise to lock the breaker in the test position at the end of the normal travel from disconnect to test. The movement of the handle provides an open signal that remains throughout all intermediate breaker positions and the floor trip will be combined with a closing signal between the disconnect and test position to discharge the closing springs. The breaker remains in the trip-free state until the test position is reached. The test position can be verified by the inability to move the breaker in or out, the Interlock Pedal is in the up position, and the cell label “test” is visible on the floor of the cell in front of the breaker’s left front wheel.

g. (Domestic Version) In the “test” position, the breaker can be operated manually and electrically, thus allowing maintenance tests or checks. To operate the breaker electrically, the secondary control block must be engaged at this time. The slider is located on the lower right hand area of the circuit breaker frame. If electrical testing is desired at this stage, engage the secondary control block slider by releasing the slide latch and pushing the slider toward the rear several inches. Push firmly on the front side of the slider until the contact block engages with the corresponding cell receptacle. Return the manual motor cutoff switch to the “on” position. The spring charging motor will begin to run and charge the closing springs. The breaker is now in the “test” position, with control voltage applied, and ready for electrical or manual testing.

h. To install the breaker in the connected position the levering handle will have to be used. Insure the breaker is open and engage the levering handle with the breaker and floor levering cutouts. (See Figure 5.5)

i. Depress the Interlock Pedal and start levering in the breaker by shifting the levering handle back and forth. Once movement has started, the pedal should be released. 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). At this point any attempt to mechanically close the breaker will cause a trip-free operation with no recharging of the closing springs (PS2 has open-circuited the charging motor circuit and the Interlock Pedal operation has automatically turned the motor cutoff switch to “off”). As advancement into the cell continues, the primary voltage source shutters will open allowing the breaker stabs to engage with the source.

j. Continue moving the breaker into the cell using the levering handle from the test position until a mechanical stop is reached. This is the fully engaged or connected position. The connect position can be verified by the inability to move the breaker in or out, the Interlock Pedal is up and has released the trip mechanism, and the cell label “operating” is visible on the floor of the cell in front of the breaker’s left front wheel. Manually return the motor cutoff switch to the “on” position. The breaker is now ready for service.

5.10.3 REMOVAL PROCEDURE (LEVERING-IN VERSION)

To remove the breaker from the cell it must be in the open position. Insure the breaker is open and engage the levering handle. The Interlock Pedal must be depressed which will raise the trip mechanism and trip the breaker. Move the breaker out using the levering handle illustrated in Figure 5.5. The breaker will start coming out of the cell before the main stabs are disconnected and will be in a non-operable mode and will go through a trip-free operation if any attempt to close it is made in the intermediate position. Also, the secondary control block will disengage automatically before the main stabs are disconnected.

Note: (Canadian Version) The secondary block will remain connected until the breaker is removed from the test position. The shutters will close after the main stabs have cleared, isolating the breaker from its source. Continue levering out until the position indicator on the floor of the cell shows test and the Interlock Pedal rises to lock the breaker in position. At this time you are in the test
position and the trip mechanism is released, allowing the breaker to be operated either electrically or mechanically. If you desire to electrically open or close the breaker in the test position, the secondary control block must be re-engaged and the manual motor cutoff switch turned “on”.

To remove the breaker from the test position to the disconnect position, the breaker must be tripped if closed, the Interlock Pedal must be depressed, and the secondary contact block should be disengaged. When moving out of the test position, a floor close signal will combine with the trip signal from the Interlock Pedal to force a trip-free condition. This will cause the charging springs to discharge leaving the breaker in the open position and the closing springs discharged. The breaker is in a non-operable state.

Once the breaker is withdrawn past the floor trip activation area, it is in the disconnected position. The levering handle should be removed at this point. The breaker is ready to be removed from the cell if desired.

Note: For Canadian breakers, the interlock plunger will engage in the disconnect position in the interlock rail on the cell floor.

5.11 OPERATION, INSERTION, AND REMOVAL FOR 5kV AND 15kV MODELS WITH ROTARY RACKING PROVISIONS

5.11.1 Operational Positions (Domestic and some Canadian Rotary Racking Versions)

The breaker has three basic operational positions:

(1) Breaker withdrawn from the circuit breaker compartment (cell) in “disconnect” position.
(2) Breaker in the cell in the “disconnect/test” position.
(3) Breaker in the “connect” position.

Note: Some Canadian versions of the DST-2 have four operational positions, they have a “withdrawn”; a “disconnect”, a “test”; and a “connect” position. These versions have one mechanical stop “disconnect” and one for test unlike all US versions which have a common Disc/Test position. The “disconnect/test” and “connect” positions can be verified by the breaker position indicator shown in Figure 5.5.

5.11.2 5kV Insertion Procedure (DST-2-5-VR+ 250, Domestic and Canadian Rotary Racking Version)

a. Verify that the circuit breaker racking system is in the fully withdrawn position. This is an important step, as breaker maintenance outside the breaker compartment may have required that the rotary racking be positioned so that the circuit breaker could be closed. It must be returned to the fully withdrawn condition prior to insertion in the circuit breaker compartment.

Figure 5.5. Rotary Racking Breaker Position Indicator

b. From the withdrawn position, align the center groove of the breaker wheels with the guide rails of the cell.

c. 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.

Note: The motor cutoff switch is located on the lower cover where it can be easily accessed (See Figure Set 3.3). Position the switch to “OFF” before inserting the breaker into the cell.

d. Push the circuit breaker into the cell until the mechanical stop is reached; this will be indicated by an audible click. At this point, the mechanical stop has fallen in the front slot of the guide rail. In this position, the breaker can be operated. This position can also be verified by noting that the foot petal moves upward as the mechanical stop drops. When the interlock foot petal moves up, it also exposes the racking screw hex head.

Note: For Canadian versions with separate “disconnect” and “test” positions, it will be necessary to step on the racking interlock pedal and push the circuit breaker to the next mechanical stop. At that mechanical stop, the circuit breaker is in the “test” position. Provisions in the racking system prevent the circuit breaker from being pushed beyond this mechanical stop even when the interlock pedal is depressed; any additional movement toward the “connect” position must be achieved with the rotary racking feature. With the circuit breaker in the “test” position, item (e.) below can be performed.

e. In the “Disc/Test” position, the breaker can be operated manually and electrically, thus allowing maintenance tests or checks. To operate the breaker electrically, the secondary control block must be engaged at this time. The slider is located on the lower right hand area of the circuit breaker frame. If electrical testing is desired at this stage, engage the secondary control block slider by releasing the slide latch and pushing the slider forward the rear several inches. Push firmly on the front side of the slider until the contact block engages with the corresponding cell receptacle. Return the manual motor cutoff switch to the “on” position. The spring charging motor will begin to run and charge the closing spring. The breaker is now in the “test” position, with control voltage applied, and ready for electrical or manual testing.

f. From the “Disc/Test” position, the circuit breaker can be advanced to the “connect” position. It is NOT necessary to step on the racking interlock pedal when the circuit breaker is in this position. Place the rotary racking handle onto the rotary racking hex head. Turn the rotary racking handle clockwise until the “connect” position is reached and the handle can no longer be turned, as indicated on the switchgear floor mounted breaker position indicator, Figure 5.5. Do not force the rotary racking handle beyond this point as breaker damage will occur.
5.11.3 5kV Removal Procedure (DST-2-5-VR+ 250, Domestic and Canadian Rotary Racking Version)

a. To remove the circuit breaker from the cell, verify that the breaker is in the "OPEN" position and the motor cutoff switch is in the "OFF" position. Place the rotary racking handle on the rotary racking hex head. Rotating the racking handle counterclockwise to move the circuit breaker from the "connect" position to the "Disc/Test" position. As the circuit breaker leaves the "connect" position, the shutters will start to close after the primary disconnects have cleared, isolating the breaker from the line and load connections. Continue rotating the racking handle counterclockwise until the position indicators on the breaker indicate the "Disc/Test" position and it is not possible to turn the racking handle with normal force. (Damage to the circuit breaker will occur if the racking handle is forced counterclockwise beyond this point of resistance.) In this position, the secondary disconnect control power connections can be reconnected so the breaker can be operated either electrically or manually. Remove the racking handle prior to performing and breaker tests.

Note: For Canadian versions with separate "disconnect" and "test" positions, it will stop first at the "test" position. Electrical and mechanical tests of the circuit breaker can be performed in this position. Remove the racking handle prior to performing any breaker test.

b. If the circuit breaker is to be withdrawn from the cell, remove the rotary racking handle, and depress the interlock petal while pulling the breaker out of the circuit breaker compartment using the handles on the front of the breaker.

Note: For Canadian versions with separate "disconnect" and "test" positions, it will be necessary to remove the racking handle, step on the interlock petal and pull the circuit breaker to the next mechanical stop. At that mechanical stop, the circuit breaker is in the "disconnect" position. Stepping on the interlock petal again will release the circuit breaker so that it can be pulled to the fully withdrawn position and out of the circuit breaker compartment.

c. During this travel from the "Disc/Test" position, the circuit breaker closing springs will discharge automatically with a loud noise similar to the noise made when the circuit breaker is closed. At this point, the breaker will be open with the springs discharged.

Note: If through-the-door racking is desired, the cell door must be modified by cutting a hole in it which aligns with the rotary racking hex head. A sub-cover must also be installed to block access to the racking hex head until required. Even with this modification, it will be necessary to position the circuit breaker compartment door open. Only after doing that, can closed door racking be performed from the "test" position to the "connect" position. The motor disconnect switch can be accessed while the door is open for racking be performed from the "test" position to the "connect" position. It is NOT necessary to step on the racking unlock petal and pull the breaker out of the circuit breaker compartment using the handles on the front of the breaker.

d. Push the circuit breaker into the cell until the mechanical stop is reached; this will be indicated by an audible click. At this point, the front plunger has fallen in the front slot of the guide rail. In this position, the breaker can be operated. This position can also be verified by noting that the foot petal moves upward as the mechanical stop drops into the slot in the floor mounted rail. The racking hex head access handle is also released so that it can be raised for rotary racking. (Figure 5.5)

Note: For Canadian versions with separate "disconnect" and "test" positions, it will be necessary to step on the racking unlock petal and push the circuit breaker to the next mechanical stop. At that mechanical stop, the circuit breaker is in the "test" position. Provisions in the racking system prevents the circuit breaker from being un-latched and pushed beyond this mechanical stop, any additional movement toward the "connect" position must be achieved with the rotary racking feature. With the circuit breaker in the "test" position, item (e. below) can then be performed.

e. In the "Disc/Test" position, the breaker can be operated manually and electrically, thus allowing maintenance tests or checks. To operate the breaker electrically, the secondary control block must be engaged at this time. The slider is located on the lower right hand area of the circuit breaker frame. If electrical testing is desired at this stage, engage the secondary control block slider by releasing the slide latch and pushing the slider toward the rear several inches. Push firmly on the front side of the slider until the contact block engages with the corresponding cell receptacle. Return the manual motor cutoff switch to the "ON" position. The spring charging motor will energize and charge the closing spring. The breaker is now in the "Test" position, with control voltage applied, and ready for electrical or manual testing.

⚠️ NOTICE

ONCE THE SECONDARY DISCONNECT BLOCK IS ENGAGED IN THE "TEST" POSITION, IT WILL REMAIN CONNECTED THROUGHOUT FURTHER INWARD MOVEMENT AS THE BREAKER ADVANCES FROM THE "DISC/TEST" TO THE "CONNECT" POSITION.

THE SPRING CHARGING MOTOR WILL ENERGIZE, IF THE MOTOR CUT-OFF SWITCH IS IN THE "ON" POSITION (FIGURE SET 3.3), AND CHARGE THE CLOSING SPRINGS AS THE SECONDARY CONNECTION IS MADE AS LONG AS CONTROL POWER IS AVAILABLE.

f. From the "Disc/Test" position, the breaker can be advanced to the "connect" position. It is NOT necessary to step on the racking unlock foot petal when the circuit breaker is in this position. Lift the racking access handle by pulling it up and over to the right to gain access to the racking hex head. (This step must be performed prior to closed door racking.) The handle will be retained allowing full exposure of the racking hex head. Place the rotary racking handle onto the rotary racking hex head. Turn the rotary racking handle clockwise until the "connect" position is reached and the handle can no longer be turned, as indicated on the switchgear floor mounted breaker position indicator, Figure 5.6. Do not force the rotary racking handle beyond this point as breaker damage will occur.

Figure 5.6. Lifting Racking Access Handle

5.11.4 15kV Insertion Procedure (DST-2-15-VR+ 500/750 Domestic and Canadian Rotary Racking Version)

a. Verify that the circuit breaker racking system is in the fully withdrawn position. This is an important step, as breaker maintenance outside the breaker compartment may have required that the rotary racking be racked-in so that the circuit breaker could be closed. It must be returned to the fully withdrawn condition prior to insertion in the circuit breaker compartment.

b. From the withdrawn position, align the center groove of the breaker wheels with the guide rails of the cell.

c. Check that the closing spring status is located on the lower cover where it can be easily accessed (See Figure Set 3.3). Position the switch to "OFF" before inserting the breaker into the cell.

d. Push the circuit breaker into the cell until the mechanical stop is reached; this will be indicated by an audible click. At this point, the front plunger has fallen in the front slot of the guide rail. In this position, the breaker can be operated. This position can also be verified by noting that the foot petal moves upward as the mechanical stop drops into the slot in the floor mounted rail. The racking hex head access handle is also released so that it can be raised for rotary racking. (Figure 5.5)
5.11.5 15kV Removal Procedure (DST-2-15-VR+ 500/750

Domestic and Canadian Rotary Racking Version)

a. To remove the circuit breaker from the cell, verify that the breaker is in the “OPEN” position and the motor cutoff switch is in the “OFF” position. Verify that the rotary racking access handle is in the retaining slot. (That handle would have been placed there at the time prior to racking the circuit breaker to the “connect” position.) Place the rotary racking handle on the rotary racking hex head. Rotate the racking handle counter-clockwise to move the circuit breaker from the “Connect” position to the “Disc/Test” position. As the circuit breaker leaves the “Connect” position, the shutters will start to close after the primary disconnects have cleared, isolating the breaker from the line and load connections. Continue rotating the racking handle counter-clockwise until the position indicators on the breaker indicate the “Disc/Test” position and it is not possible to turn the racking handle with normal force. (Damage to the circuit breaker will occur if the racking handle is forced counter-clockwise beyond this point of resistance.) In this position, the secondary disconnect control power connections remain connected so the breaker can be operated either electrically or mechanically. Remove the racking handle prior to performing any breaker tests. **Lift the racking access handle and move it to the left allowing it to drop so that the racking screw hex head is covered. This is a very important step as it unlocks the foot-operated interlock petal to allow complete withdrawal of the circuit breaker.**

**Note:** For Canadian versions with separate disconnect and test positions, it will stop at the “test” position. Electrical and mechanical tests of the circuit breaker can be performed in this position. Remove the racking handle and reposition the racking handle as instructed above prior to performing any breaker tests.

b. If the circuit breaker is to be withdrawn from the cell, depress the foot-operated interlock petal while pulling the breaker out of the circuit breaker compartment using the handles on the front of the breaker.

**Note:** For Canadian versions with separate “disconnect” and “test” positions, when stepping on the interlock petal and pulling the breaker out, it will stop at another mechanical stop. The circuit breaker is now in the “disconnect” position. Stepping on the interlock petal again will permit the final release of the circuit breaker so that it can be pulled to the fully withdrawn position and out of the circuit breaker compartment.

c. During this travel from the “Disc/Test” position, the circuit breaker closing springs will discharge automatically with a loud crashing noise. At this point, the breaker will be open with the springs discharged.

**Note:** If through-the-door racking is desired, the cell door must be modified by cutting a hole in it which aligns with the rotary racking hex head. A sub-cover must also be installed to block access to the racking hex head until required. Even with this modification, it will be necessary to position the circuit breaker in the “Disc/Test” (or “Test” position on some Canadian versions) with the circuit breaker compartment door open. Only after doing that, can closed door racking be performed from the “test” position to the “connect” position. The motor disconnect switch can be accessed while the door is open for installation or removal process, or flipped on or off with the racking handle.
SECTION 6: INSPECTION & MAINTENANCE

⚠️ DANGER

DO NOT WORK ON A CIRCUIT BREAKER IN THE 'CONNECT' POSITION.

DO NOT WORK ON A CIRCUIT BREAKER WITH SECONDARY DISCONNECTS ENGAGED.

DO NOT WORK ON A CIRCUIT 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.

STAND AT LEAST ONE METER AWAY FROM THE CIRCUIT BREAKER WHEN TESTING FOR VACUUM INTEGRITY.

6.1 INSPECTION FREQUENCY

The scheduled maintenance interval for the VR-Series+ circuit breaker is once every ten years or ten thousand operations, whichever comes first when applied in normal applications as defined by IEEE C37.04-1999. However, if the circuit breaker is operating in a high level of natural elements or in a corrosive environment, inspection should be performed twice each year. The circuit breaker should also be inspected and a vacuum interrupter integrity test performed (Section 6.3) any time the circuit breaker is transported to another physical location or switchgear assembly. In addition, the circuit breaker should have a full inspection if the circuit breaker interrupts a fault current.

Note: Refer to the table below for maintenance and inspection check points.

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 with lint-free cloth</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No cracking</td>
<td>Visual check</td>
<td>Replace cracked unit</td>
</tr>
<tr>
<td>Vacuum Integrity</td>
<td>Between main circuit with terminals ungrounded</td>
<td>Withstand 27kV 60Hz for 1 Minute</td>
<td>Hi-pot 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 (5kV Rating)</td>
<td>Hi-pot Tester</td>
<td>Clean and retest or replace</td>
</tr>
<tr>
<td>Control circuit to ground (Charging Motor disconnected)</td>
<td>Withstand 1125V, 60Hz for 1 Minute</td>
<td>Hi-pot Tester</td>
<td>Clean and retest or replace</td>
<td></td>
</tr>
<tr>
<td>2. Power Element</td>
<td>Vacuum Interrupter Assembly</td>
<td>Contact erosion visibility</td>
<td>Visual - Close the circuit breaker and look for “T” cutout on Vacuum Interrupter Assembly (See Figure 6.1 and 6.2)</td>
<td>If cutout is not visible, replace Vacuum Interrupter Assembly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contact wipe visible</td>
<td>Visual (Figure 6.1 and 6.2)</td>
<td>Replace Vacuum Interrupter Assembly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adequate vacuum</td>
<td>See Section 6.3</td>
<td>Replace Vacuum Interrupter Assembly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dirt on ceramic body</td>
<td>Visual check</td>
<td>Clean with dry lint-free cloth</td>
</tr>
<tr>
<td>Primary Disconnects</td>
<td>No burning or damage</td>
<td>Visual check</td>
<td>Replace if burned, damaged or eroded</td>
<td></td>
</tr>
<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 circuit breaker twice</td>
<td>Replace any defective device - Identify per Trouble-Shooting Chart</td>
</tr>
<tr>
<td></td>
<td>Wiring</td>
<td>Securely tied in proper place</td>
<td>Visual check</td>
<td>Repair or tie as necessary</td>
</tr>
<tr>
<td></td>
<td>Terminals</td>
<td>Tight</td>
<td>Visual check</td>
<td>Tighten or replace if necessary</td>
</tr>
<tr>
<td></td>
<td>Motor</td>
<td>Smooth and correct operation by control power</td>
<td>Test closing and tripping of the circuit breaker twice</td>
<td>Replace brushes or motor</td>
</tr>
<tr>
<td></td>
<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>
</tr>
<tr>
<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>
</tr>
<tr>
<td></td>
<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>
</tr>
<tr>
<td></td>
<td>CloSure™ Test</td>
<td>≥ 0.6 inch over travel</td>
<td>CloSure™ Test 6.8.1</td>
<td>If &lt; 0.6 Contact the PBC at 1-877-276-9379</td>
</tr>
</tbody>
</table>

Note: Contact Eaton for any mechanism maintenance other than adjustment or replacement of control components.

<table>
<thead>
<tr>
<th>BOLT SIZE</th>
<th>TORQUE Lbs. In.</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 - 32</td>
<td>24</td>
</tr>
<tr>
<td>10 - 32</td>
<td>36</td>
</tr>
<tr>
<td>25 - 20</td>
<td>72</td>
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<td>31 - 18</td>
<td>144</td>
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<tr>
<td>38 - 16</td>
<td>300</td>
</tr>
<tr>
<td>50 - 13</td>
<td>540</td>
</tr>
</tbody>
</table>

Failure to follow any of these instructions may cause death, severe personal injury, equipment damage and/or improper operation. See Section 2 - Safe Practices for more information.
6.3 VACUUM INTERRUPTER INTEGRITY TEST

Vacuum interrupters used in Type VR-Series circuit breakers are highly reliable interrupting components. 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 warnings 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 CIRCUIT BREAKER.

DC HI-POTENTIAL TESTS ARE NOT RECOMMENDED BY EATON. DO NOT APPLY DC AT ANY LEVEL TO VR-SERIES CIRCUIT BREAKERS

With the circuit 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 circuit 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 circuit 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.

The current delivery capability of 25 mA ac applies when all three vacuum interrupters are tested in parallel. If individual vacuum interrupters are tested, current capability may be one third of this value.

Table 6.1. Vacuum Interrupter Integrity Test Voltage

<table>
<thead>
<tr>
<th>Circuit Breaker Rated Maximum Voltage</th>
<th>Vacuum Interrupter Integrity Test Voltage ac 60Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to and including 15.0 kV</td>
<td>27 kV</td>
</tr>
</tbody>
</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, or high numbers of operations, it is possible for a minimal amount of erosion on the contact surfaces. It is also possible for further compaction of the conductor electrodes that has been known to reduce the amount of contact wipe. The VR-Series vacuum interrupter assembly incorporates both the original vacuum interrupter erosion indicator and the contact-spring wipe into one all-encompassing indicator. The adequacy of the remaining contact erosion and wipe can easily be determined by observing the vacuum interrupter side of the operating rod assembly on a closed circuit breaker. The procedure to determine the adequacy of the “T” cutout on the vacuum interrupter assembly is depicted in Figures 6.1 and 6.2. Some configurations may require the use of a small mirror and flashlight to clearly see the “T” cutout. As long as any part of the “T” cutout is visible on each pole unit, the contact surfaces and spring pressure are adequate for the circuit breaker to interrupt its full rated nameplate short circuit and carry continuous current without over-heating. If the wipe is inadequate (no part of the “T” cutout is visible) then the vacuum interrupter assembly must be replaced. Field adjustment is not possible.

**WARNING**

FAILURE TO REPLACE A VACUUM INTERRUPTER ASSEMBLY WHEN THE “T” CUTOUT IS NOT VISIBLE WILL CAUSE THE CIRCUIT BREAKER TO FAIL TO INTERRUPT AND THEREBY CAUSE PROPERTY DAMAGE OR PERSONAL INJURY.

Figure 6.1. The Arrow Shows The “T” Contact Wipe Indicator - (If the “T” or any portion of its visible as shown with the circuit breaker closed, the wipe is satisfactory)(See next figure for graphic of all possibilities)

Figure 6.2. Wipe Indication Procedure (Performed Only With Circuit Breaker Closed)
6.5 INSULATION
In VR-Series® circuit 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 circuit 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 circuit breaker. For the circuit breakers rated 4.76 kV the test voltage is 15 kV RMS, 60 Hz. Conduct the test as follows:

Close the circuit breaker. Connect the high potential lead of the test machine to one of the poles of the circuit breaker. Connect the remaining terminals and circuit 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 circuit breaker. Connect the high potential lead of the test machine to one of the terminals of the circuit breaker. Connect the remaining terminals and circuit 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.

SECONDARY CIRCUIT:
Isolate the motor by disconnecting the two motor leads from the terminal block. Connect all points of the secondary disconnect contact pins with a shooting wire. Connect this wire to the high potential lead of the test machine. Ground the circuit breaker contact pins with a shooting wire. Connect this wire to the high potential lead of the test machine. Connect the remaining terminals and circuit 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. 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.

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 circuit breaker compartment
  - Close the circuit 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% as stated in IEEE C37.09. Factory test levels are recorded on the circuit breaker test form, which is included with the circuit breaker. If measurements exceed 200%, contact the manufacturer.

6.8 VR-SERIES® CIRCUIT BREAKER ELEMENT 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 circuit breaker components. Operate the circuit 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.

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 circuit breaker contacts fully. It provides a quantitative measure of the extra energy available in terms of over travel in inches to close the circuit 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 6.2.) If the CloSure™ travel obtained is as specified, the mechanism performance is satisfactory. If the CloSure™ travel does not conform as shown in Figure 6.14, contact Eaton's Electrical Services & Systems for further information. (See Step 13).

⚠️ DANGER
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.

Safety Precautions: Read and understand these instructions before attempting any maintenance, repair or testing on the circuit breaker. The user is cautioned to observe all recommendations, warnings and cautions relating to the safety of personnel and equipment.

Note: Hearing protection is recommended as the circuit breaker is opened and closed.

The recommendations and information contained herein are based on Eaton experience and judgment, but should not be considered to be all-inclusive or covering every application or circumstance which may arise. If further information is required, you should consult Eaton's Electrical Services & Systems.

Testing Procedures: Assuming that the circuit breaker is safely removed from the circuit breaker compartment enclosure and positioned in an area outside the arc fault boundary, follow this procedure to perform the CloSure™ test. For further instructions on removal of the circuit breaker from the circuit breaker compartment, refer to the appropriate section of this manual.
Figure 6.3. Status Indicators ("A" shows the spring indication and "B" shows the contact status indication.)

Step 1 - On the front cover, identify the status indicators. Confirm the closing spring status indicates ‘Discharged’ and the main contact indicator shows ‘Open’ (Figure 6.3).

Step 2 - Remove the circuit breaker front cover. Be sure to save the original fasteners for reassembly.

Step 3 - Charge the circuit breaker, close the circuit breaker, then open the circuit breaker. Alternately depress the Open and Close clappers a few times to ensure the circuit breaker is completely discharged.

Step 4 - Cut a piece of one inch wide drafting / masking tape approximately 8 to 10 inches long.

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 6.4).

Figure 6.4. Wrapping Tape Around Cam

Step 6 - Mount the transparent CloSure™ Test Tool (Figure 6.5.b) with two bolts and washers. Refer to Figure 6.5.a 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 6.7 and 6.11. 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 6.6).

Figure 6.5.a. Attaching CloSure™ Test Tool

Figure 6.5.b. Front View of CloSure™ Tool Showing Mounting / Testing Hole Locations (6352C49H01)

A-1 ○
A-2 ○
A-3 ○ C-1 ↓ C-4 C-5 C-6
A-4 ○ ○ ○ ○
B-1 ○
B-2 ○

Table 6.2. CloSure™ Tool Mounting / Testing Locations by Circuit Breaker Type

<table>
<thead>
<tr>
<th>CIRCUIT BREAKER DESIGNATION</th>
<th>APPROXIMATE MECHANISM CHASSIS WIDTH (INCH)</th>
<th>LOWER MOUNTING HOLE</th>
<th>LOWER MOUNTING HOLE</th>
<th>MARKER PLACEMENT HOLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>VR-Series +</td>
<td>18</td>
<td>A1</td>
<td>B2</td>
<td>C1</td>
</tr>
</tbody>
</table>

Step 9 - Place the marker back in the hole. While holding the marker tip against the tape, close the circuit breaker (Figure 6.8). Remove the marker from the hole.

Step 10 - While closely observing the pole shaft at the left side of the circuit breaker (Figure 6.9), 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 tape or paper (Figures 6.12 and 6.13).

Step 14 - Evaluate the CloSure™ performance by comparing the test tape with the illustration in Figure 6.14. Measure the over travel "X". If "X" is greater than or equal to 0.6", the circuit breaker performance is satisfactory. If "X" is less than 0.6", this indicates a problem with the circuit breaker - consult the Power Breaker Center for technical support.

Step 15 - Reassemble the front cover onto the circuit breaker. Return the circuit breaker to its original configuration and setup.
Figure 6.10. Move the Sharpie® 15° Left and Right

Figure 6.11. Top view of Cam and Marker Interface

Figure 6.12. Evaluate the CloSure™ Performance

Figure 6.13. Determining the Distance Traveled

Figure 6.14. Illustrative Testing Tape Sample

*Note: Use the center of the marker diameter to determine “X” distance

*Figure not to scale
6.9 MAINTENANCE RECOMMENDATION

The VR-Series+ circuit breaker is lubricated during assembly with a long lasting synthetic lubricant. When applied in “usual service conditions” as defined by IEEE C37.04-1999, the VR-Series+ circuit breaker element requires maintenance only once every ten years or ten thousand operations, which ever comes first.

After a ten year service interval or when ten thousand operations have been reached, contact your local Eaton representative to arrange for factory recertification.

During the ten year service interval, no supplemental lubrication with light machine oil is recommended. Machine oil may be incompatible with the advanced lubricant in the VR-Series+ vacuum replacement circuit breaker and will damage the components of the stored energy mechanism.
### DST-2-VR+ Replacement Circuit Breaker

#### 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>
<tr>
<td>Closing Springs Not Charged</td>
<td>Control Circuit</td>
<td>• Control Power (Fuse blown or switch off)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Secondary Disconnect Contacts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Motor Cut-off Switch (Poor or burned contacts. Lever not operational.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Terminals And Connectors (Poor or burned contacts)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Motor (Brushes worn or commutator segment open)</td>
</tr>
<tr>
<td>Mechanism</td>
<td></td>
<td>• Pawls (Slipping or broken)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Ratchet Wheel (Teeth worn or broken)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Cam Shaft Assembly (Sluggish or jammed)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Oscillator (Reset Spring off or broken)</td>
</tr>
<tr>
<td>Closing Springs Not Charged</td>
<td>Control Circuit</td>
<td>• Control Power (Fuse blown or switch off)</td>
</tr>
<tr>
<td>Circuit Breaker Does Not Close</td>
<td>(Close Coil does not pick up)</td>
<td>• Secondary Disconnect Contacts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Anti Pump Relay (Y Relay N.C. contact open or burned or relay picks up)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Close Coil (Open or burned)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Latch Check Switch (Contact open - Bad switch or trip bar not reset)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Auxiliary Switch (B Contact open or burned)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Motor Cut-Off (Contacts open or burned)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Trip Coil Assembly (Clapper fails to reset)</td>
</tr>
<tr>
<td>Closing sound but no close</td>
<td></td>
<td>• Pole Shaft (Not open fully)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Trip Latch Reset Spring (Damaged or missing)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Trip Bar-D Shaft (Fail to remain reset)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Trip Latch-Hatchet (Fails to remain reset)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Trip Floor Tripper (Fails to remain reset)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Close Latch (Binding)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Close Latch Roller (Binding)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Trip Circuit Energized</td>
</tr>
<tr>
<td><strong>UNDESIRABLY CLOSES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Circuit</td>
<td></td>
<td>• Close Circuit (CS/C getting shorted)</td>
</tr>
<tr>
<td>Mechanism</td>
<td></td>
<td>• Close Release Latch (Fails to reset)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Close Floor Tripper (Fails to reset)</td>
</tr>
<tr>
<td><strong>FAILS TO CLOSE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Trip Sound</td>
<td>Control Circuit</td>
<td>• Control Power (Fuse blown or switch off)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Secondary Disconnect Contacts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Auxiliary Switch (A contact not making poor or burned)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Trip Coil (Burned or open)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Terminals and connections (Poor or burned or open)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Trip Clapper (Jammed)</td>
</tr>
<tr>
<td>Trip Mechanism</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trip Sound But No Trip</td>
<td>Trip Mechanism</td>
<td>• Trip Bar, Trip Latch (Jammed)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Pole Shaft (Jammed)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Operating Rod Assembly (Broken or pins out)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vacuum Interrupter (One Or More Welded)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>UNDESIRABLY TRIPS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Circuit</td>
<td></td>
<td>• Control power (CS/T Switch, remains made)</td>
</tr>
<tr>
<td>Mechanism</td>
<td></td>
<td>• Trip Coil Clapper (Not resetting)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Trip Bar or Trip Latch (Poor engagement of mating or worn surfaces)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Trip Bar Reset Sprint (Loss of torque)</td>
</tr>
</tbody>
</table>
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 circuit 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 7.1 Common Replacement Parts - Descriptions and Style Numbers

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Voltage</th>
<th>Style Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ANTI-PUMP (Y) RELAY</td>
<td>(48Vdc)</td>
<td>94C9525H01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(125Vdc)</td>
<td>94C9525H02</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(250Vdc)</td>
<td>94C9525H03</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(120Vac)</td>
<td>94C9525H04</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(240Vac)</td>
<td>94C9525H05</td>
</tr>
<tr>
<td>2</td>
<td>RECTIFIER</td>
<td>Rectifier</td>
<td>94C9525G09</td>
</tr>
<tr>
<td>3</td>
<td>SPRING CHARGING MOTOR</td>
<td>(48Vdc)</td>
<td>94C9525G10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(125Vdc)</td>
<td>94C9525G11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(250Vdc / 240Vac)</td>
<td>94C9525G12</td>
</tr>
<tr>
<td>4</td>
<td>AUXILIARY SWITCH</td>
<td>Circuit Breaker</td>
<td>94C9525G13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Auxiliary Switch</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>POSITION SWITCH</td>
<td>Circuit Breaker</td>
<td>94C9525H06</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Position Switch</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PS1</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>POSITION SWITCH</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Circuit Breaker</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Position Switch</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PS2</td>
<td>94C9525H07</td>
</tr>
<tr>
<td>7</td>
<td>LATCH CHECK SWITCH</td>
<td>Latch Check Switch</td>
<td>94C9525H08</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(LC)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>MOTOR CUTOFF SWITCHES</td>
<td>(LS)</td>
<td>94C9525G15</td>
</tr>
<tr>
<td>9</td>
<td>SPRING RELEASE COILS / SHUNT TRIPS</td>
<td>24Vac</td>
<td>94C9525G16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24Vac</td>
<td>94C9525G17</td>
</tr>
<tr>
<td></td>
<td></td>
<td>125Vac / 120Vac</td>
<td>94C9525G18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>250Vac / 240Vac</td>
<td>94C9525G19</td>
</tr>
<tr>
<td>10</td>
<td>CONTROL COMPONENTS KIT</td>
<td>48Vac</td>
<td>94C9525G01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>125Vac</td>
<td>94C9525G02</td>
</tr>
<tr>
<td></td>
<td></td>
<td>250Vac</td>
<td>94C9525G03</td>
</tr>
<tr>
<td></td>
<td></td>
<td>120Vac-C/M 48Vac-T</td>
<td>94C9525G04</td>
</tr>
<tr>
<td></td>
<td></td>
<td>240Vac-C/M 48Vac-T</td>
<td>94C9525G05</td>
</tr>
<tr>
<td></td>
<td></td>
<td>120Vac-C/M 120Vac-CT</td>
<td>94C9525G06</td>
</tr>
<tr>
<td></td>
<td></td>
<td>240Vac-C/M 240Vac-CT</td>
<td>94C9525G07</td>
</tr>
</tbody>
</table>