

# 5PV-VR & 15PV-VR Replacement Circuit Breaker



15PV-VR 500 1200A Shown



*Powering Business Worldwide*

**DISCLAIMER OF WARRANTIES AND LIMITATION OF LIABILITY**

The information, recommendations, descriptions and safety notations in this document are based on Eaton Corporation's ("Eaton") experience and judgment and may not cover all contingencies. If further information is required, an Eaton sales office should be consulted. Sale of the product shown in this literature is subject to the terms and conditions outlined in appropriate Eaton selling policies or other contractual agreement between Eaton and the purchaser.

THERE ARE NO UNDERSTANDINGS, AGREEMENTS, WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY, OTHER THAN THOSE SPECIFICALLY SET OUT IN ANY EXISTING CONTRACT BETWEEN THE PARTIES. ANY SUCH CONTRACT STATES THE ENTIRE OBLIGATION OF EATON. THE CONTENTS OF THIS DOCUMENT SHALL NOT BECOME PART OF OR MODIFY ANY CONTRACT BETWEEN THE PARTIES.

In no event will Eaton be responsible to the purchaser or user in contract, in tort (including negligence), strict liability or other-wise for any special, indirect, incidental or consequential damage or loss whatsoever, including but not limited to damage or loss of use of equipment, plant or power system, cost of capital, loss of power, additional expenses in the use of existing power facilities, or claims against the purchaser or user by its customers resulting from the use of the information, recommendations and descriptions contained herein. The information contained in this manual is subject to change without notice.

---

**⚠ WARNING**

---

**IMPROPERLY INSTALLING OR MAINTAINING THESE PRODUCTS CAN RESULT IN DEATH, SERIOUS PERSONAL INJURY OR PROPERTY DAMAGE.**

---

**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 BOOK SHOULD NOT BE CONSIDERED ALL INCLUSIVE REGARDING INSTALLATION OR MAINTENANCE PROCEDURES. IF FURTHER INFORMATION IS REQUIRED, YOU SHOULD CONSULT EATON'S ELECTRICAL SERVICES & SYSTEMS.**

---

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

---

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

---

**THESE VACUUM REPLACEMENT CIRCUIT BREAKERS ARE DESIGNED TO BE INSTALLED PURSUANT TO THE AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI). SERIOUS INJURY, INCLUDING DEATH, CAN RESULT FROM FAILURE TO FOLLOW THE PROCEDURES OUTLINED IN THIS MANUAL.**

---

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

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

## Contents

### Sections

INTRODUCTION . . . . .	4
SAFE PRACTICES . . . . .	6
RECEIVING, HANDLING, AND STORAGE . . . . .	7
DESCRIPTION AND OPERATION . . . . .	11
INSPECTION & INSTALLATION . . . . .	18
INSPECTION & MAINTENANCE . . . . .	22
REPLACEMENT PARTS . . . . .	30

## SECTION 1: INTRODUCTION

The purpose of this book is to provide instructions for receiving and handling, storage, installation, operation and maintenance of the Powell type 5PV & 15PV VR-Series circuit breaker. The Vacuum Replacement Circuit Breakers (also referred to as VR-Series) are designed to be used in existing 5PV & 15PV metal-clad switchgear and provide equal or superior electrical and mechanical performance as compared to the design ratings of the original circuit breaker. VR-Series Circuit Breakers provide reliable control, protection and performance, with ease of handling and maintenance. Like ratings are interchangeable with each other.

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

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

### **⚠ WARNING**

**SATISFACTORY PERFORMANCE OF THESE BREAKERS IS CONTINGENT UPON PROPER APPLICATION, CORRECT INSTALLATION AND ADEQUATE MAINTENANCE. THIS INSTRUCTION BOOK 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 A EATON CORPORATION TRAINED ENGINEER OR TECHNICIAN.**

**VR-SERIES 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'S ELECTRICAL SERVICES & SYSTEMS REPRESENTATIVE SHOULD BE CONTACTED.**

### 1.1 AVAILABLE 5PV-VR & 15PV-VR CIRCUIT BREAKERS

Refer to Table 1.

**Table 1.1 PV-VR Availability and Interchangeability**

Breaker Type	Nominal Voltage Class (kV)	Existing Breaker MVA Rating	Existing Breaker Rated Continuous Current at 60 Hz (Amps)	MVA Designation of VR-Series Breaker	Rated Voltage Factor K	Rated Withstand ANSI Test Voltage		Rated Short-Circuit kA RMS at Rated Max kV	Closing and Latching / Momentary Capabilities kA RMS/Peak
						Low Freq. kV RMS	Impulse kV Crest		
5PV-VR	4.16	250	1200	5PV-VR250	1.24	19	60	29	58 / 97
	4.16	350	1200	5PV-VR350	1.19	19	60	41	78 / 132
15PV-VR	7.2	500	1200	15PV-VR500	1.25	36	95	33	66 / 111
	13.8	500	1200	15PV-VR500	1.30	36	95	18	37 / 62
	13.8	750	1200	15PV-VR750	1.30	36	95	28	58 / 97

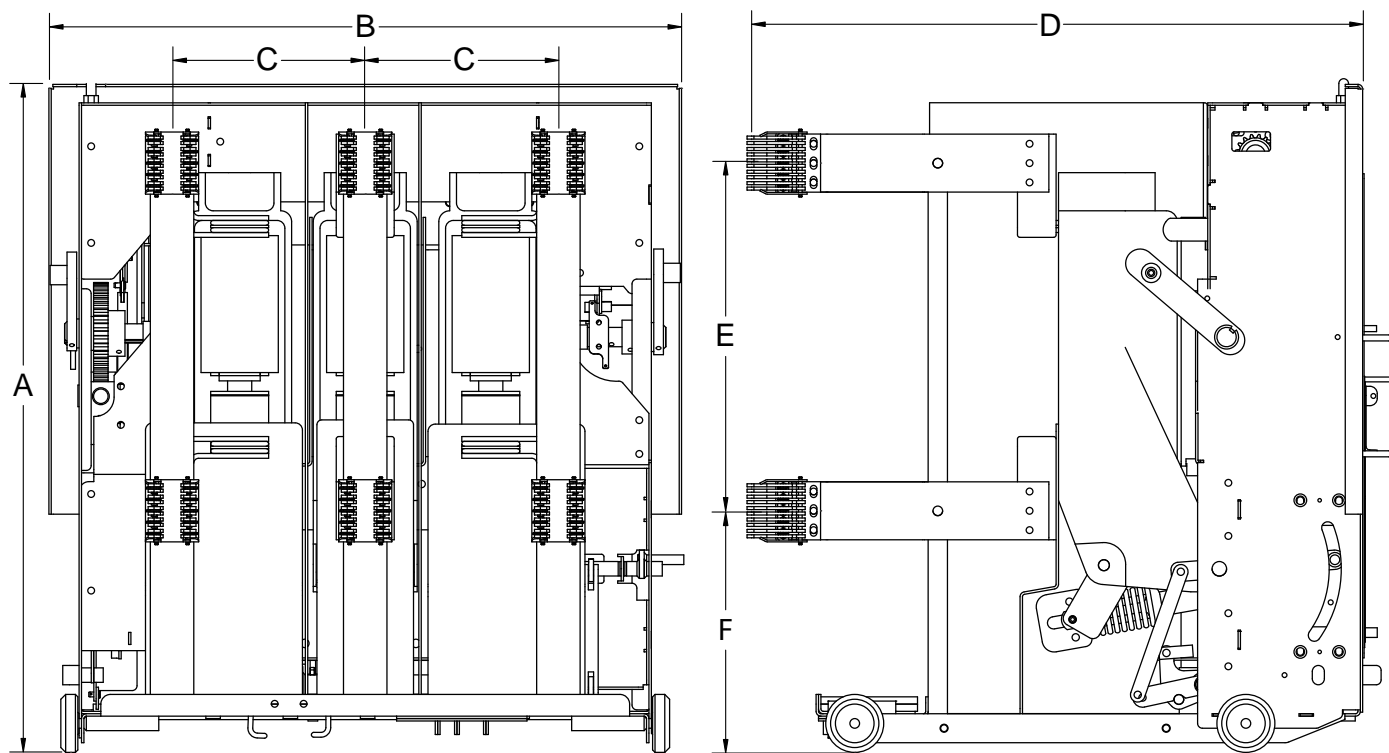


Table 1. PV-VR Dimensions

Breaker Type	Existing Breaker Rated Continuous Current at 60 Hz (Amps)	A	B	C	D	E	F
5/15PV-VR	1200	34.58	32.75	10.00	31.50	18.00	12.50

## SECTION 2: SAFE PRACTICES

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

---

### **WARNING**

---

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

---

- Only qualified persons, as defined in the National Electrical Safety Code, who are familiar with the installation and maintenance of medium voltage circuits and equipment, should be permitted to work on these breakers.
- Read these instructions carefully before attempting any installation, operation or maintenance of these breakers.
- Always remove the breaker from the enclosure before performing any maintenance. Failure to do so could result in electrical shock leading to death, severe personnel injury or property damage.
- Do not work on a breaker with the secondary test coupler engaged. Failure to disconnect the test coupler could result in an electrical shock leading to death, personnel injury or property damage.
- Do not work on a closed breaker or a breaker with closing springs charged. The closing spring should be discharged and the main contacts open before working on the breaker. Failure to do so could result in cutting or crushing injuries.
- Do not use a circuit breaker by itself as the sole means of isolating a high voltage circuit. Remove the breaker to the Disconnect position and follow all lockout and tagging rules of the National Electrical Code and any and all applicable codes, regulations and work rules.
- Do not leave the breaker in an intermediate position in the cell. Always have the breaker either in the Test or Connected position. Failure to do so could result in a flash over and possible death, personnel injury or property damage.
- Always remove the maintenance tool from the breaker after charging the closing springs.
- Breakers are equipped with safety interlocks. Do not defeat them. This may result in death, bodily injury or equipment damage.

### SECTION 3: RECEIVING, HANDLING, AND STORAGE

Type 5PV & 15PV VR-series circuit breakers are subjected to complete factory production tests and inspection before being packed. They are shipped in packages designed to provide maximum protection to the equipment during shipment and storage and at the same time to provide convenient handling. Accessories such as the maintenance tool, cell code plate, etc. are shipped with the breaker (Figure 3.1).

#### 3.1 RECEIVING

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

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

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

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

#### Tools and Accessories

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

**Racking Handle:** The racking handle is used to drive the racking mechanism which moves the circuit breaker into and out of the cell. The original OEM racking handle will interface with the VR-Series replacement breaker racking mechanism and is therefore not provided as part of the vacuum replacement breaker. A replacement racking handle is available upon request. (Style# 94A6103G99)

**Secondary Connection Block Extension Cable:** An 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. The original OEM extension cable will interface with the VR-Series replacement breaker therefore an additional extension cable is not included as part of the vacuum replacement breaker.

Figure 3.1.a. Typical Manual Charge Handle



Figure 3.1.b. Rotary Racking Handle



#### 3.2 HANDLING

##### **⚠ WARNING**

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

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

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

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

Figure 3.2. Lifting 15PV-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. Before placing it in storage, checks should be made to make sure that the breaker is free from shipping damage and is in satisfactory operating condition.

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

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

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

**3.4 5PV-VR & 15PV-VR APPROXIMATE WEIGHTS**

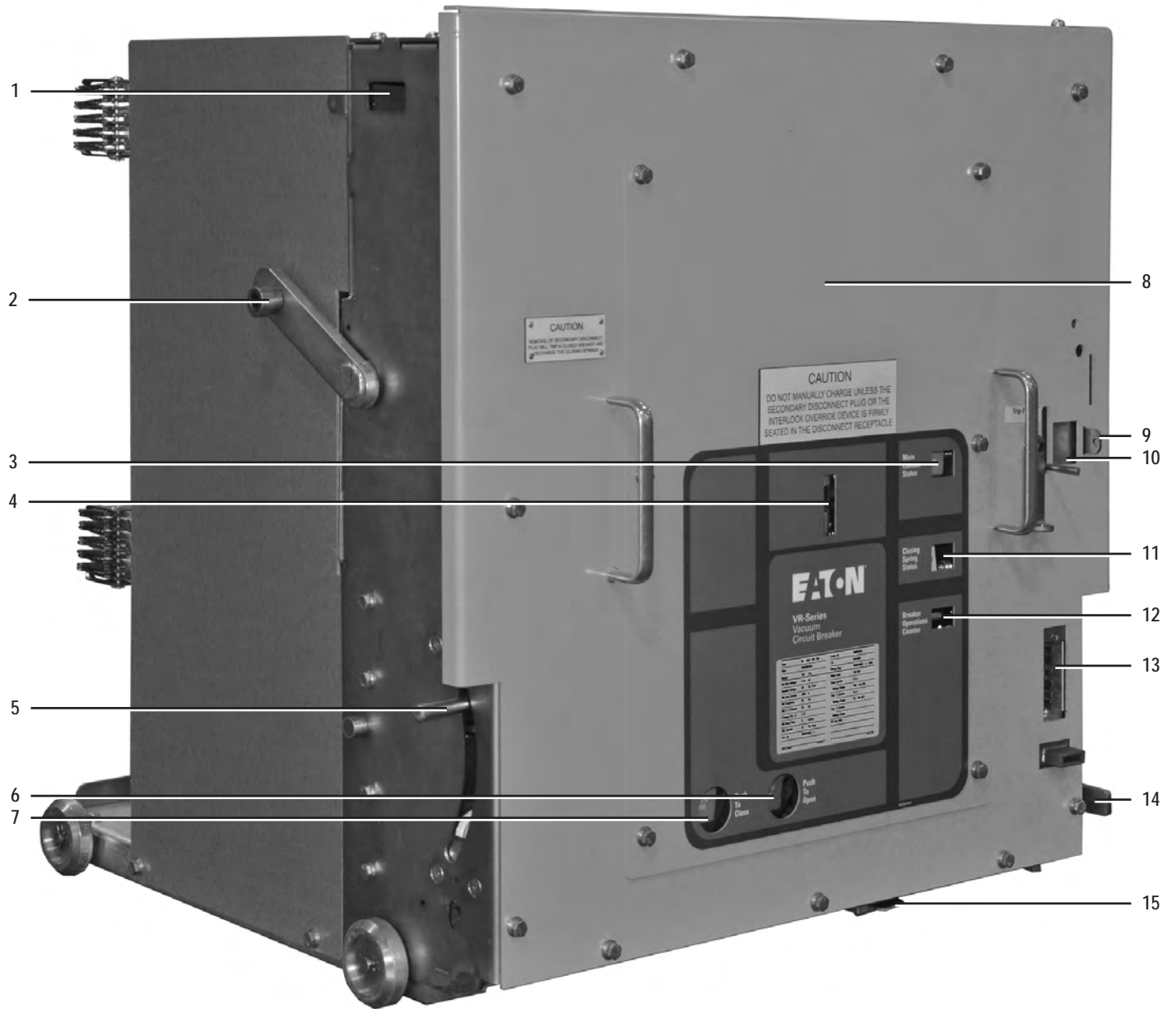
Refer to Table 3.

**Table 2. Maximum Weight by Type**

Type	Amperes	LBs
5/15PV-VR	1200	545



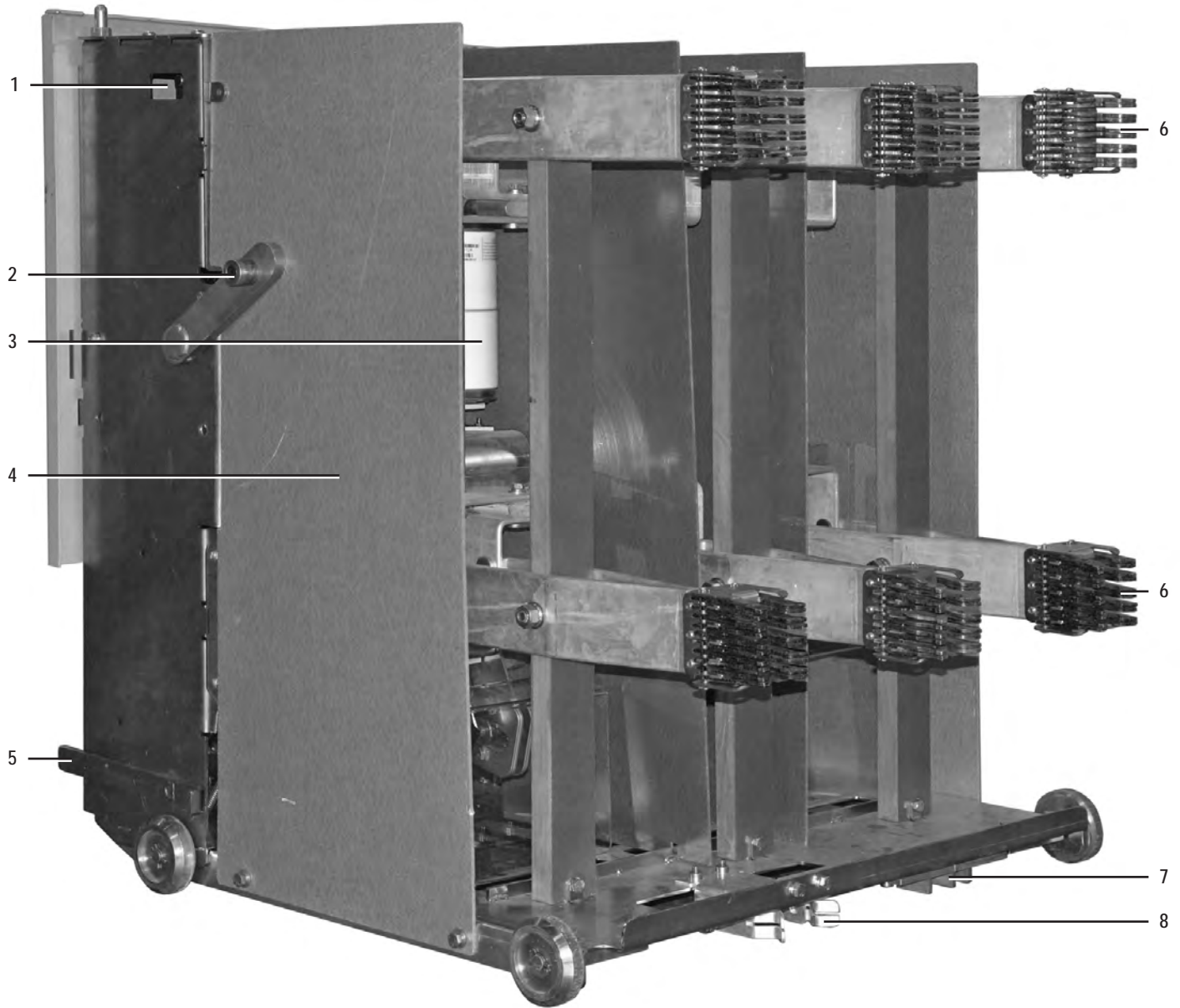
Figure 3.3. Front External View of 15PV-VR (1200A Shown)



**Front External View**

1	Lifting Point	6	Push To Open Button	11	Spring Charged / Discharged Indicator
2	Racking Arm	7	Push To Close Button	12	Operations Counter
3	Breaker Contacts Indicator	8	Removable Faceplate	13	Secondary Disconnect Receptacle
4	Manual Charge Socket	9	Lock Out Provision	14	Rail Latch
5	MOC Switch Operating Mechanism	10	Racking Access Shutter	15	Connect Indicator

Figure 3.4. Rear External View of 15PV-VR (1200A Shown)



**Rear External View**

1	Lifting Point	4	Phase Barrier	7	Code Plate
2	Racking Arm	5	Rail Latch	8	Ground Contact
3	Vacuum Interrupter	6	Primary Disconnect Contact		

## SECTION 4: DESCRIPTION AND OPERATION

VR-Series vacuum replacement breakers are designed to be used with existing installations of equivalent switchgear 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 as the vapor leaves the contact area, it condenses into the metal shield which surrounds the contacts.

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

#### 4.1.1 THE INTERRUPTER ASSEMBLY

Each interrupter is assembled at the factory as a unit to assure correct dimensional relationships between working components. The interrupter assembly consists of a vacuum interrupter, a molded glass polyester stand-off insulator, upper and lower clamps, flexible shunts, bell crank, operating rod, and contact load spring. The vacuum interrupter is mounted vertically with the fixed stem upward and the moving stem downward. The upper and lower glass polyester stand-off insulator and clamps support the interrupter and are fastened to the breaker's stored energy mechanism frame. Upper and lower flexible shunts provide electrical connections from each interrupter to the breaker's primary bushings while providing isolation from mechanical shock and movement of the interrupter's moving stem. The operating rod, loading spring, and bell crank transfer mechanical motion from the breaker's operating mechanism to the moving stem of the interrupter. A vacuum interrupter contact erosion indicator is located on the moving stem of the interrupter. It is visible when the breaker is withdrawn and is viewed from the rear of the breaker. (See Figure 6.2 and Figure 6.3)

#### 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. If contact erosion reaches 1/8 inch, the interrupter must be replaced. A contact erosion indicator mark is located on the moving stem of the interrupter (Figure 6.2 and 6.3).

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

Because of the nature of the design, the erosion indicator is not easily viewed, although it is possible with the use of a light and an inspection mirror.

Figure 4.1 5/15PV-VR Interrupter Assembly  
(18WR Design Shown)



Figure 4.2 5/15PV-VR Interrupter Assembly  
(18WR Design Shown) (All Three Poles)



**⚠ WARNING**

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

**4.1.3 CONTACT WIPE AND STROKE**

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

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

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

**⚠ WARNING**

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

**4.2 PHASE BARRIERS**

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

**⚠ WARNING**

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

**4.3 BUSHINGS AND DISCONNECTING CONTACT ASSEMBLIES**

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

**4.4 STORED ENERGY MECHANISM**

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

The mechanism stores the closing energy by charging the closing springs. When released, the stored energy closes the breaker, charges the wipe and resets the opening springs. The mechanism may rest in any one of the four positions shown in Figure 4.6 as follows:

- Breaker open, closing springs discharged.
- Breaker open, closing springs charged.
- Breaker closed, closing springs discharged.
- Breaker closed, closing springs charged.

The mechanism is a mechanically "trip-free" design. Trip-free is defined later in this section.

In normal operation the closing spring is charged by the spring charging motor, and the breaker is closed electrically by the switchgear control circuit signal to energize the spring release coil. Tripping is caused by energizing the trip coil through the control circuit.

For maintenance inspection purposes the closing springs can be charged manually by using the maintenance tool and the breaker can be closed and tripped by pushing the "Push to Close" and "Push to Open" buttons on the front panel.

**⚠ WARNING**

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

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

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

**4.4.1 CLOSING SPRING CHARGING**

Figure 4.5 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 maintenance tool in the manual charging socket. Move it up and down several times (about 36) until a clicking sound is heard and closing spring status indicator shows "charged" (Figure 3.3). Any further motion of the maintenance tool will result in free wheeling of the ratchet wheel and will not result into advance of charging.

**4.4.2 CLOSING OPERATION**

Figure 4.6 shows the positions of the closing cam and tripping linkage for four different operational states. In Figure 4.6a the breaker is open and the closing springs are discharged. In this state, the trip latch is disengaged from the trip "D" shaft (unlatched). After the closing springs become charged, the trip latch snaps into the fully reset or latched position (Figure 4.6b)

When the spring release clapper (Figure 4.5, Item 13) moves into the face of the spring release coil (electrically or manually), the upper portion of the clapper pushes the spring release latch (1) upward.

When the spring release latch moves, the cam shaft assembly is free to rotate. The force of the closing cam (Figure 4.6.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 4.6c. Interference of the trip "D" shaft with the trip latch prevents the linkage from collapsing, and holds the breaker closed.

Figure 4.6d shows the breaker in the closed state after the closing springs have been recharged. The recharging of the spring rotates the closing cam one half turn. In this position the main link roller rides on the cylindrical portion of the cam, and the main link does not move out of position.

#### 4.4.3 TRIPPING OPERATION

When the trip bar "D" shaft (Figure 4.6.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 rise. The energy of the opening spring and contact loading springs is released to open the main contacts. The mechanism is in the state illustrated (Figure 4.6b) after the breaker is tripped open.

#### 4.4.4 TRIP-FREE OPERATION

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

#### 4.5 CONTROL SCHEMES

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

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

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

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

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

**Table 4. Time Per Event**

Event	Milliseconds / Maximum
Closing Time (From Initiation of Close Signal to Contact Make)	75
Opening Time (Initiation of Trip Signal to Contact Break)	45
Reclosing Time (Initiation of Trip Signal to Contact Make)	190

#### 4.6 SECONDARY CONNECTION BLOCK

The breaker control circuit is connected to the switchgear control through secondary connection block, located at the lower right front of the breaker. The contacts are manually engaged when the breaker is pushed into the "Disconnect/Test" position. The secondary remains connected throughout the racking process to "Connect". The secondary cannot be removed until racked to the "Disconnect/Test" position.

#### 4.7 INTERLOCKS

### **⚠ 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.

#### 4.7.1 ANTI-CLOSE INTERLOCK

The anti-close interlock prevents discharging of the closing springs if the breaker is already closed (Figure 4.15, Item 11). When the breaker is closed, the interlock component moves away from the spring release clapper so that it cannot lift the spring release latch (9).

#### 4.7.2 RACKING SYSTEM TRIP AND SPRING RELEASE INTERLOCKS

The racking interlock prevents engaging or disconnecting a shut breaker with live cell buss work or removing a mechanically hazardous breaker from the cell. The basic premise of this interlock is that no breaker should be connected to or removed from cell primary circuitry when shut and no breaker should be removed from the cell with charged open or closing springs. The racking interlock accomplishes this by providing a trip signal to the breaker automatically from the racking mechanism interlock cams whenever the breaker is in an intermediate position in the cell and adding a close signal between the DISCONNECT and WITHDRAWN positions to render the breaker trip-free prior to leaving the cell (close and open springs discharged).

#### 4.7.3 SECONDARY DISCONNECT INTERLOCK

This breaker features an umbilical plug secondary that must be installed in the Disconnect/Test position. When racking the breaker from Disconnect/Test position to the Connect position; the secondary will become mechanically locked in position.

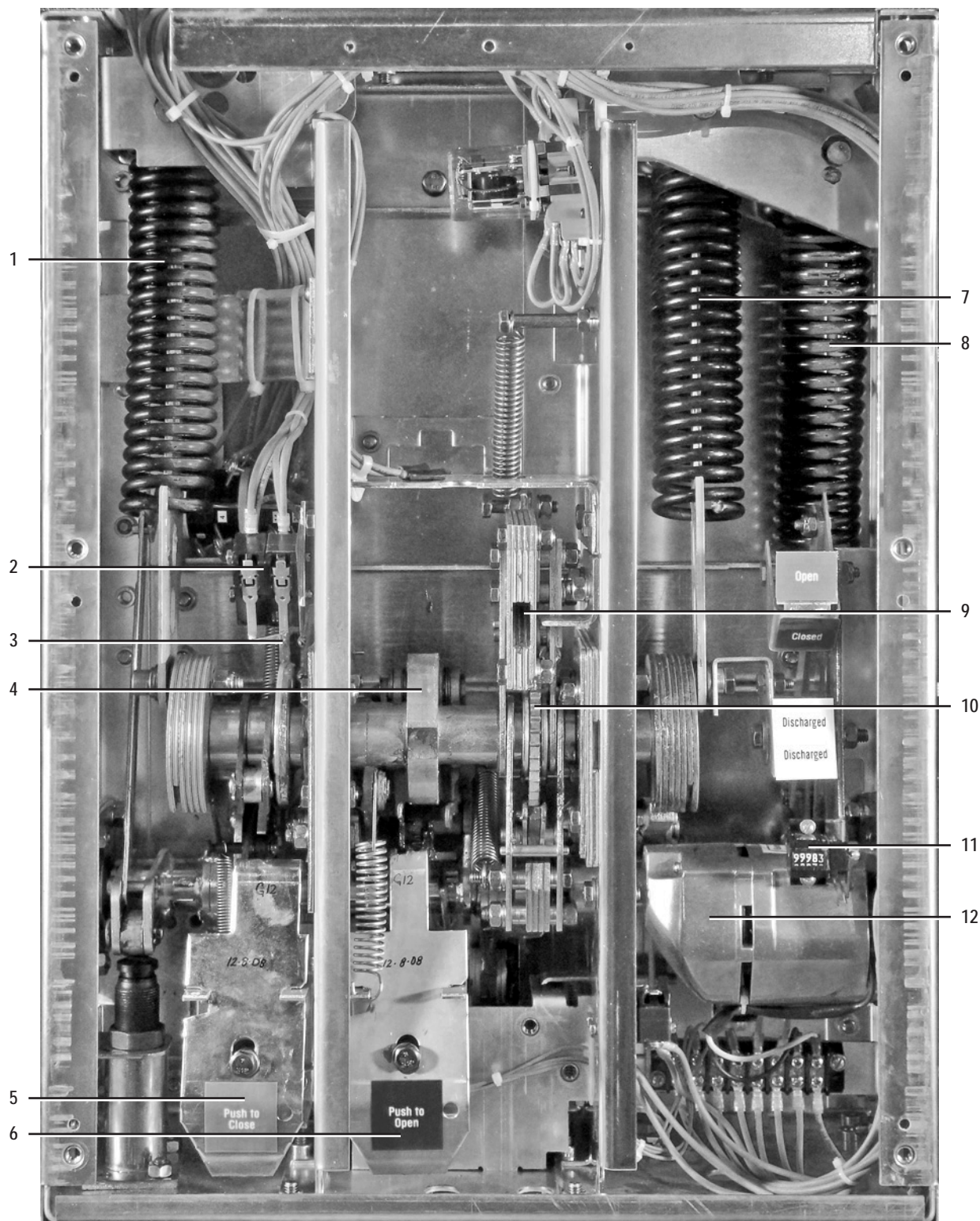
### **⚠ CAUTION**

**REMOVAL OF SECONDARY DISCONNECT PLUG WILL TRIP A CLOSED BREAKER.**

### **⚠ WARNING**

**DO NOT MANUALLY CHARGE BREAKER UNLESS SECONDARY DISCONNECT PLUG OR INTERLOCK OVERRIDE DEVICE IS FIRMLY SEATED IN THE DISCONNECT RECEPTACLE.**

Figure 4.3. 18WR Vacuum Element - Front Faceplate Removed

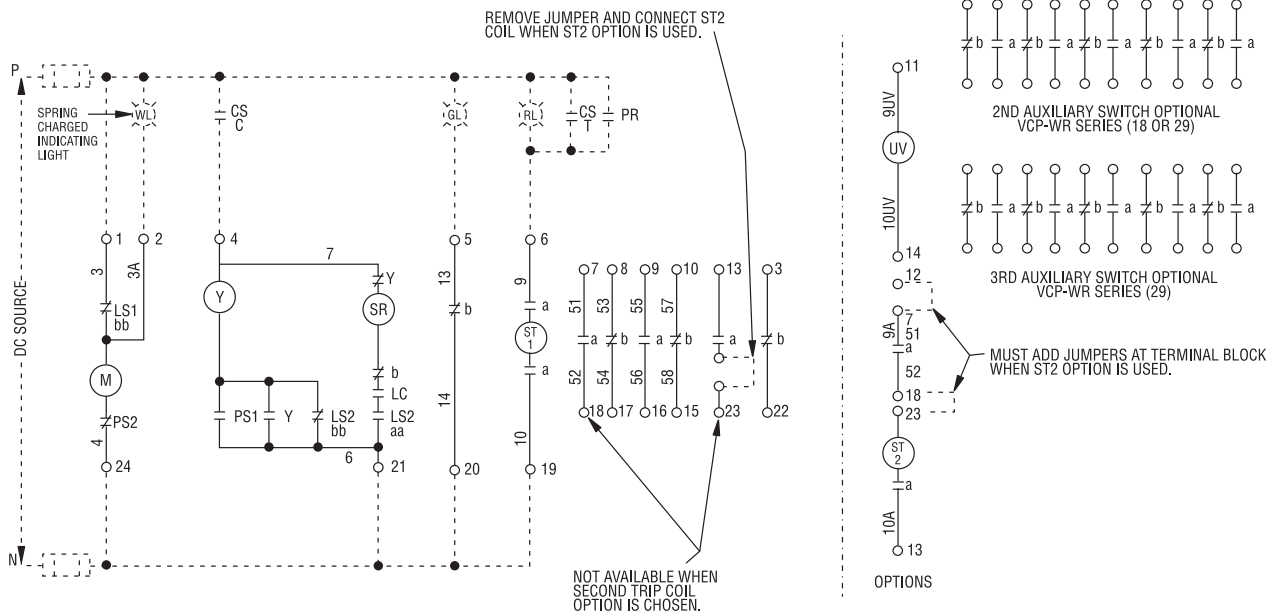


**18WR Vacuum Element**

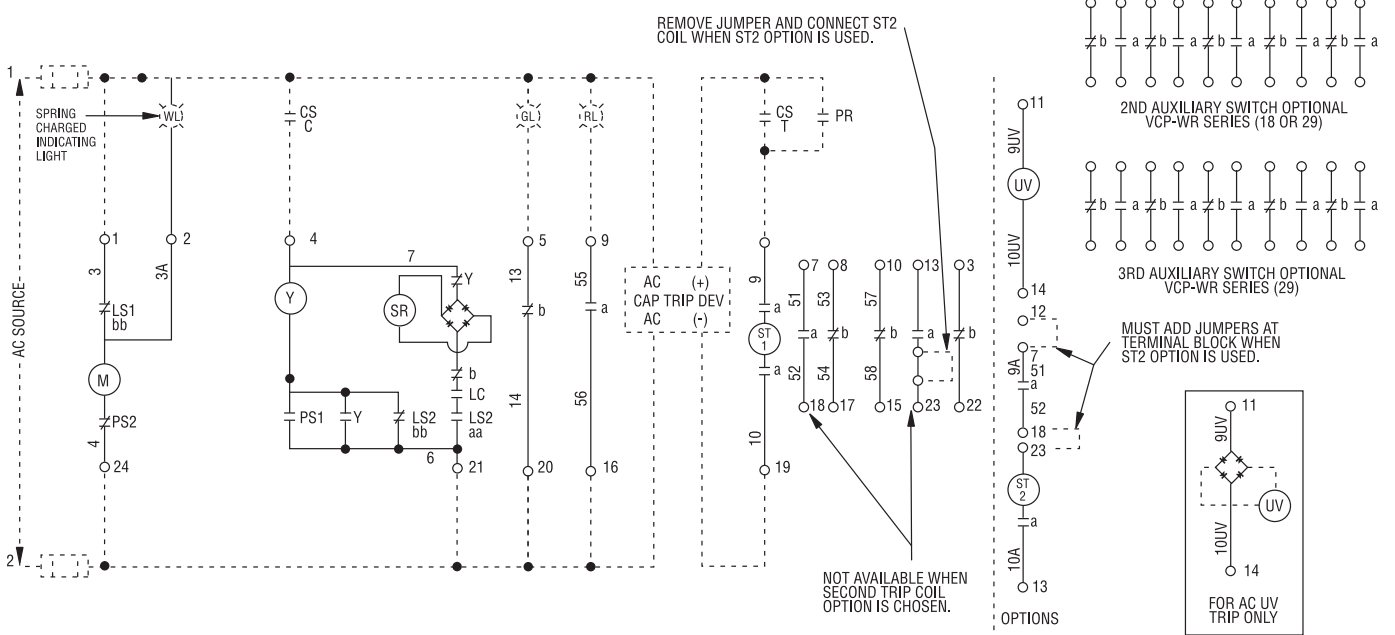
1	LH Closing Spring	5	Spring Release Assembly	9	Manual Charge Socket
2	Motor Cutoff Switch	6	Shunt Trip Assembly	10	Ratchet wheel
3	Latch Check Switch (Rear)	7	RH Closing Spring	11	Operations Counter
4	Closing Cam	8	Reset Opening Spring	12	Charging Motor

Figure 4.4. Typical AC/DC Schematic

VCP-WR (18, 20, 29) BREAKER DC CONTROL SCHEMATIC



VCP-WR (18, 20, 29) BREAKER AC CONTROL SCHEMATIC



OPERATION

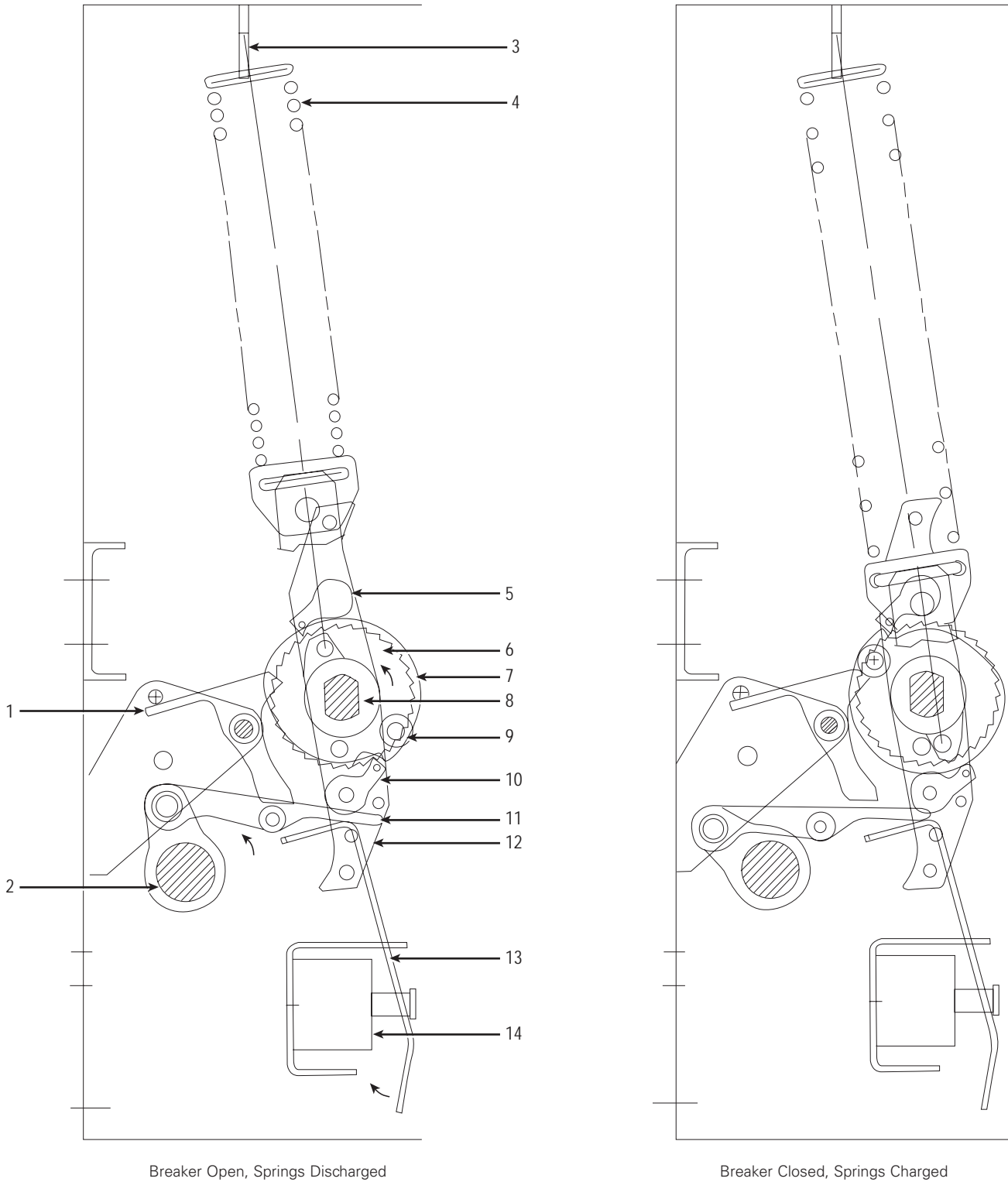
SWITCH TERMINAL

- CS - Breaker Control Switch - close
- C
- CS - Breaker Control Switch - trip
- T
- 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
- PS1 - Position Switch 1
- PS2 - Position Switch 2

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

- 'C' and 'NO' - Brown Switch
- 'C' and 'NC' - Black Switch
- 'C' and 'NO' - Black Switch
- 'C' and 'NC' - Black Switch
- 'C' and 'NO' - Brown Switch

Figure 4.5. Closing Cam and Trip Linkage

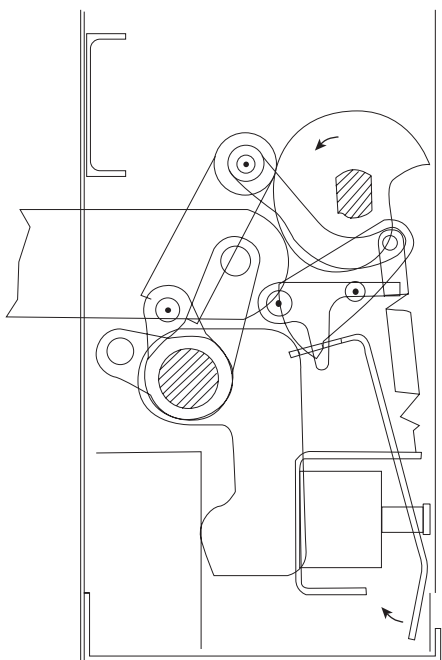


**Closing Cam and Trip Linkage**

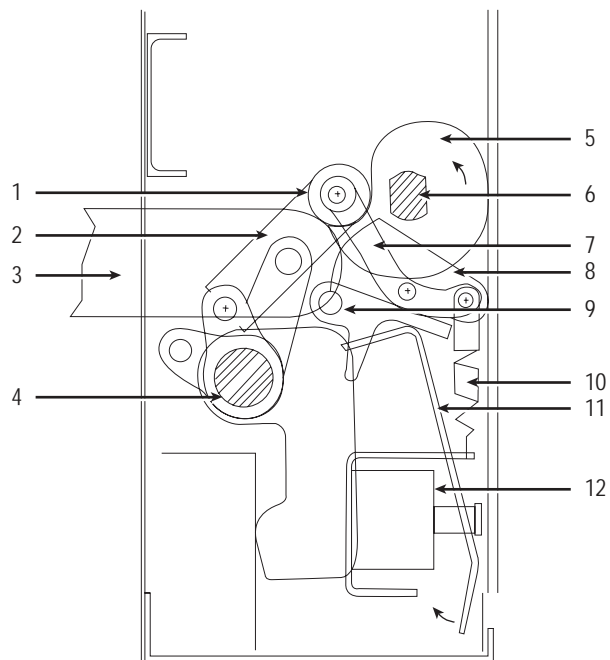
1	Spring Release (Close) Latch	6	Ratchet Wheel	11	Anti-Close Interlock
2	Pole Shaft	7	Spring Crank	12	Motor Ratchet Lever
3	Closing Spring Fixed End	8	Cam Shaft	13	Spring Release (Close) Clapper
4	Closing Spring	9	Spring Release Latch (Close Roller)	14	Spring Release (Close) Coil
5	Holding Pawl	10	Drive Pawl		



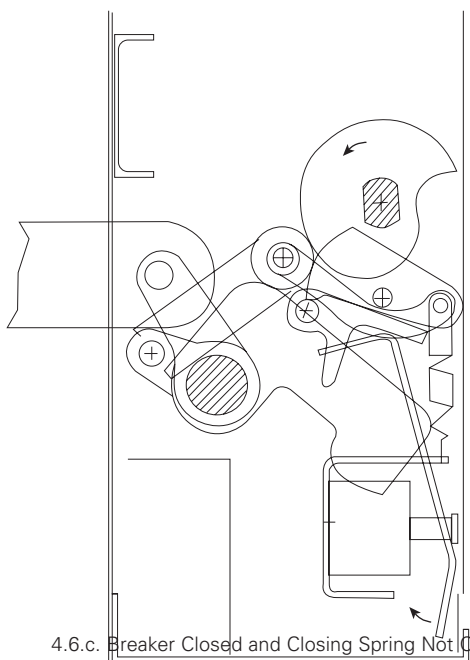
Figure 4.6. Charging Schematic



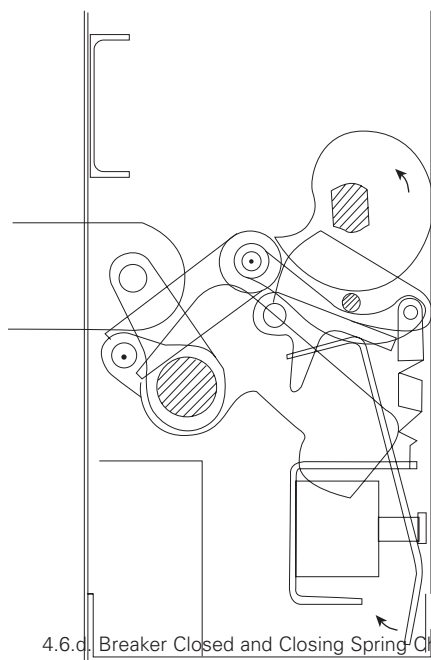
4.6.a. Breaker Open and Closing Spring Not Charged



4.6.b. Breaker Open and Closing Spring Charged



4.6.c. Breaker Closed and Closing Spring Not Charged



4.6.d. Breaker Closed and Closing Spring Charged

**Charging Schematic**

1	Main Link Roller	5	Closing Cam	9	Trip Bar "D" Shaft
2	Main Link	6	Cam Shaft	10	Trip Latch Reset Spring
3	Operating Rod	7	Banana Link	11	Shunt Trip Lever
4	Pole Shaft	8	Trip latch	12	Shunt Trip Coil

## SECTION 5: INSPECTION & INSTALLATION

### **⚠ WARNING**

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

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

#### 5.1 EXAMINATION FOR DAMAGE

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

##### 5.1.1 NAMEPLATE VERIFICATION

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

### **⚠ WARNING**

**ALWAYS DE-ENERGIZE/ISOLATE THE POWER SOURCE FEEDING THE POWER CIRCUIT BREAKERS/SWITCHGEAR AND LOCK-OUT/TAG-OUT THE POWER SOURCE PRIOR TO INSERTION OR REMOVAL OF ANY POWER CIRCUIT BREAKER. NEVER ATTEMPT TO MAINTAIN OR MODIFY A CIRCUIT BREAKER WHILE INSERTED IN A SWITCHGEAR CELL STRUCTURE. ALWAYS REMOVE THE POWER 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.**

#### 5.8 SURE CLOSE MECHANISM ADJUSTMENT

### **⚠ WARNING**

**FOR ALL TYPE PV HOUSINGS EQUIPPED WITH MECHANISM OPERATED CELL (MOC) SWITCHES, THE STEPS OUTLINED IN THIS SECTION MUST BE PERFORMED BEFORE INSTALLING A REPLACEMENT PV-VR CIRCUIT BREAKER. FAILURE TO COMPLY COULD CAUSE SEVERE PERSONAL INJURY, DEATH, EQUIPMENT DAMAGE AND/OR IMPROPER OPERATION.**

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

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

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

Figure 5.1. MOC Drive Spring (Front Cover Removed)

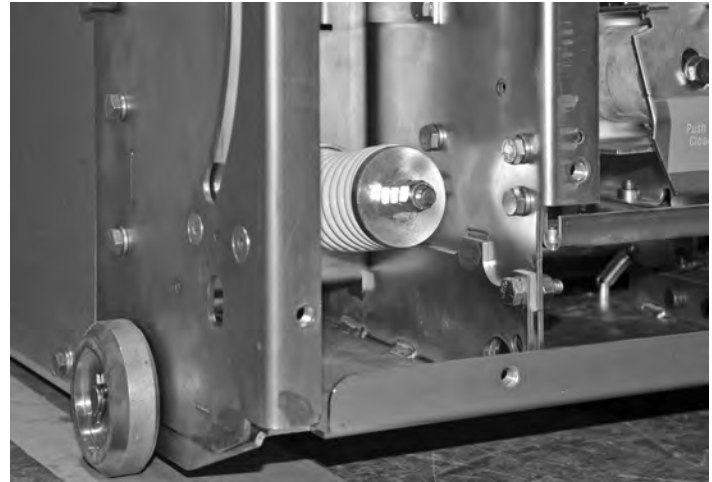
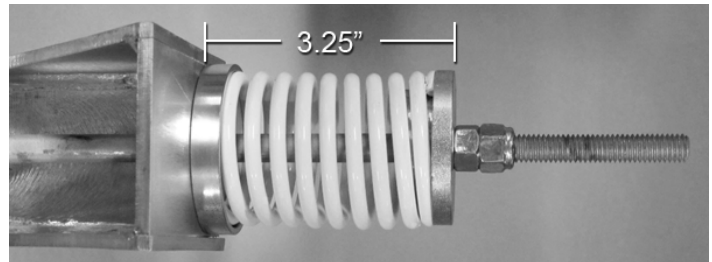


Figure 5.2. SURE CLOSE Spring Adjustment Setting



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

**Step 1:** Locate the MOC drive spring (Figure 5.1). It is located in the left lower portion of the breaker as viewed from the top front of the breaker.

**Note:** Will need to remove front cover for access.

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

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

**Step 4:** With the breaker out of the cell, close the breaker and measure the output of the MOC drive with a spring gauge. Open the breaker. The MOC drive force should exceed the MOC cell force required by 10 - 15lbs. If not, an adjustment is required.

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

### **⚠ WARNING**

**WITH THE BREAKER IN THE OPEN POSITION, THE SPRING COMPRESSION SHOULD NEVER BE SET TO A DIMENSION LESS THAN 3 INCHES AS MEASURED IN FIGURE 5.2.**

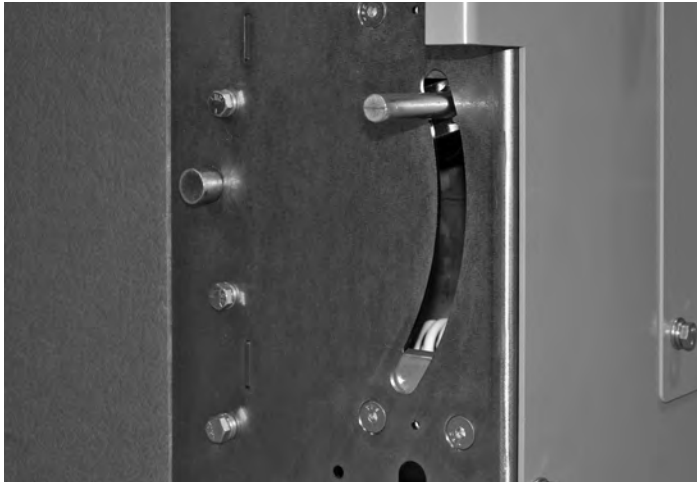
**Step 6:** Remeasure the MOC output spring force in the closed position. Repeat until the MOC forces are adequate.

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

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

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

Figure 5.3. 15PV-VR MOC Operator



**Step 10:** Anytime an adjustment is made, make sure the new compressed spring length (measured in the open position) is recorded if different than the dimension in this instruction book.

**Step 11:** After an adjustment is made, make sure that all nuts are secured in place, prior to returning to service.

### 5.2 MANUAL OPERATIONAL CHECK

Manual operational checks must be performed before the breaker is connected to a live circuit. Tests must be performed with the breaker withdrawn or in the disconnect position. Plug in interlock override device, then place the maintenance handle into the manual charging opening and charge the closing spring. Approximately 36 up and down strokes of the handle are required to cause the "Charging Spring Status" indicator to show "Charged." Remove the maintenance handle.

---

#### **⚠ WARNING**

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

---

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

Repeat the charge, close, and trip procedure several times to confirm that the mechanism operates consistently and reliably.

---

#### **⚠ WARNING**

**DO NOT ATTEMPT TO INSTALL OR OPERATE A VACUUM CIRCUIT BREAKER UNTIL THE TESTS OF SECTION 5.6 THROUGH 5.10 ARE SUCCESSFULLY PERFORMED.**

---

Remove the breaker from the cell and move to an area with adequate room for the following tests:

### 5.3 VACUUM INTEGRITY TEST

Check the vacuum integrity of the interrupters of the three pole units by conducting the applied potential test described in Section 6.4 of this book.

### 5.4 LOW FREQUENCY WITHSTAND TEST (INSULATION CHECK)

Perform insulation integrity tests as described in Section 6.7.

### 5.5 CONTACT EROSION AND STROKE, CONTACT WIPE

Close the breaker. Check all three vacuum interrupter erosion indicator marks as described in Section 6.5 and illustrated in Figure 6.3 to verify that contact erosion is not greater than the service limit of 1/8". Check contact wipe as described in Section 6.5 and illustrated in Figure 6.5.

### 5.6 PRIMARY CIRCUIT RESISTANCE TESTS

Check the primary circuit resistance of the three pole units as described in Section 6.8. The resistance should not exceed the values specified. Record the values for future reference.

### 5.7 ELECTRICAL OPERATIONAL CHECKS

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

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

---

#### **⚠ WARNING**

**DO NOT PERFORM ELECTRICAL OPERATION CHECKS WITH THE BREAKER IN THE "CONNECT" POSITION BECAUSE OF THE POSSIBILITY OF CONNECTING DE-ENERGIZING LOAD CIRCUITS TO THE ELECTRICAL POWER SOURCE, RESULTING IN DEATH, PERSONNEL INJURY OR EQUIPMENT DAMAGE.**

---

### 5.8 PADLOCK PROVISION

Each 5/15PV-VR vacuum replacement breaker is provided with a pad lock provision to prevent insertion or removal of the circuit breaker with the levering device. The padlock provision is located on the right front of the circuit breaker. To lock-out the circuit breaker, follow the levering instructions and remove the breaker to the "Disconnect/Test" position. Remove the levering tool. There are two major components that comprise the lock-out provision. (Figure 3.3, Lock Out Provision) The Lock Out Provision consists of the Padlock Interlock Lever and the Padlock Interlock Plate.

After the breaker is moved to the "Disconnect/Test" position, slide the Padlock Interlock Lever up and align the holes in the Padlock Interlock Plate. This exposes the padlock slot in the Padlock Interlock Plate. Insert the padlock or locking hasp and secure with lock(s).

### 5.9 OPERATIONAL POSITIONS

These operational instructions apply to the 5/15PV line of Eaton vacuum replacement circuit breakers. Each breaker has four basic operational positions:

1. Breaker in the 'withdrawn' position. (Figure 5.4) In the 'withdrawn' or 'out' position, the circuit breaker racking parts are disengaged from the circuit breaker compartment racking parts. It may be rolled into or out of the circuit breaker compartment in this position.
2. Breaker in the 'disconnect' position. (Figure 5.5) In the 'disconnect' position, the circuit breaker racking arms are engaged in the breaker compartment racking parts while a latch on the lower right hand side holds it securely in the cell.

---

#### **⚠ WARNING**

**PV CIRCUIT BREAKERS INSTALLED IN UPPER COMPARTMENT OF THEIR SWITCHGEAR MUST BE RACKED TO THE 'DISCONNECT' POSITION AT A MINIMUM TO PREVENT THEM FROM ROLLING OUT OF THE CIRCUIT BREAKER COMPARTMENT AND FALLING FROM THE SWITCHGEAR.**

---

Figure 5.4. Withdrawn From Cell (15PV-VR 1200A Shown)



3. Breaker in the 'test' position. In the 'test' position, the circuit breaker secondary disconnects are manually plugged in and the grounding system is automatically engaged. The primary disconnects, however, are not connected, and the stationary primary disconnect shutters are not open. In this position the circuit breaker can be charged electrically. Manual and electrical close and trip operation tests can be performed to confirm the operation of the circuit breaker. Mechanism operated cell switch operation can also be confirmed if the circuit breaker compartment is equipped with an MOC operator that operates in both the 'test' and 'connect' positions. Consult the your original switchgear manufacturer paperwork to confirm which type you have.

4. Breaker in the 'connect' position. (Figure 5.4) In the 'connect' position, the primary disconnects are fully engaged on the circuit breaker compartment primary connections.

### 5.10 INSERTION PROCEDURE

During the installation process, great care should be exercised. Follow the guidelines of your local authority having jurisdiction on safe racking practices. Eaton 5/15PV-VR circuit breakers are designed to allow closed door racking. Throughout the racking process, the circuit breaker is prevented from closing both mechanically and electrically. Only after racking crank removal, the circuit breaker can be closed in the 'test' or 'connect' positions.

1. Inspect the circuit breaker compartment to confirm that shutters are closed and that there is no foreign material in the circuit breaker compartment. Key interlocking in the circuit breaker compartment, if any, must also be cleared.
2. Confirm that the circuit breaker motor disconnect switch is in the 'off' and there are no pad locks on the racking padlock provisions. The circuit breaker must be open with the closing springs discharged. The breaker must be fully racked to the 'withdrawn' position as indicated by the 'Withdrawn' indication on the green background of the racking position window.

3. Align and push the circuit breaker so that it engages the rails in the floor of the circuit breaker compartment. The circuit breaker

Figure 5.5. Disconnect Position (15PV-VR 1200A Shown)



must be pushed forward until it stops, blocked by the breaker compartment racking parts. This is the Disconnect/Test position for the circuit breaker.

### **⚠ WARNING**

**PV CIRCUIT BREAKERS INSTALLED IN AN UPPER SWITCHGEAR COMPARTMENT MUST BE RACKED TO THE 'DISCONNECT' POSITION AT A MINIMUM TO PREVENT THEM FROM ROLLING OUT OF THE CIRCUIT BREAKER COMPARTMENT AND FALLING FROM THE SWITCHGEAR.**

4. From the Disconnect/Test position, plug in the secondary to achieve electrical 'test' position. In the 'test' position, the circuit breaker secondary disconnects are engaged with the breaker compartment secondary disconnects. The circuit breaker ground connections are also connected to the circuit breaker compartment grounding parts. Both the secondary disconnects and the ground parts remain connected between 'test' and 'connect' racking positions.

Various circuit breaker tests can be performed in the 'test' position.

- Remote electrical close and trip functions may be performed in the 'test' position. Remember that closing and opening operations on the circuit breaker may operate the mechanism operated cell switch; care should be taken to determine what equipment might be signaled by the MOC switch.

6. When all "in-cell" tests are complete, confirm that the circuit breaker contacts are open. When accessing the racking shaft, a closed breaker will open. Opening the breaker will allow racking access. Insert the racking crank and rotate the crank clockwise to move the circuit breaker to the 'connect' position. It may be possible to hear the circuit breaker compartment shutters open at this point. Immediately following shutter opening, racking forces on the crank will increase where the point is reached that the breaker primary

Figure 5.6. Manually Plugging Secondary Disconnect



Figure 5.7. Racking Handle Engagement



disconnects engage the stationary disconnect stabs in the cell. Continue to rack the breaker until 'Connect' is shown on the racking indicator. In this position, the circuit breaker can be closed, providing power to its downstream load. It is also serves it protective functions when connected to a circuit protective relay.

**5.11 REMOVAL PROCEDURE**

1. Confirm that the circuit breaker is open. It will be necessary to open the breaker to allow access to the circuit breaker racking shaft. Any attempt to access racking screw while breaker is closed will result in an open breaker condition. It is possible to rack the circuit breaker from the 'connect' position to the Disconnect/Test position if necessary.
2. If circuit breaker testing is needed, the breaker can be stopped in the 'test' position.
3. When the PV-VR breaker is located in an upper compartment, we strongly recommend that racking be stopped at the disconnect

Figure 5.8. Racking Into Cell (15PV-VR 1200A Shown)



Figure 5.8. 15PV-VR in the Connect Position (1200A Shown)



position so that the circuit breaker is mechanically retained in the circuit breaker compartment until one desires to remove it.

4. Between the 'disconnect' and 'out' position, the closing springs of the circuit breaker will automatically discharge.

Stationary primary disconnect shutters open between 'test' and connect. The 'connect' position is the operating position of the circuit breaker where it connected to primary current and the load the circuit breaker is feeding.

**SECTION 6: INSPECTION & MAINTENANCE**

**⚠ WARNING**

**DO NOT WORK ON A BREAKER IN THE "CONNECTED" POSITION.**

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

**DO NOT WORK ON A BREAKER WITH SPRINGS CHARGED OR CONTACTS CLOSED.**

**DO NOT DEFEAT ANY SAFETY INTERLOCKS.**

**DO NOT LEAVE MAINTENANCE TOOL IN THE SOCKET AFTER CHARGING THE CLOSING SPRINGS.**

**⚠ WARNING**

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

**FAILURE TO FOLLOW ANY OF THESE INSTRUCTIONS MAY CAUSE DEATH, SERIOUS BODILY INJURY, OR PROPERTY DAMAGE. SEE SECTION 2 - SAFE PRACTICES FOR MORE INFORMATION.**

**6.1 INSPECTION FREQUENCY**

Inspect the breaker once a year when operating in a clean, non corrosive environment. For a dusty and corrosive environment, inspection should be performed twice a year. Additionally, it is recommended to inspect the breaker every time it interrupts fault current.

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

**6.2 INSPECTION AND MAINTENANCE PROCEDURES**

NO. / SECTION	INSPECTION ITEM	CRITERIA	INSPECTION METHOD	CORRECTIVE ACTION IF NECESSARY		
1. Insulation	Stand Off Insulators, Operating Rods, Tie-Bars and Barriers	No Dirt	Visual Check	Clean With Lint-Free Cloth		
		No Cracking	Visual Check	Replace Cracked Unit		
	Vacuum Integrity	Between Main Circuit With Terminals Ungrounded	Withstand 27k 60Hz For 1 Minute	Hipot Tester	Clean And Retest Or Replace	
	Insulation Integrity	Main Circuit To Ground	Withstand 15kV, 60Hz For 1 Minute (5kV Rating) 27kV, 60Hz For 1 Minute (15kV Ratings)	Hipot Tester	Clean And Retest Or Replace	
Control Circuit To Ground (Charging Motor Disconnected)		Withstand 1125V, 60Hz For 1 Minute	Hipot Tester	Clean And Retest Or Replace		
2. Power Element	Vacuum Interrupters	Contact Erosion Visibility Of Mark	Visual - Close The Breaker And Look For Green Mark On Moving Stem From The Rear Of The Breaker (See Figure 6.1 and 6.2)	If Mark Is Not Visible, Replace Interrupter Assembly		
		Contact Wipe Visible	Visual (Figure 6.3 and 6.4)	Replace VI Assembly		
		Adequate Vacuum	See Section 6.3	Replace Interrupter Assembly If Vacuum Is Not Adequate		
		Dirt On Ceramic Body	Visual Check	Clean With Dry Lint-Free Cloth		
	Primary Disconnects	No Burning Or Damage	Visual Check	Replace If Burned, Damaged Or Eroded		
3. Control Circuit Parts	Closing And Tripping Devices Including Disconnects	Smooth And Correct Operation By Control Power	Test Closing And Tripping Of The Breaker Twice	Replace Any Defective Device-Identify Per Trouble-Shooting Chart		
	Wiring	Securely Tied In Proper Place	Visual Check	Repair Or Tie As Necessary		
	Terminals	Tight	Visual Check	Tighten Or Replace If Necessary		
	Motor	Smooth And Correct Operation By Control Power	Test Closing And Tripping Of The Breaker Twice	Replace Brushes Or Motor		
	Tightness Of Hardware	No Loose Or Missing Parts	Visual And Tightening With Appropriate Tools	Tighten Or Reinstate If Necessary		
4. Operating Mechanism	Dust Or Foreign Matter	No Dust Or Foreign Matter	Visual Check	Clean As Necessary		
	Lubrication	Smooth Operation And No Excessive Wear	Sight And Feel	Lubricate Very Sparingly With Light Machine Oil		
	Deformation Or Excessive Wear	No Excessive Deformation Or Wear	Visual And Operational	Remove Cause And Replace Parts		
	Manual Operation	Smooth Operation	Manual Charging Closing And Tripping	Correct Per Trouble-Shooting Chart If Necessary		
	CloSure™ Test	≥ 0.6 Inch Over Travel	CloSure™ Test 6.8.1	If < 0.6 Contact P.B.C. At 1-877-276-9379		
<b>BOLT SIZE</b>	8 - 32	10 - 32	.25 - 20	.31 - 18	.38 - 16	.50 - 13
<b>TORQUE Lb. In.</b>	24	36	72	144	300	540

**6.3 VACUUM INTERRUPTER INTEGRITY TEST**

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

**⚠ WARNING**

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

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

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

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

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

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

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

**⚠ WARNING**

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

Breaker Rated Maximum Voltage	Vacuum Interrupter Integrity Test Voltage	
	AC 60Hz	DC
Up to and including 15.0 kV	27 kV	40 kV

**6.4 CONTACT EROSION AND WIPE**

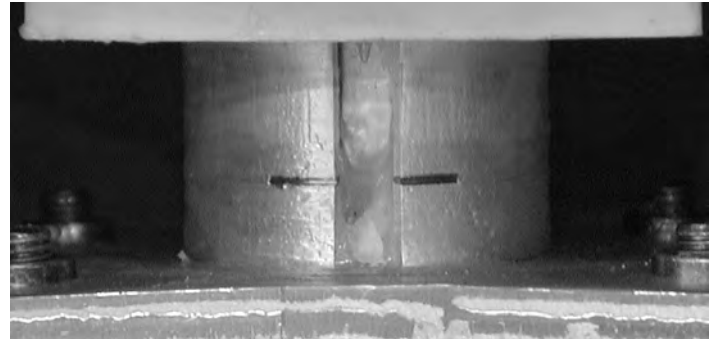
Since the contacts are contained inside the interrupter, they remain clean and require no maintenance. However, during high current interruptions there may be a minimal amount of erosion from the contact surfaces. Maximum permitted erosion is 1/8 inch. To determine contact erosion, close the breaker and observe the vacuum interrupter moving stem from the rear of the breaker. If the mark on each stem is visible, erosion has not reached maximum value thus indicating satisfactory contact surface of the interrupter. If the mark is not visible, the vacuum interrupter assembly must be replaced (Figure 6.1 and 6.2).

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

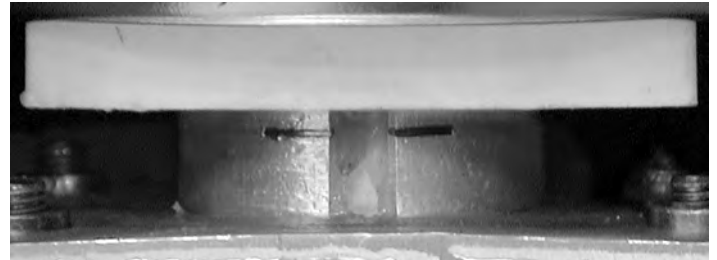
**⚠ WARNING**

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

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



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



**Figure 6.3. The Arrow Shows The "T" Contact Wipe Indicator - Example with Blue Spring (If the "T" or any portion of its visible as shown with the breaker closed, the wipe is satisfactory) (See Next Figure for Graphic of All Possibilities)**



**6.5 INSULATION**

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

**6.6 INSULATION INTEGRITY CHECK**

**PRIMARY CIRCUIT:**

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

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

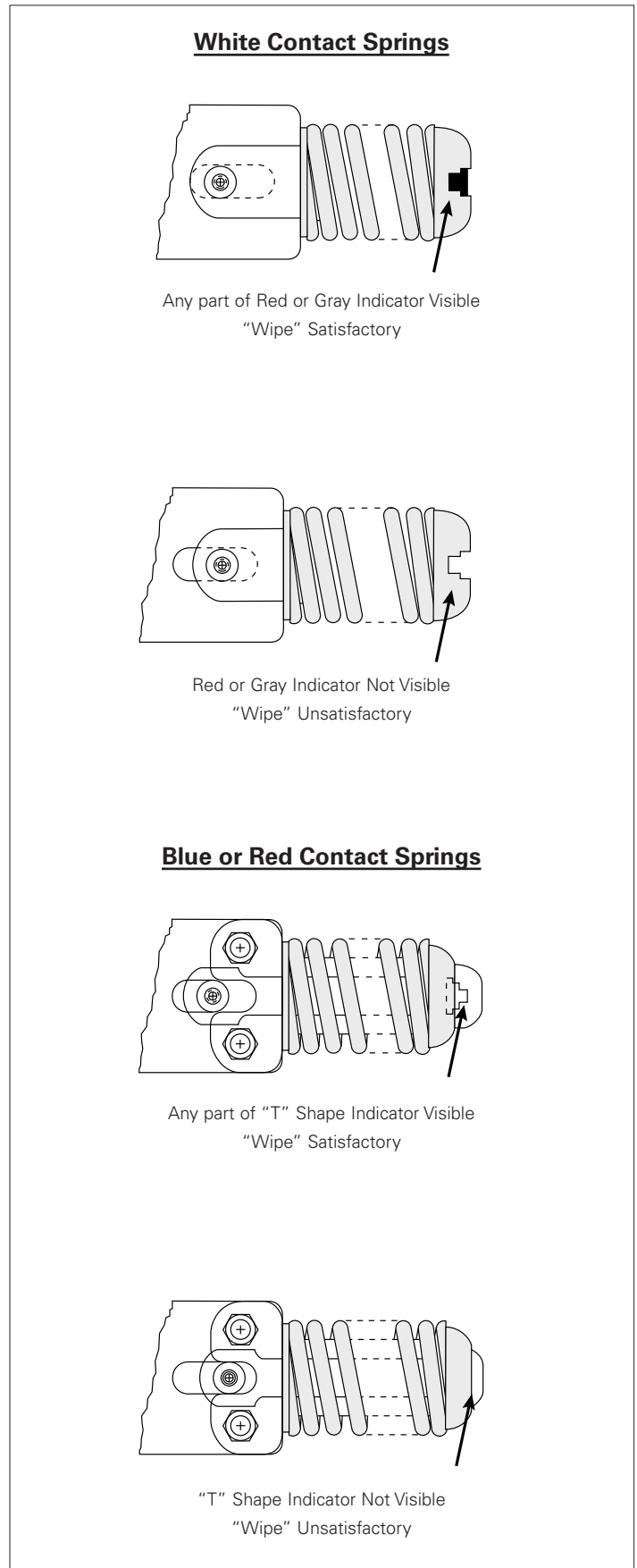
Open the breaker. Connect the high potential lead of the test machine to one of the poles of the breaker. Connect the remaining poles and breaker frame to ground. Start the machine with output potential at zero and increase to the test voltage. Maintain the test voltage for one minute. Repeat for the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

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

**SECONDARY CIRCUIT:**

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

**Figure 6.4. Wipe Indication Procedure (Performed Only With Breaker Closed)**





**6.7 PRIMARY CIRCUIT RESISTANCE CHECK**

Since the main contacts are inside the vacuum chamber they remain clean and require no maintenance at any time. Unlike most typical circuit breaker designs, VR-Series breakers do not have sliding contacts at the moving stem either. Instead they use a highly reliable and unique flexible clamp design that eliminates the need for lubrication and inspection for wear.

If desired, the DC resistance of the primary circuit may be measured as follows: close the breaker, pass at least 100 amps DC current through each primary conductor path of the breaker (Connect the current leads to the ends of the line and load bushings). Using a low resistance measurement instrument, measure resistance across the complete current path of each phase of the breaker. The measured resistance should not exceed the original factory test values by more than 15% when adjusted to the same temperature recorded during the factory test. Refer to the original Power Breaker Center test forms.

**6.8 MECHANISM CHECK**

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

**6.8.1 CLOSURE™ TEST**

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

At times, circuit breakers are called upon to operate MOC (Mechanism Operated Control) switches that place extra load upon the closing mechanism of the circuit breaker. If this load is excessive, it can prevent the circuit breaker from closing fully. In such a case, it is important to determine that the circuit breaker will close fully. The CloSure™ Test provides this assurance.

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

**⚠ WARNING**

**DO NOT ATTEMPT TO INSTALL OR PERFORM MAINTENANCE OR TESTS ON THE EQUIPMENT WHILE IT IS ENERGIZED. NEVER PUT YOUR HANDS NEAR THE MECHANISM WHEN THE CIRCUIT BREAKER IS IN THE CHARGED OR CLOSED POSITION. DEATH OR SEVERE PERSONAL INJURY CAN RESULT FROM CONTACT WITH ENERGIZED EQUIPMENT. ALWAYS VERIFY THAT NO VOLTAGE IS PRESENT BEFORE PROCEEDING WITH THE TASK, AND ALWAYS FOLLOW GENERALLY ACCEPTED SAFETY PROCEDURES.**

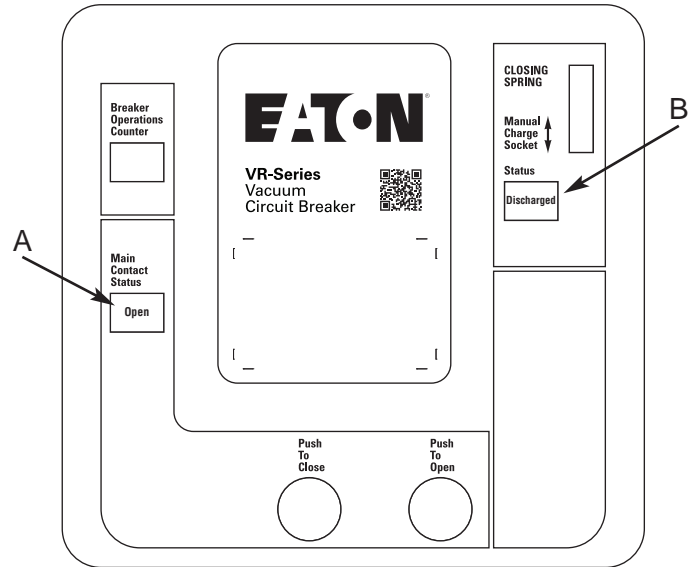
**Safety Precautions:** Read and understand these instructions before attempting any maintenance, repair or testing on the breaker. The user is cautioned to observe all recommendations, warnings and cautions relating to the safety of personnel and equipment.

The recommendations and information contained herein are based on Eaton Electrical 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 switchgear 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 switchgear, refer to the appropriate section of this manual.

**Step 1** - On the front cover, identify the status indicators. Make sure the closing spring status indicates “DISCHARGED” and the main contact indicator shows “OPEN” (Figure 6.5).

**Figure 6.5. Status Indicators (“A” shows the contact status indication and “B” shows the spring indication.)**



**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 6.6).

**Figure 6.6. Wrapping Tape Around Cam**



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

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

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

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

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

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

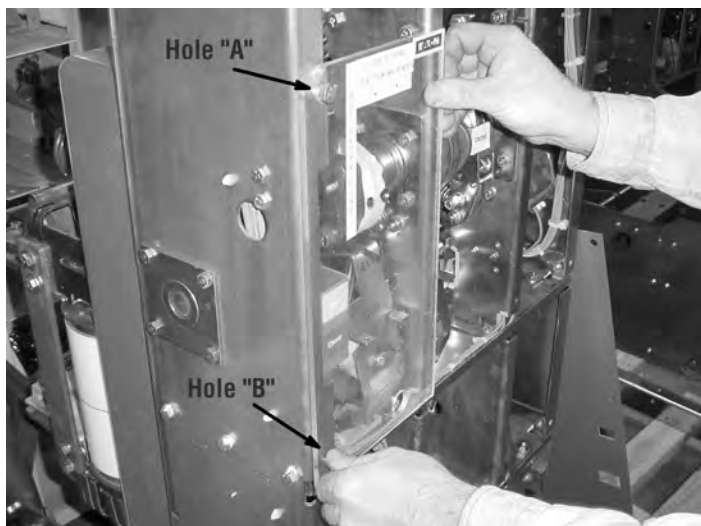
**Step 12** - Inspect the circuit breaker to assure it is in the open position and the closing springs are discharged. Alternately depress the Open and Close clappers a few times to ensure the circuit breaker is completely discharged. Remove the transparent CloSure™ Tool.

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

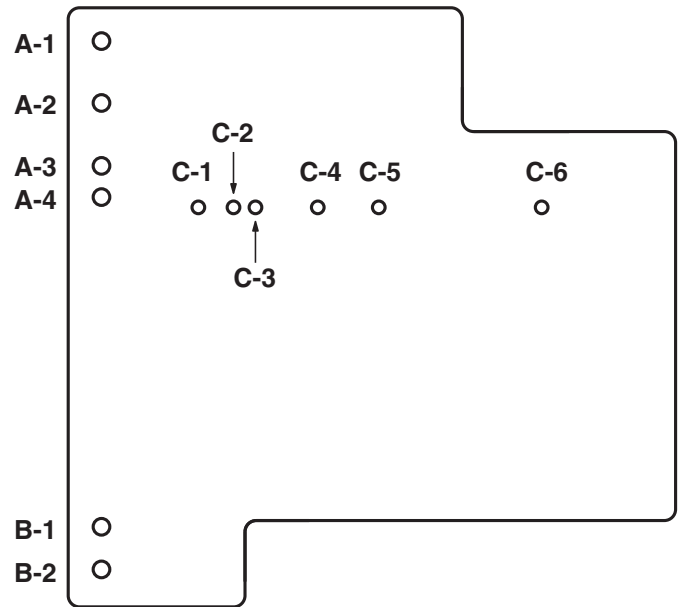
**Step 14** - Evaluate the CloSure™ performance by comparing the test tape with the illustration in Figure 6.16. Measure the over travel "X". If "X" is not greater than or equal to 0.6", this indicates a problem with the circuit breaker - consult the factory.

**Step 14** - Reassemble the front cover onto the circuit breaker. Return the circuit breaker to its original configuration and setup.

**Figure 6.7. Attaching CloSure™ Test Tool at Hole "A" & "B"**



**Figure 6.7b. Front View of CloSure™ Tool Showing Mounting / Testing Hole Locations (6352C49H01)**



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

BREAKER LINE	APPROXIMATE MECHANISM CABINET WIDTH (INCH)	UPPER MOUNTING HOLE	LOWER MOUNTING HOLE	MARKER PLACEMENT HOLE
18WR	18	A1	B2	C1
20WR	20	A1	B2	C2
29WR	27	A1	B2	C5

**Figure 6.7c. Typical Circuit Breaker Front View with CloSure™ Tool Attached (Approximate Mechanism Chassis Width)**

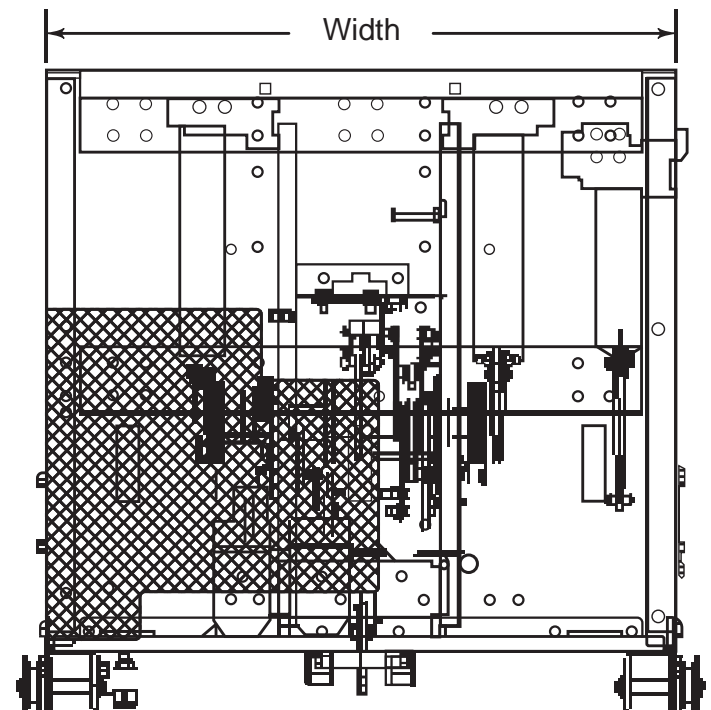


Figure 6.8. Manually Charging Closing Springs

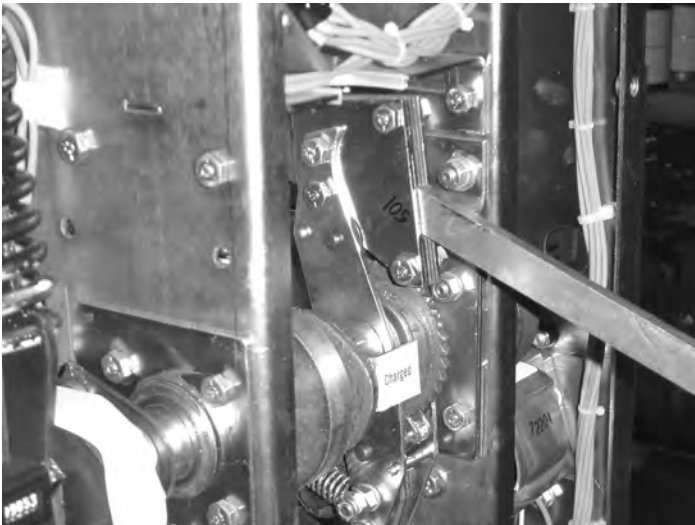


Figure 6.9. Make a Clear and Heavy Mark



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



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

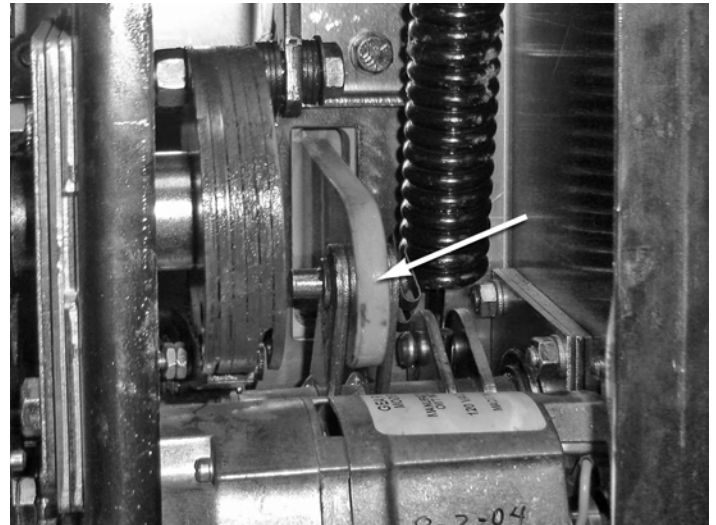


Figure 6.12. Move the Sharpie® 15° Left and Right



Figure 6.13. Top view of Cam and Marker Interface

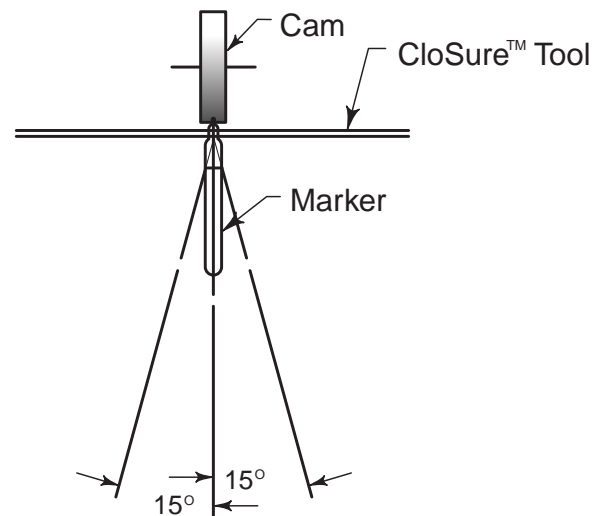


Figure 6.14. Evaluate the CloSure™ Performance

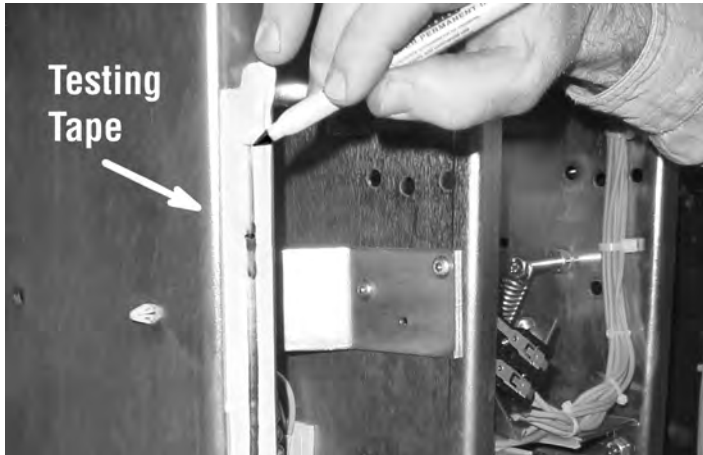


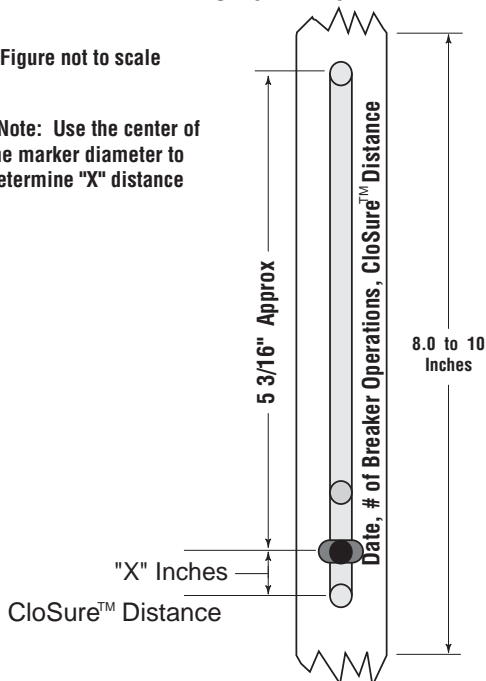
Figure 6.15. Determining the Distance Traveled



Figure 6.16. Illustrative Testing Tape Sample

\*Figure not to scale

\*Note: Use the center of the marker diameter to determine "X" distance



## 6.9 LUBRICATION

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

After lubrication, operate the breaker several times manually and electrically.

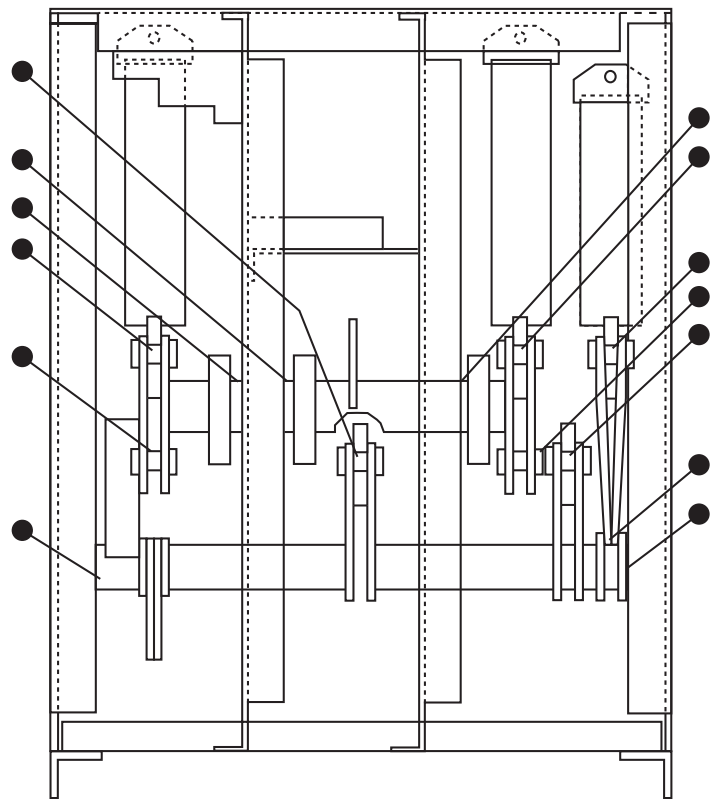
Roller bearings are used on the pole shaft, the cam shaft, the main link and the motor eccentric. These bearings are packed at the factory with a top grade slow oxidizing grease which normally should be effective for many years. They should not be disturbed unless there is definite evidence of sluggishness,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

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

Table 6.2. Proper Lubrication Times Per Rating

RATINGS	OPERATIONS
29kA and below	750
Above 29kA	400
3000 Amp	400

Figure 6.17. Lubrication Areas



- Apply one drop of non-synthetic light machine oil at locations shown.

**Table 6.3. Troubleshooting Chart**

<b>SYMPTOM</b>	<b>INSPECTION AREA</b>	<b>PROBABLE DEFECTS</b>
<b>FAILS TO CLOSE</b>		
Closing Springs Not Charged	Control Circuit	<ul style="list-style-type: none"> <li>Control Power (Fuse Blown Or Switch Off)</li> <li>Secondary Disconnects</li> <li>Motor Cut-off Switch (Poor Or Burned Contacts. Lever Not Operational.)</li> <li>Terminals And Connectors (Poor Or Burned Contacts)</li> <li>Motor (Brushes Worn Or Commutator Segment Open)</li> </ul>
	Mechanism	<ul style="list-style-type: none"> <li>Pawls (Slipping Or Broken)</li> <li>Ratchet Wheel (Teeth Worn Or Broken)</li> <li>Cam Shaft Assembly (Sluggish Or Jammed)</li> <li>Oscillator (Reset Spring Off Or Broken)</li> </ul>
Closing Springs Not Charged Breaker Does Not Close	Control Circuit (Close Coil Does Not Pick Up)	<ul style="list-style-type: none"> <li>Control Power (Fuse blown or switch off)</li> <li>Secondary Disconnects</li> <li>Anti Pump Relay (Y Relay N.C. Contact Open Or Burned Or Relay Picks Up)</li> <li>Close Coil (Open Or Burned)</li> <li>Latch Check Switch (Contact Open - Bad Switch Or Trip Bar Not Reset)</li> <li>Auxiliary Switch (B Contact Open Or Burned)</li> <li>Motor Cut-Off (Contacts Open Or Burned)</li> <li>Trip Coil Assembly (Clapper Fails To Reset)</li> </ul>
	Closing Sound But No Close	<ul style="list-style-type: none"> <li>Pole Shaft (Not Open Fully)</li> <li>Trip Latch Reset Spring (Damaged Or Missing)</li> <li>Trip Bar-D Shaft (Fail To Remain Reset)</li> <li>Trip Latch-Hatchet (Fails To Remain Reset)</li> <li>Trip Floor Tripper (Fails To Remain Reset)</li> <li>Close Latch (Binding)</li> <li>Close Latch Roller (Binding)</li> <li>Trip Circuit Energized</li> </ul>
<b>UNDESIRABLY CLOSES</b>		
	Control Circuit	<ul style="list-style-type: none"> <li>Close Circuit (CS/C Getting shorted)</li> </ul>
	Mechanism	<ul style="list-style-type: none"> <li>Close Release Latch (Fails To Reset)</li> <li>Close Floor Tripper (Fails To Reset)</li> </ul>
<b>FAILS TO CLOSE</b>		
No Trip Sound	Control Circuit	<ul style="list-style-type: none"> <li>Control Power (Fuse Blown Or Switch Off)</li> <li>Secondary Disconnects</li> <li>Auxiliary Switch (A Contact Not Making Poor Or Burned)</li> <li>Trip Coil (Burned Or Open)</li> <li>Terminals And Connections (Poor Or Burned Or Open)</li> <li>Trip Clapper (Jammed)</li> </ul>
	Trip Mechanism	
Trip Sound But No Trip	Trip Mechanism	<ul style="list-style-type: none"> <li>Trip Bar, Trip Latch (Jammed)</li> <li>Pole Shaft (Jammed)</li> <li>Operating Rod Assembly (Broken Or Pins Out)</li> </ul>
	Vacuum Interrupter (One Or More Welded)	
<b>UNDESIRABLY TRIPS</b>		
	Control Circuit	<ul style="list-style-type: none"> <li>Control Power (CS/T Switch, remains made)</li> </ul>
	Mechanism	<ul style="list-style-type: none"> <li>Trip Coil Clapper (Not Resetting)</li> <li>Trip Bar or Trip Latch (Poor Engagement Of Mating Or Worm Surfaces)</li> <li>Trip Bar Reset Sprint (Loss Of Torque)</li> </ul>

**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.

**7.1.1 ORDERING INSTRUCTIONS**

1. The style numbers in Table 7.1 should be sufficient to purchase control components for most applications. Some breakers have special control schemes. Supply complete nameplate information for verification or if additional components are needed.
2. Specify the method of shipping desired.
3. Send all orders or correspondence to the nearest Eaton's Electrical Services & Systems sales office or contact the PBC direct at 1-877-276-9379.
4. Include negotiation number with order when applicable.

**Table 7.1. Common Replacement Parts**

ITEMS	DESCRIPTIONS	CURRENT EATON STYLE NUMBER
<b>RELAYS</b>		
	Anti-Pump (Y) Relay (48vDC)	8237A27H03
	Anti-Pump (Y) Relay (125vDC)	8237A27H04
	Anti-Pump (Y) Relay (250vDC)	8237A27H05
	Anti-Pump (Y) Relay (120vAC)	8237A27H01
	Anti-Pump (Y) Relay (240vAC)	8237A27H02
<b>RECTIFIER</b>		
	Rectifier	3759A79G02
<b>SPRING CHARGING MOTORS</b>		
	Spring Charging Motor (48vDC)	699B196G06
	Spring Charging Motor (125vDC)	699B196G04
	Spring Charging Motor (250vDC / 240vAC)	699B196G05
<b>SWITCHES</b>		
	Breaker Auxiliary Switch	5697B02G02
	Breaker Position Switch PS1	699B147H01
	Breaker Position Switch PS2	3759A93H01
	Breaker Position Switch PS2	3759A93H01
	Latch Check Switch (LC)	699B147H04
	Motor Cutoff Switch (LS) (20WR / 29WR) - (Shown) Motor Cutoff Switch (LS) (18WR)	699B199G04 5677B02G01
<b>COILS OR SHUNT TRIPS</b>		
	Coil or Shunt Trip 24vDC	692C215G09
	Coil or Shunt Trip 48vDC	692C215G01
	Coil or Shunt Trip 125vDC / 120vAC	692C215G02
	Coil or Shunt Trip 250vDC / 240vAC	692C215G03
<b>CONTROL COMPONENTS KIT</b>		
	48vDC	94C9525G01
	125vDC	94C9525G02
	250vDC	94C9525G03
	120vAC-C/M 48vDC-T	94C9525G04
	240vAC-C/M 48vDC-T	94C9525G05
	120vAC-C/M 120vAC-CT	94C9525G06
	240vAC-C/M 240vAC-CT	94C9525G07



**Eaton Corporation**  
Electrical Sector  
1111 Superior Ave.  
Cleveland, OH 44114  
United States  
877-ETN-CARE (877-386-2273)  
Eaton.com

© 2011 Eaton Corporation  
All Rights Reserved  
Printed in USA  
Publication No. IB182081EN  
May 2013



Eaton is a registered trademark  
of Eaton Corporation.

All trademarks are property of their  
respective owners.