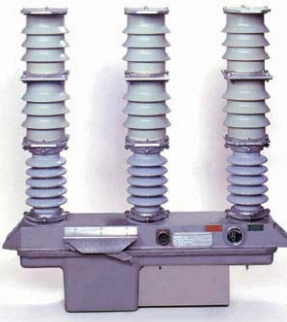


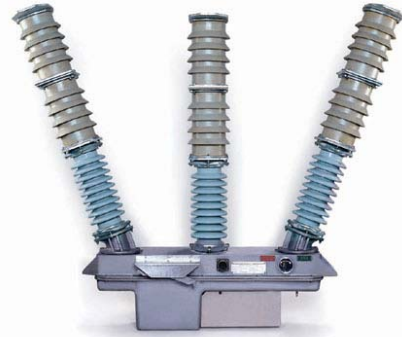
# VBM - Varmaster Instructions



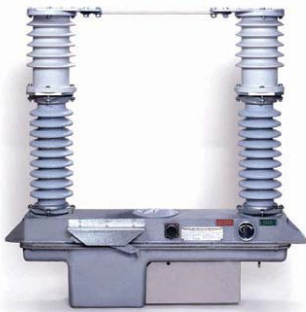
THREE PHASE  
 15kV/25kV Grounded 400A  
 15kV/25kV Grounded 600A



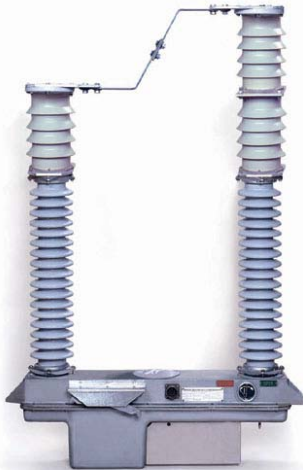
THREE PHASE  
 25kV 200A  
 25kV 300A  
 25kV 400A



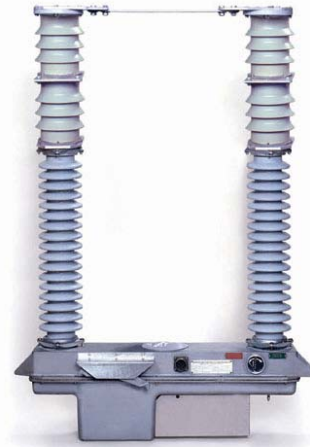
THREE PHASE  
 38kV 300A



ONE POLE\*  
 38kV 400A  
 38kV 600A  
 48.5kV 200A  
 (with longer insulators)



ONE POLE\*  
 48.5kV 300A  
 48.5kV 400A



ONE POLE\*  
 72.5kV 300A

\*Three poles required for a three phase installation.

Joslyn Hi-Voltage  
 4000 E. 116<sup>th</sup> St.  
 Cleveland, OH 44105  
 Ph (216) 271-6600 Fax (216) 341-3615  
 Email: [info@joslynhv.com](mailto:info@joslynhv.com)  
[www.joslynhivoltage.com](http://www.joslynhivoltage.com)

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## I. Safety

### Hazard Statement Definitions



**WARNING:** Refers to hazards or unsafe practices which could result in death, severe personal injury, or significant equipment damage.



**CAUTION:** Refers to hazards or unsafe practices which could result in damage to equipment or in personal injury.



**WARNING:** Before installing, operating, maintaining, or testing this equipment, carefully read and understand the contents of this manual. Improper operation, handling, or maintenance can result in death, severe personal injury, or equipment damage.



**WARNING:** This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply may result in death, severe personal injury and/or equipment damage.



**WARNING:** Hazardous voltage. Do not rely on the contact position indicator to determine that the line has been de-energized. Always establish a visible disconnect and establish person grounds when performing de-energized line work. Failure to follow proper safety practices can result in contact with high voltage, which can cause death or severe personal injury.



**WARNING:** Hazardous voltage. Contact with high voltage will cause serious personal injury or death. Follow all locally approved safety procedures when working around high voltage lines and equipment.

## II. General Description

The VBM switch is manufactured in voltage ratings from 15kV to 69kV with continuous current capabilities from 200 amperes. The mechanism may be operated manually, or electrically by solenoid or motor operators.

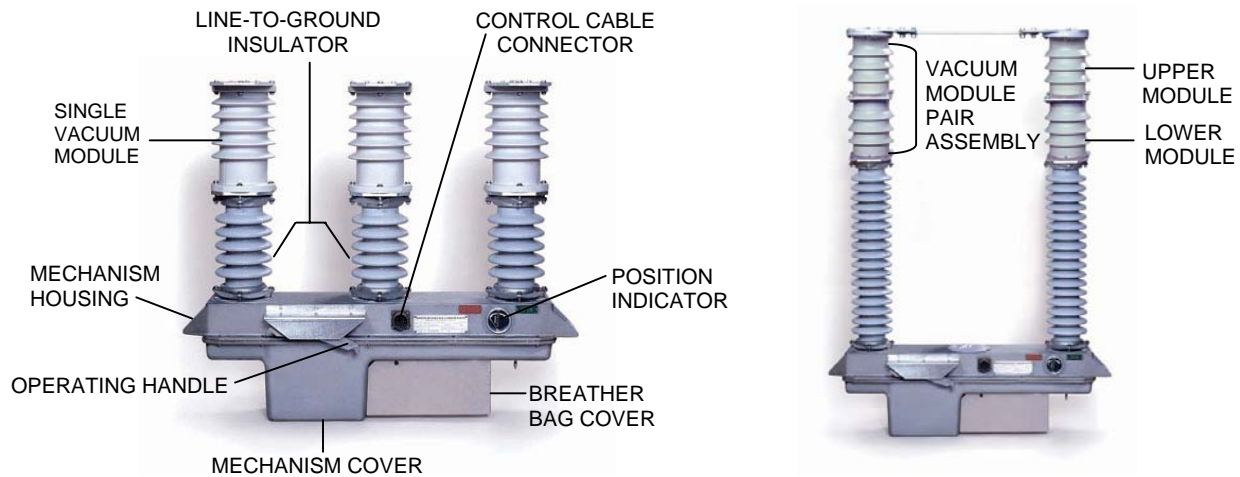


Figure 1: Diagram VBM Switch

The assembly containing the vacuum interrupter is called a module (Figure 2). Each module has a vacuum interrupter contact sealed in Joslyte, a solidified foam which provides mechanical strength, high dielectric strength and complete moisture sealing. The module housings are cycloolephetic or EPR rubber bonded to a fiberglass tube. One or two modules are mounted on each insulator and connected to the mechanism by a high strength pull rod.

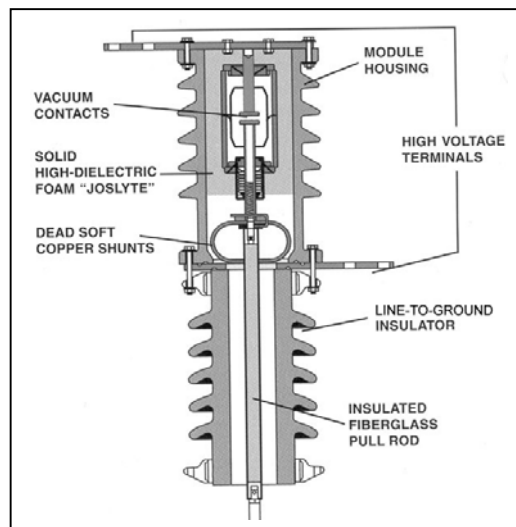


Figure 2: Cutaway Drawing of a Single Vacuum Module on 15kV Line-to-Ground Insulator

The VBM is offered with two types of mechanisms: motor and solenoid.

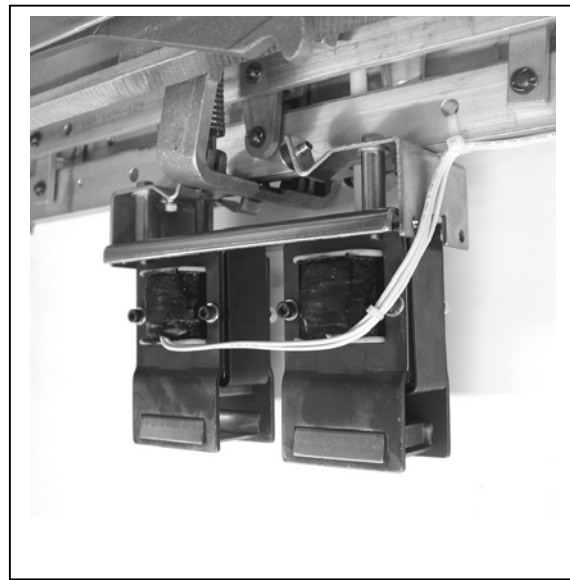
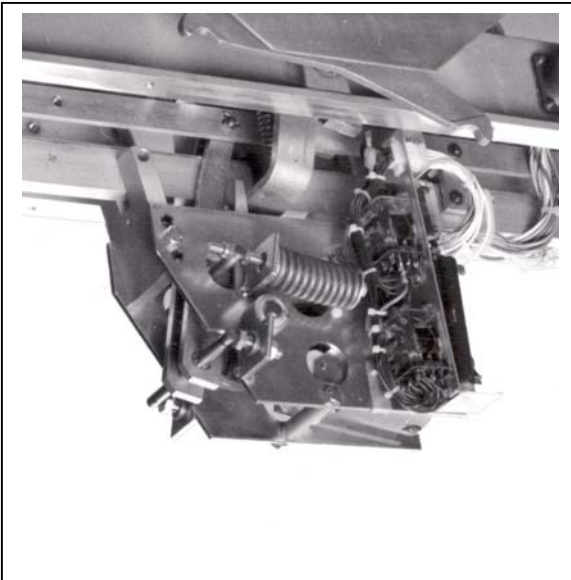


Figure 3a: Motor Operator  
(For single mechanism switches only)

Figure 3b: Solenoid Operator

The completely sealed operating mechanism housing supports line-to-ground insulators and the modules. An expansion bag in the housing prevents “breathing-in” contaminants or moisture and contains a desiccant package to maintain dry air.

All electrical control connections to the mechanisms are made through a single environmental control cable connector.

An “Open-Closed” position indicator is directly coupled to the mechanism. A separate operating crank enables manual operation of the switch. The entire assembly can withstand several G’s without damage. Depending upon rating there may be one or more mechanisms for a three-phase switch.

### III. Installation

#### Inspection and Uncrating

Carefully inspect the equipment on arrival. Contact carrier and file a claim if damaged during shipment.

Remove crating or carton surrounding the VBM switch. Do not unbolt switch from the wooden base to prevent accidental contact from knocking over switch.

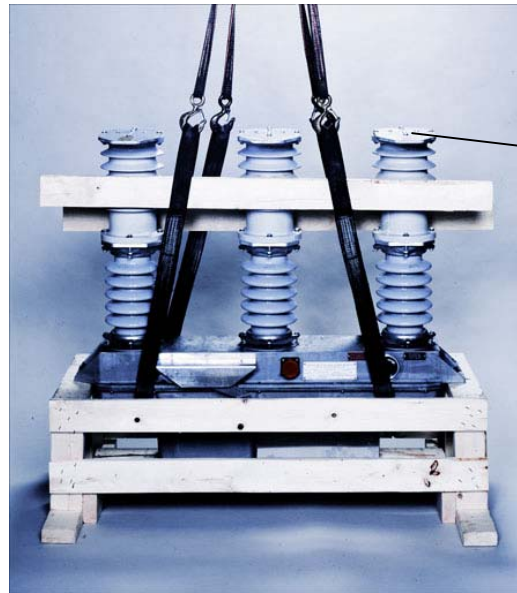


**CAUTION:** PERFORM A VACUUM INTERRUPTER INTEGRITY TEST DESCRIBED IN THIS SECTION, PRIOR TO PUTTING EQUIPMENT INTO SERVICE.

## Mounting


Attach an erecting sling to each mechanism as shown in Figure 4. Make certain the lift is stabilized. Remove the three nuts holding VBM to wooden base. Hoist the switch to its mounting location with the manual operating handle facing the desired direction. Fasten the VBM to its mounting with three 5/8" bolts and remove the erecting sling.

**CAUTION**  
The two boards shown are for stabilization only. Be careful that the sling exerts no forces on the vacuum contacts or insulators.



**CAUTION**  
Do not lift from terminal pads

Figure 4: Typical Erecting Sling

 **CAUTION: THE STRUCTURE AND VBM MECHANISM HOUSING MUST BE SOLIDLY GROUNDED.**

**Control Power**

A variety of control voltage options are available. Refer to the table below.

Control Voltage	Operating Mechanism	Control Current Per Switch Mechanism	Close Time	Trip Time
48 VDC	Motor <sup>1</sup>	3 amps	5 sec	2 cycles
	Solenoid <sup>4</sup>	60 amps <sup>3,4</sup>	6 cycles	6 cycles
	Reclosing	7 amps	6 cycles	3 cycles
125 VDC	Motor <sup>1</sup>	4 amps	3 sec	2 cycles
	Solenoid	60 amps <sup>2</sup>	6 cycles	6 cycles
	Reclosing	7 amps	6 cycles	3 cycles
120 VAC	Motor <sup>1</sup>	5 amps	3 sec	2 cycles
	Solenoid	60 amps <sup>3,4</sup>	6 cycles	6 cycles
	Reclosing	7 amps	5 cycles	3 cycles
250 VDC	Solenoid	60 amps	6 cycles	6 cycles

**Note 1:** Motor operating mechanisms are designed for single mechanism switches.

**Note 2:** Current is 60 amperes peak for one, two, or three mechanism switch systems.

**Note 3:** Current is 120 amperes for 34.5kV 300A VBM.

**Note 4:** Current for three mechanism switch systems is approximately 180 amperes.

Control power must meet the requirements of the drawing supplied with the switch. Refer to the appropriate power input tables for proper requirements.

**Solenoid Operated Switches**

Direct Energy DC Operated VBM Switch	3045A0176
Direct Energy AC Operated VBM Switch	3045A0169

**Motor Operated Switches**

5A max during operation
-------------------------



**CAUTION:** FAILURE TO COMPLY WITH THE CONTROL POWER AND WIRING REQUIREMENTS MAY RESULT IN SWITCH MALFUNCTION OR DAMAGE.



### Control Wiring

All control connections to the VBM switch are made through either of the following methods:

- a. Environmental cable and connector. The cable may be shortened to desired length if supplied with a connector on the switch end only.

**NOTE:** For multiple mechanism switches, all cable lengths should be cut to the same length. Connection to the control enclosure must be in accordance with the specific wiring diagram for the system supplied.

- b. A junction box mounted on the housing wired to the mechanism through conduit.

### High Voltage Connections

The terminal pads are aluminum alloy with standard NEMA two-hole drilling. The electrical connection at the terminal pad must be treated with Alcoa No. 2 joint compound or equivalent. Wire brushing through the compound will improve the connection.

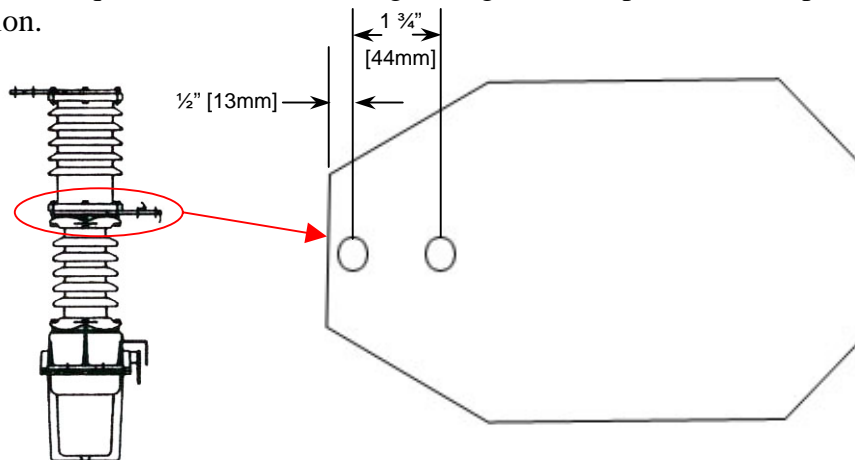


Figure 5: Terminal Pad Diagram

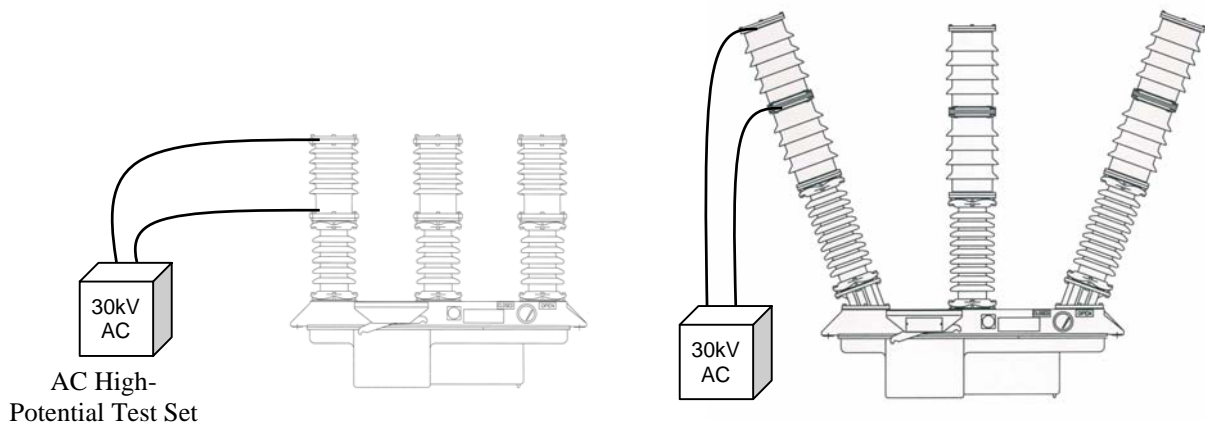
## Vacuum Interrupter Integrity Test

Two tests, high potential withstand and contact resistance, may be performed to evaluate the vacuum contacts. They should be performed across each module separately. Figure 6 indicates connection points for vacuum module assemblies.

### High Potential Withstand



**WARNING:** DISCONNECT ANY HIGH VOLTAGE CONNECTIONS TO THE SWITCH PRIOR TO HIGH POTENTIAL TESTING.



### *Test Performed with switch in OPEN position*

Figure 6: AC High Potential Test Set Connections

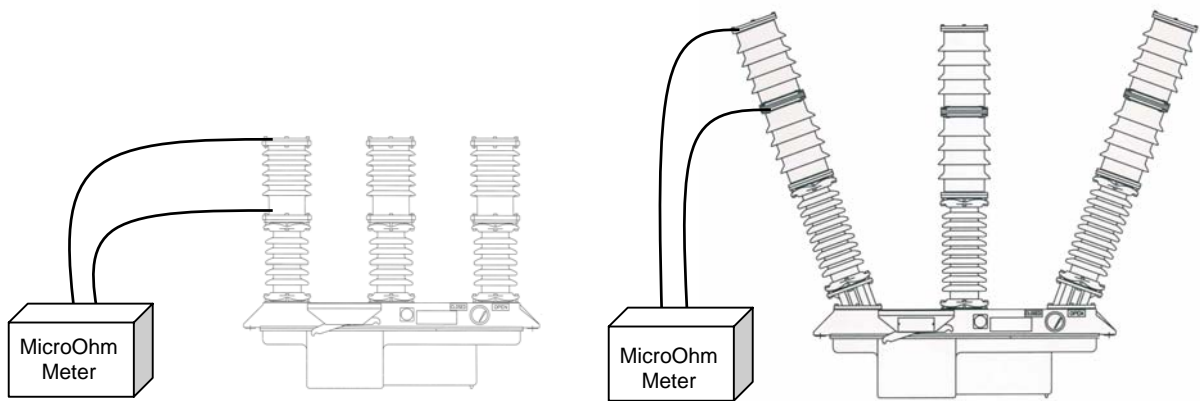
**NOTE:** Test each module separately

Loss of vacuum results in complete breakdown across an open vacuum contact at voltages below 30kV RMS. Only AC high potential testing is meaningful. DC testing cannot be used. Apply 30kV RMS across each individual contact for 15 seconds with the switch open. To avoid possible generation of X-rays, do not apply more than 30kV RMS.

During the high potential testing, self-extinguishing, momentary breakdowns lasting only a few microseconds may occur. These “barnacles” are not significant but can result in false indication of vacuum loss, if the test set utilizes a high speed overload relay or breaker.

During normal operation with the switch in service, loss of vacuum or a defective switch module may be indicated by excessive radio noise with the switch open or observation of different surface temperatures of modules on the same switch. See Joslyn Engineering Memo TD 750-918.

Vacuum Contact Resistance Test



*Test Performed with switch in Closed position*

Figure 7: Contact Resistance Test Connections

**NOTE:** Test each module separately

With the switch closed, the resistance across each module should be less than 200 micro-ohms. On switches with modules connected in parallel for higher current operation, remove the connecting bus to perform this test. If higher resistance values are measured contact Joslyn Hi-Voltage.

## IV. Servicing

### Tools Required

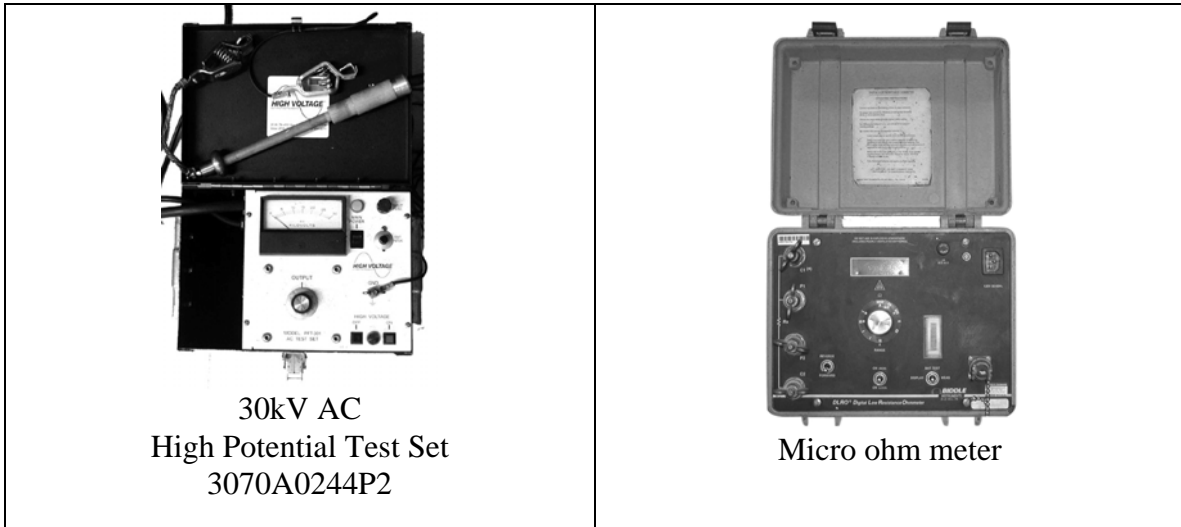
Servicing of VBM switches is easily accomplished by referring to the appropriate section of these instructions. The following tools are required:



3090X0014G1 VBM Adjustment and Repair Kit

The kit above includes the following items:

PART NUMBER	DESCRIPTION
3090X0014P1	Brightstar 1618CT Magnet Flashlight
3090X0014P3	Mounting Fixture 3090B0005G2
3090X0014P5	Starrett Indicator
3090X0014P7	Torque Wrench (10-200 in-lbs.) 3/8 drive
3090X0014P8	Torque Wrench Preset – 50 in. lbs.
3090X0014P11	1/2-3/8" Drive
3090X0014P12	5/16" Wrench
3090X0014P13	7/16-3/8" Socket
3090X0014P14	3/8" Wrench
3090X0014P15	Phillips No. 3 Screwdriver
3090X0014P16	Flat Tip 1/8" Screwdriver
3090X0014P17	7/16" Wrench
3090X0014P18	9/16" Wrench
3090X0014P19	3/4" Wrench
3090X0014P21	Tool Box
3090X0014P22	3/16" Allen Socket
3090X0014P23	Dow Corning
3090X0014P25	Adjustment Gauge 1 degree
3090X0014P26	Go-No-Go Gauge 3090A0012P1



**Replacement Parts**

Replacement parts are available from our factory in Cleveland, Ohio. Furnish complete nameplate data and the Joslyn Hi-Voltage GO order number applying to the original purchase, along with description of the part and quantity required.

**Removal and Replacement of the Housing Cover and Breather Bag**

The parts necessary to replace the breather bag are as follows:



Breather Bag

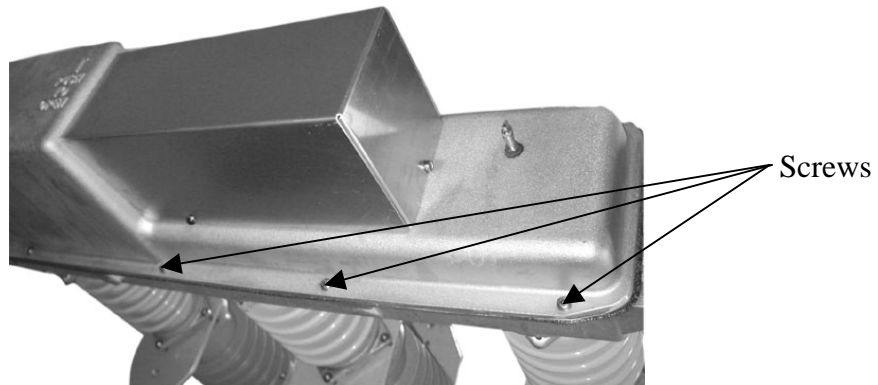


Desiccant Bag

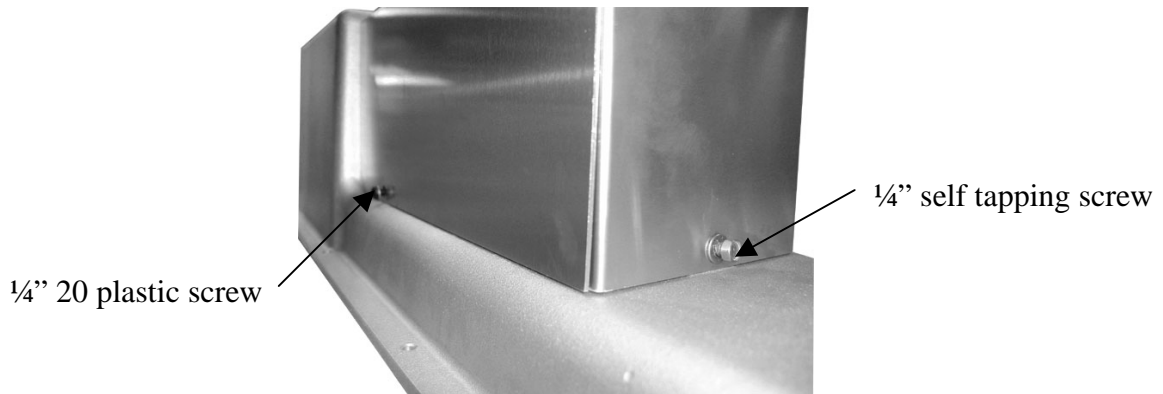


Clamping Plate

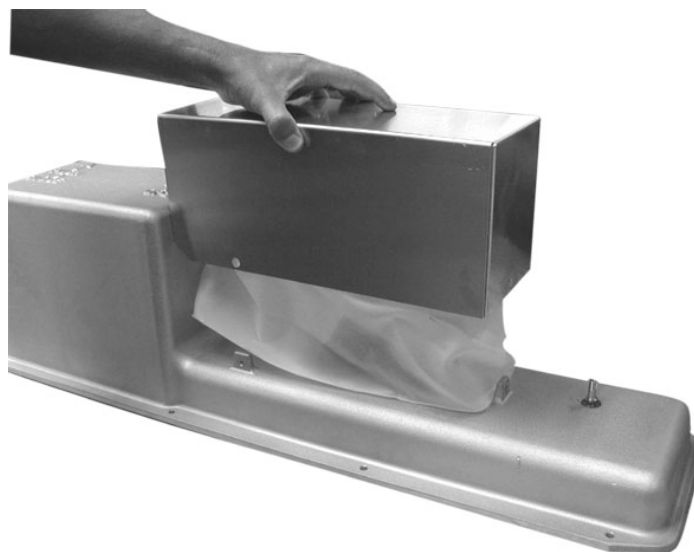
1. Place the switch on a table or use a stand to access the bottom of the switch. Remove the ten (10) or twelve (12) screws that hold the mechanism cover to the switch base.



2. Remove three (3) cover screws from breather bag cover.



3. Remove breather bag cover.



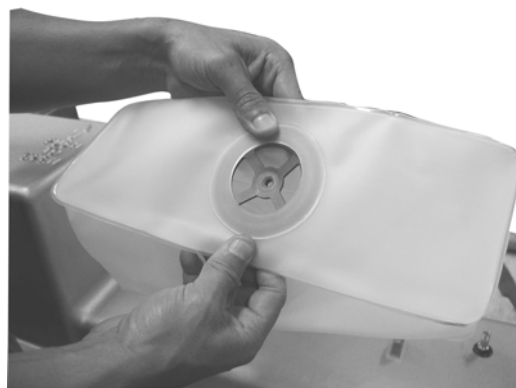
4. To remove breather bag, turn base over and remove 7/16" nut leaving the holes exposed. Turn base back over to and remove breather bag.



5. Put desiccant bag inside breather bag.



6. Put clamping plate into breather bag with beveled side facing inside the bag. The flange of the clamping plate and breather bag **MUST** be aligned properly otherwise it will not seal.



- Place bolt back through the center hole and attach breather bag by screwing the 7/16" bolt. Make sure the breather bag is sealed around clamping plate.



- Replace breather bag cover by tightening the three screws.
- Replace mechanism cover to the base of the switch by securing the ten or twelve cover screws.

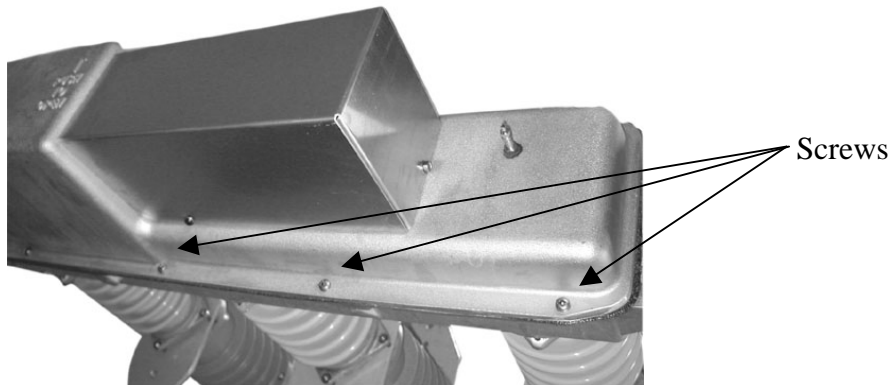
## Removal and Replacement of a Vacuum Module Assembly

### Removal

One or two modules are mounted on each insulator depending on switch rating. Module pair assemblies should not be separated in the field because special tools are required for assembly and adjustment. Furthermore, if a switch's breather bag ruptures, all vacuum modules on that switch must be replaced.

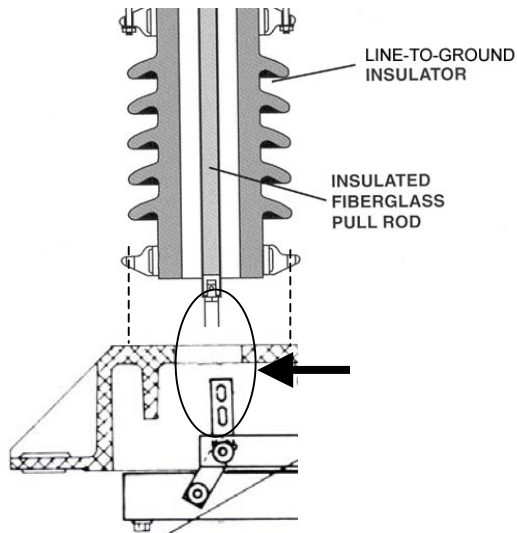
To remove a module assembly, disconnect all power from the VBM and remove the mechanism cover.

- Place the switch on a table or use a stand to access the bottom of the switch. Remove the ten (10) or twelve (12) screws that hold the mechanism cover to the switch base





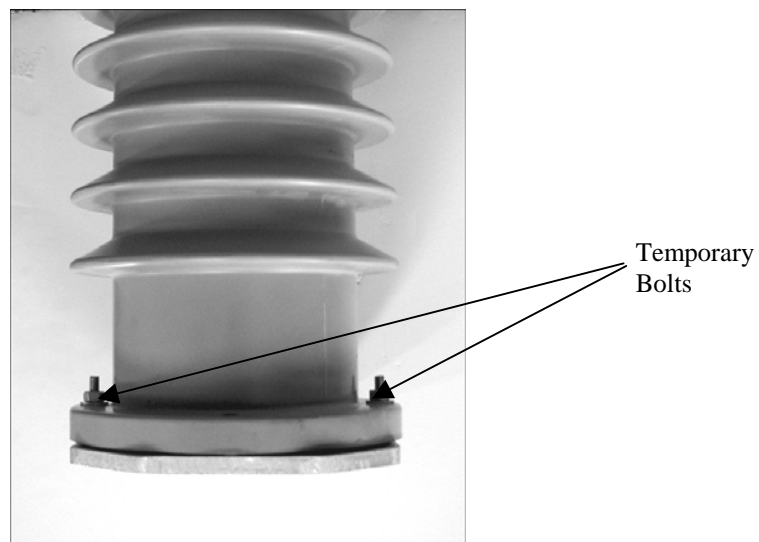
2. Disconnect pull rod from the switch mechanism by removing two bolts and washer plates.



3. Remove four bolts at top of insulator and lift module assembly complete with lower terminal pad and pull rod from the insulator. Insulators may be removed by taking out four cap screws holding them to switch base.

**Preparation of the Replacement Module Assembly**

1. Remove the bolts temporarily holding the lower terminal plate to single replacement modules.



Replacement Module with Temporary Bolts

2. Apply silicone grease (Dow Corning DC III or equivalent) to gasket channel and reuse rubber gasket if in good condition.



**CAUTION:** WITH THE BOLTS REMOVED, EXTREME CARE MUST BE USED NOT TO PUT ANY FORCE WHATSOEVER ON THE LOOSE TERMINAL PAD SINCE THIS FORCE WOULD BE DIRECTLY TRANSMITTED TO THE DELICATE BELLOWS OF THE VACUUM MODULES. ANY TWISTING COULD RESULT IN IMMEDIATE LOSS OF VACUUM.

3. Attach pullrod to the vacuum module. The double module assembly consists of two modules in series, an upper terminal plate and a lower terminal. It should not be disassembled. The single module and module pair assemblies are mounted in the same manner. An aluminum clevis link may be bolted in the mechanism end of replacement pull rods. If so, remove the aluminum clevis link and discard it. DO NOT attempt to replace the link already in the mechanism.

All single replacement modules are supplied with a separate “screw-on” pull rod. It is installed by slowly screwing onto the bolt in base of the module. Stop as thread bottoms to avoid putting any stress or strain on the vacuum contact. Back the rod off a maximum of one turn as required to mate with the clevis link on mechanism.

NOTE: Do not overtighten pull rod to module.

Earlier modules utilized either a permanently attached pull rod or a “screw-in” design. To replace a “screw-in” pull rod, slip the 1” nylon bushing supplied over the bolt end of the rod and slowly screw into the threaded module base. Stop as thread bottoms and back rod out approximately three full turns as required for proper orientation with the mechanism.

Double module assemblies of the present design utilize a pull rod which is bolted to a draw bar in the lower module. All necessary hardware is supplied with replacement double module assemblies. The former design utilized a “screw-on” pull rod system.

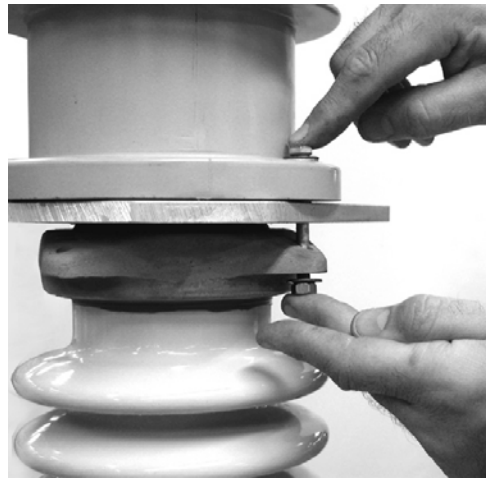
All module assemblies are interchangeable and may be used on the same mechanism, regardless of type of pull rod, however using a present and former design double module pair assembly on the same mechanism requires special considerations. If this situation is required, contact Joslyn Hi-Voltage.



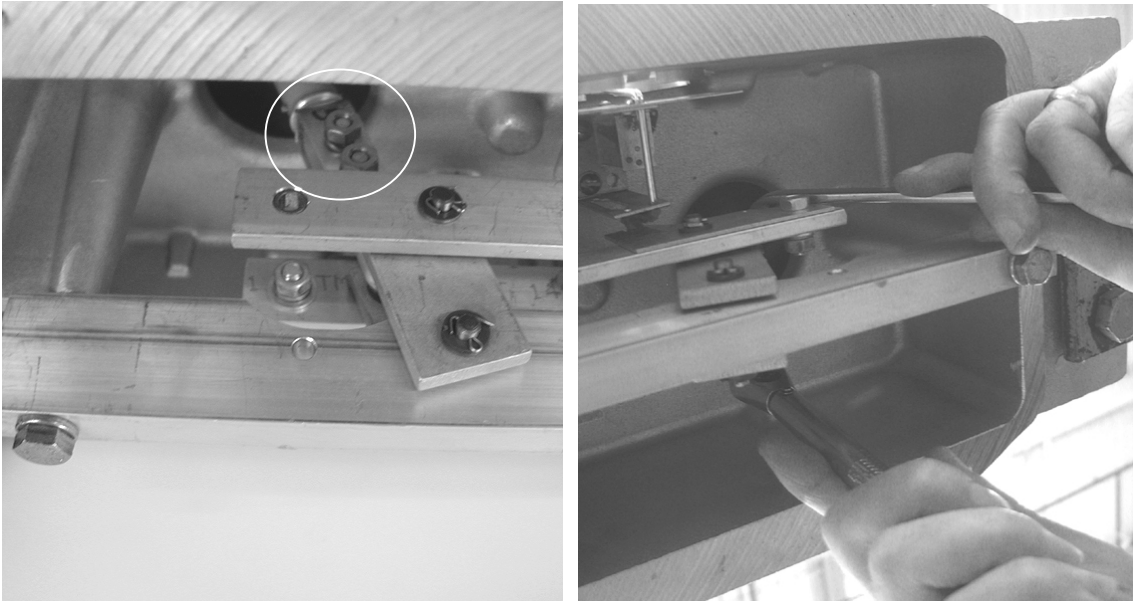
**CAUTION: BUMPING OR TWISTING ANY PULL ROD WHEN ATTACHED TO A MODULE CAN DAMAGE THE VACUUM INTERRUPTER AND REDUCE ITS LIFE.**

**Mounting the Replacement Module Assembly**

Insert pull rod through insulator with module terminals in proper position. Fasten the replacement module to insulator with the 1/4" bolts, nuts, and washers from the original module. Tighten the bolts evenly.



In mounting insulators and vacuum switch modules, particular attention should be paid to torque values. If a bolt head or nut bears on porcelain it should be torqued to 25 inch-pounds, otherwise torque to 50 inch-pounds.



With switch mechanism closed, attach pull rod to the steel clevis link of the mechanism with bronze bolts, nuts, lockwashers, and stainless steel washer plates placed outside the pull rod side pieces. Do not tighten the nuts to facilitate adjustment/synchronization.

### **Synchronization of Replacement Module Assembly**

Operation of a replacement module assembly must be synchronized with other module assemblies on the mechanism. Module pair assemblies are synchronized using the lower contacts only. Synchronization refers to the difference in overtravel of modules (or lower contacts of module pair assemblies) on the same operating mechanism. Although the actual overtravel measurement can vary depending upon the ambient temperature, synchronization is not affected by the ambient temperature.

**NOTE:** Do not attempt to synchronize a lower module with an upper module on a module pair assembly.

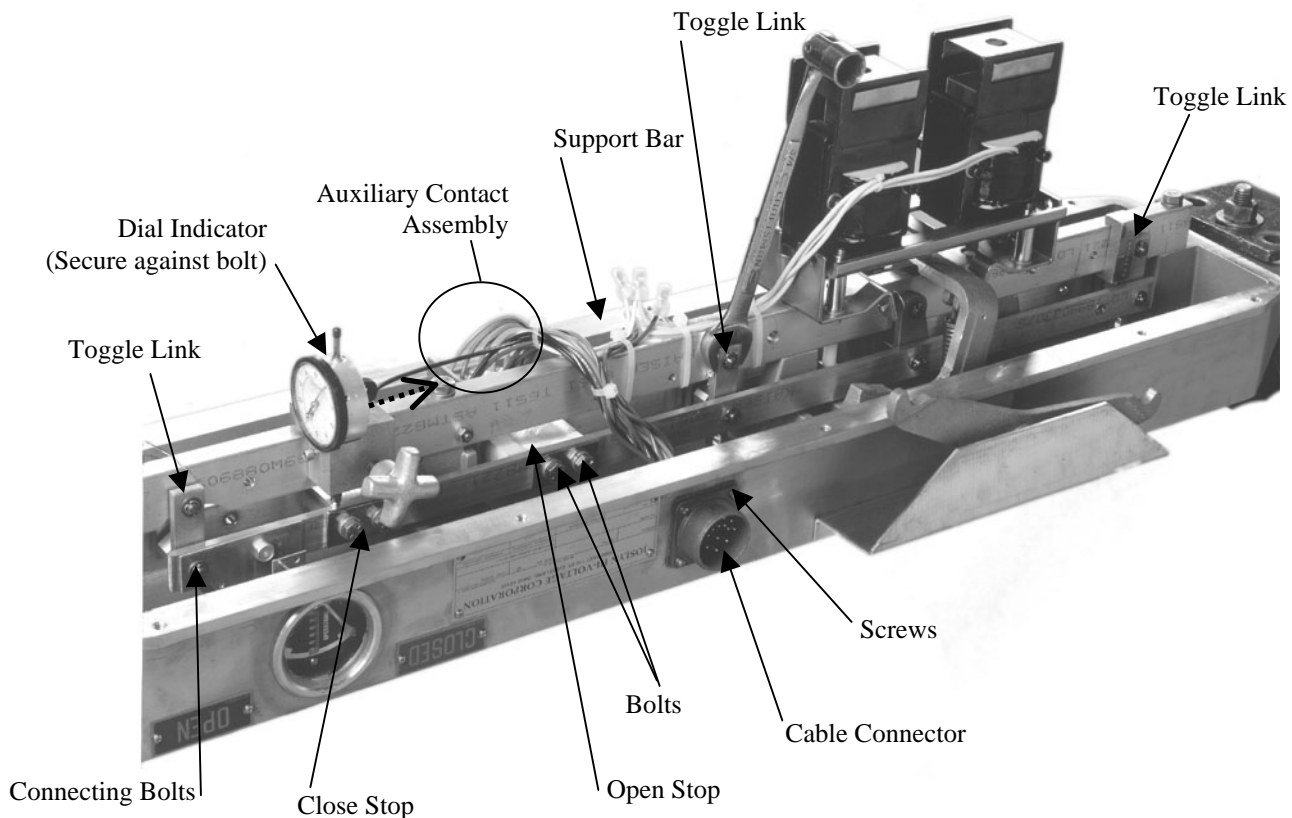


Figure 8: Synchronization of Replacement Module Assembly

1. Place the continuity lamps across all modules connected to line-to-ground insulators on the mechanism.
2. Attach a dial indicator to the mechanism to measure vertical movement of the switch actuating bar. Joslyn recommends the dial gauge indicator be positioned against the bolt head as indicated by the arrows in Figure 8. It is shown out of position to enable photographing of other components.
3. Closed Position Initial Reference. Put switch in closed position. The close stop should be positioned so that toggle links are toward the open position of the switch.

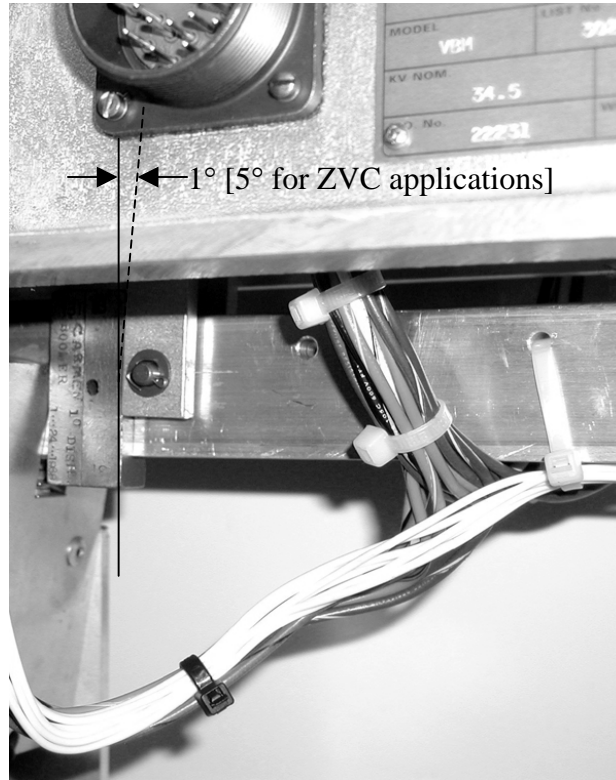
If adjustment is necessary, loosen the clamping bolts, reposition, and retorque to 120 inch-pounds. Adjust dial indicator to zero.

**For VBMs with Standard Controls**

The toggle links should be about 1 degree off vertical.

**For VBMS with Zero Voltage Closing Controls**

The toggle links should be about 5 degrees off vertical.



4. Full Travel. Put switch in open position. Dial indicator should read  $0.205'' \pm 0.005''$ . If out of tolerance, adjust open stop. Refer to Figure 8. Retorque bolts to 120 inch-pounds.
5. Overtravel. With switch in closed position, slowly move the mechanism toward the open position with  $\frac{3}{4}''$  wrench on a toggle link. Observe the dial gauge reading at which the continuity light(s) on the other module(s) goes out. This movement measured is the "OVERTRAVEL". At ambient temperatures between  $50^{\circ}\text{F}$  and  $80^{\circ}\text{F}$  the lights should go out at  $0.040'' \pm .004''$  travel. Insert a spacer between the close stop and bumper to hold the mechanism at a reading midpoint between opening readings of the two other module assemblies, or at the same reading if there are only two module assemblies on the mechanism. The spacer should be inserted on the opposite side from that shown in Figure 4. Torque the connecting bolts on the replacement assembly pull rod to 75 inch-pounds.
6. Synchronization. Remove the spacer and close the mechanism. Slowly open the mechanism and observe the continuity lamps. Note the dial readings at which the replacement and adjacent modules open. The last lamp must go out within  $.005''$  mechanism travel after the first lamp. If synchronization is not

achieved, loosen pull rod varying the “set” position in appropriate direction until all single or lower contacts open within 0.005” of mechanism travel.

7. After module pair assemblies have been synchronized using the lower contacts only, the synchronization between upper and lower contacts should be verified. The synchronization of upper and lower contacts is related to ambient temperature. At temperatures between 50°F and 80°F the dial gauge should measure a maximum of 0.010” travel of the actuating bar between the opening of each lower contact and its corresponding upper contact.

### Switch Operators

#### The Solenoid Operator

In the single solenoid operator, two solenoids, one for opening and one for closing are used to move a toggle linkage over center releasing stored spring energy to open and close the vacuum contacts. This operation is sequentially described in Figure 9.

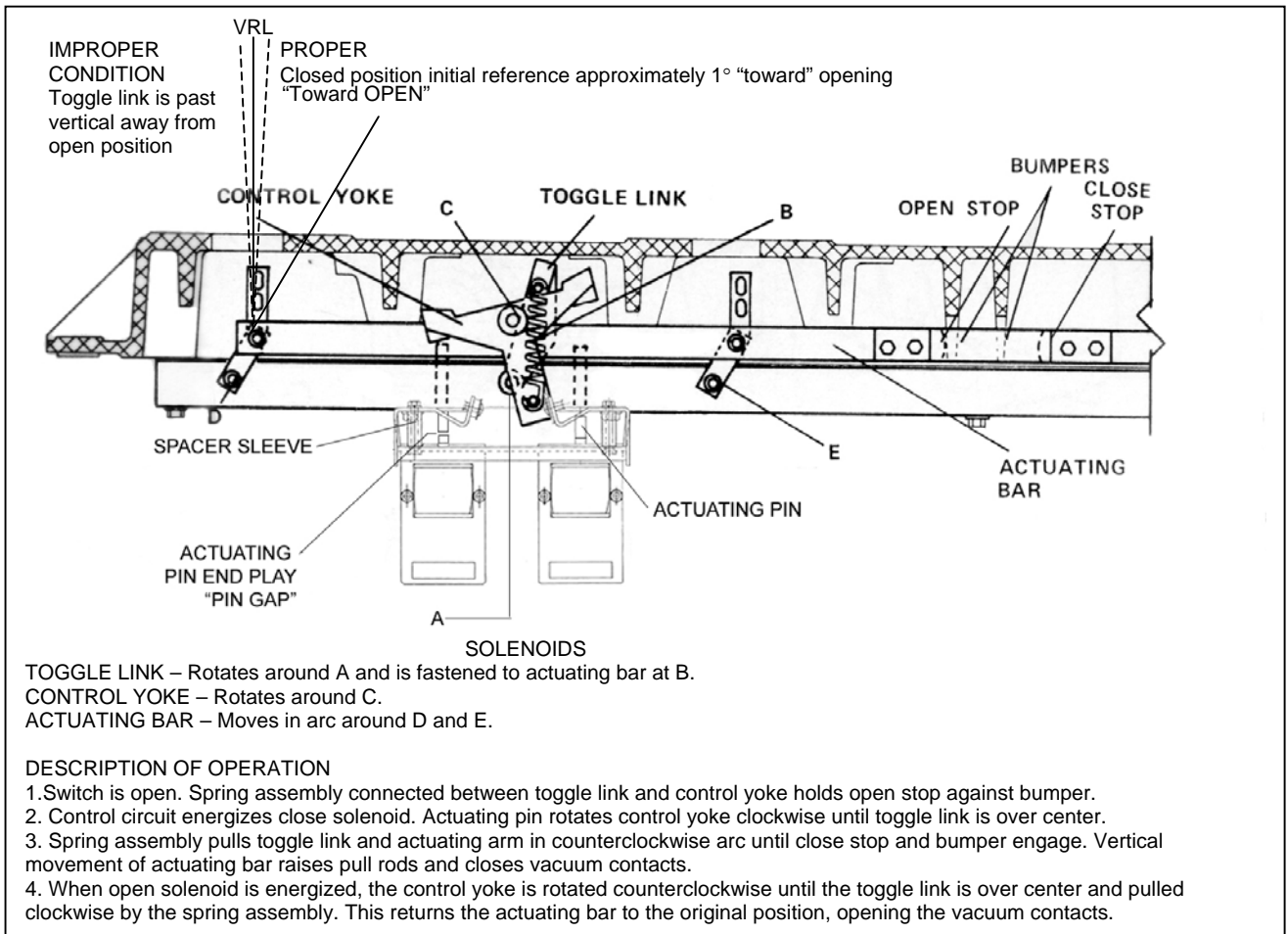


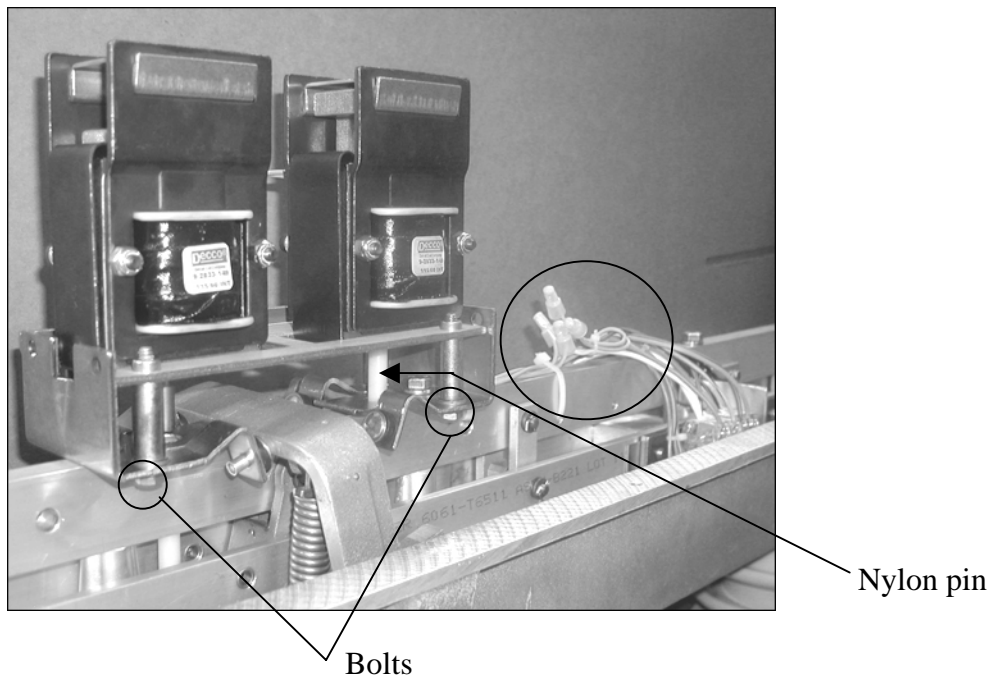
Figure 9: Description of Operation

Some solenoid operators use a double solenoid assembly which utilizes two solenoids each for close and open operation. The operation and maintenance of the double



solenoid operator is similar to that described for the single solenoid operator. The switch may be operated manually using a switch hook. An operating crank is located on the switch housing. The crank ends are notched to receive a switch hook. To close the interrupter, place a switch hook in the notch above the words “push to close” and push. This moves the toggle linkage over center, releasing spring energy to close the contacts at high speed independent of speed at which the arm is pushed. To trip, or open the interrupter, place the switch hook in the notch above the words “push to open” and push.

- a. Solenoid Assembly Replacement. Open splicing connectors on the yellow solenoid wires. Leave wires as long as possible.



Remove four bolts (two visible in picture) and the solenoid assembly is released.

As the assembly is removed, the nylon actuating pins will fall out. One or both solenoids can be replaced by removing and replacing the appropriate bolts holding the assembly together, however replacements solenoids are sold as an assembly. All bolts should be torqued to 70 inch-pounds.

To remount the solenoid assembly, insert nylon actuating pins and position the assembly. Torque four mounting bolts to 150 inch-pounds. Connect the four black solenoid coil leads to corresponding wires using new insulated compression splices.

To insure operating components freedom of movement necessary to achieve proper operation speed, use a feeler gauge to check pin gap of each actuating pin.

The gap should be .070 and .090". Manually change the switch position to check opposite pins. Pin gap is adjusted by adding or removing flat washer shims under nylon spacer sleeves.

The Motor Operator

A series motor drives a cam which loads a spring assembly. When the springs are fully loaded, the cam releases a linkage closing the vacuum switch using one-half the energy in the spring assembly. A low energy solenoid releases the remaining energy in the spring assembly through the same linkage to open the interrupter. Operation is sequentially described in the following figures. The design inherently prevents closing the switch, unless sufficient energy to trip is stored in the spring assembly.

The VBM motor operator is designed to operate at 24VDC, 48VDC, 125VDC, or 120VAC depending upon application.

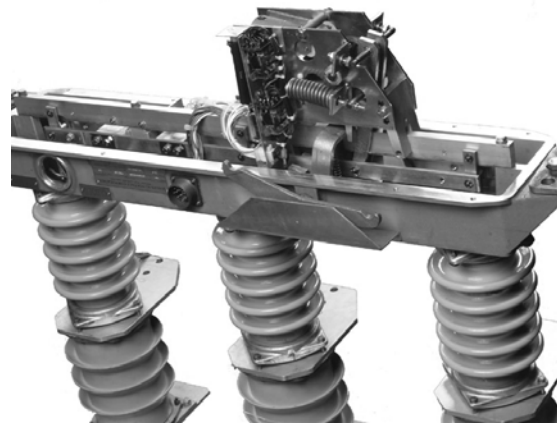


Figure 10: VBM Motor Operator Picture

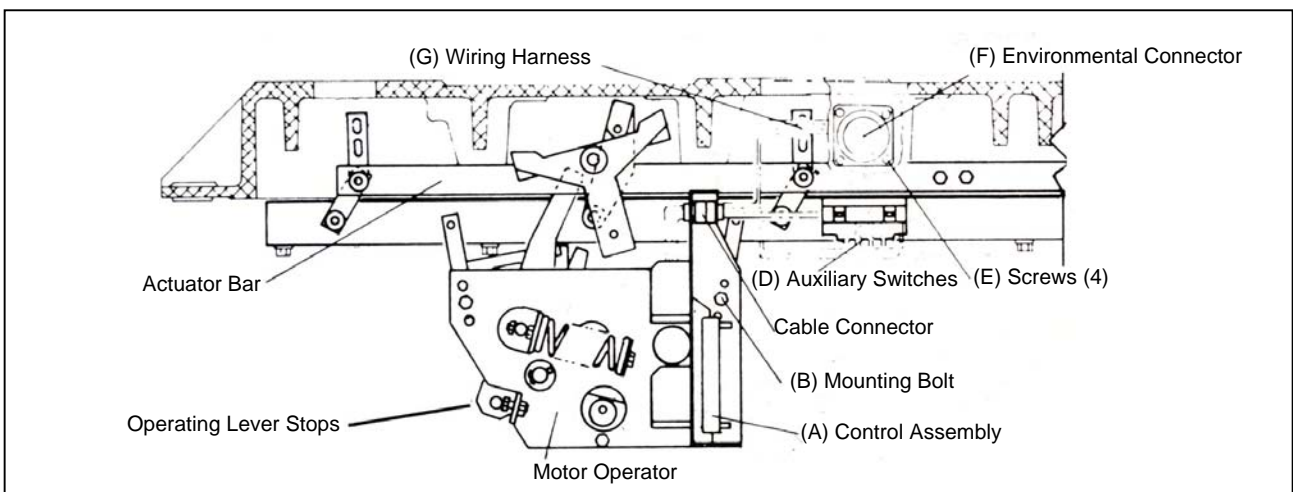


Figure 11: VBM Motor Operator Diagram

Description of Operation

The following figures illustrate the sequential operation of the assembly. The motor operator lever is connected to the switch actuating bar at point M. The actuating bar linkage is connected to the pull rods (not shown) of each module assembly.

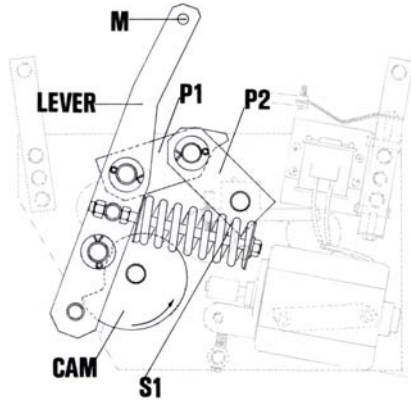


Figure 12: Sequence of Motor Operation

1. Switch is open.
2. Toggle links P1 and P2 are in relaxed position.
3. Spring assembly S1 is unloaded.
4. Cam is rotated counter-clockwise by motor or manual pumping.

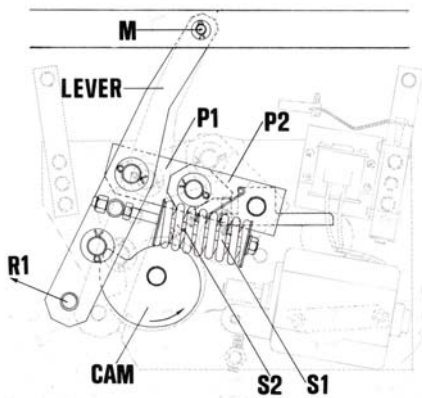


Figure 13: Sequence of Motor Operation

5. Lever is displaced in direction R1.
6. Spring assembly S1 is compressed storing energy in springs.
7. Lever pulls toggle links P1 and P2 over center.
8. Toggle spring S2 brings toggle linkage in extended position against stop.
9. The switch is open and the mechanism is ready to close.

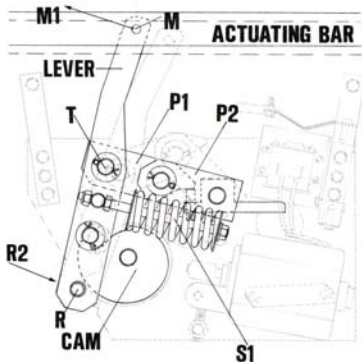


Figure 14: Sequence of Motor Operation

10. As spring assembly S1 is fully loaded the cam releases lever and stops.
11. Lever pivots around fulcrum T. Pin R moves in arc R2 and comes against motor assembly chassis stop using 1/2 total energy in spring assembly S1.
12. M is moved in arc M1. M's displacement moves the switch actuating bar and closes the interrupter contacts.

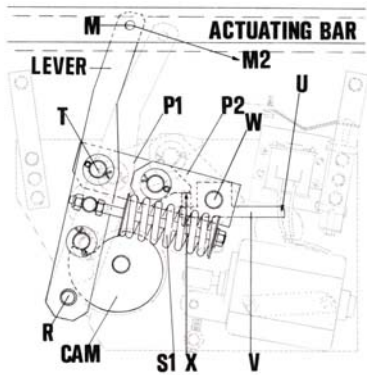


Figure 15: Sequence of Motor Operation

13. Switch is closed.
14. Solenoid exerts force U on lever V which pivots on fulcrum W exerting force X on toggle linkage P1 and P2.
15. Toggle link assembly is displaced. The remaining ½ total energy S1 pulls lever which pivots on fulcrum R.
16. M moves in arc M2 moving switch actuating bar and opening contacts.
17. The switch is open.

The switch may be operated manually using a switch hook. An operating crank is located on the switch housing. The crank ends are notched to receive the switch hook. To close the fault interrupter, place a switch hook in the notch above the words “Push to Close” and pump. After approximately 25 strokes, the switch will close. A unique rotary clutch allows strokes of any length to rotate the cam. A single swift push in the notch above the words “Push to Open” will trip the switch.

**NOTE:** SLOWLY PUSHING THE HANDLE WILL NOT PROVIDE ENOUGH ENERGY TO OPEN THE SWITCH.

Vacuum contact operating speed is independent of speed of manual activation.

The motor consists of a mechanical energy storage assembly and a control assembly. The control assembly is located in the base of the VBM switch. Connections to external circuitry are made through a control cable with environmental connectors.

## Servicing

### ELECTRICAL

- a. Control assembly (Figure 11):  
Remove entire controls assembly (A) by removing the mounting bolt (B) and disconnecting cable connector (C), and install new control assembly.
- b. Replace by disconnecting cable connector (C) and remove leads from terminals of auxiliary switch(es) (D). Remove four screws (E) which hold the environmental connector (F) and pull wiring harness (G) out of the housing. To install wiring harness (G), clean surfaces of casting where connector mounts. Apply a small amount of silicone grease to gasket of new connector. Install new harness (G) and rewire.
- c. Auxiliary switch(es) (D) (Figure 11):  
Refer to Auxiliary Switch Adjustment section.

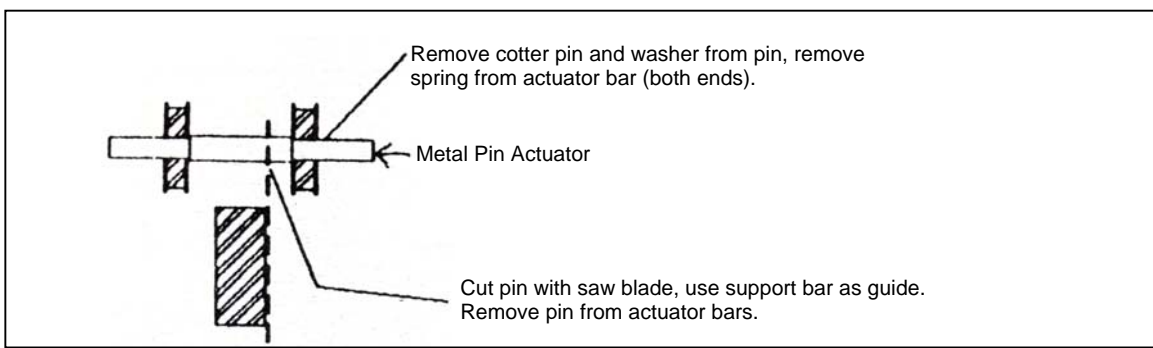


Figure 16: Removal of Old Metal Pin Actuator

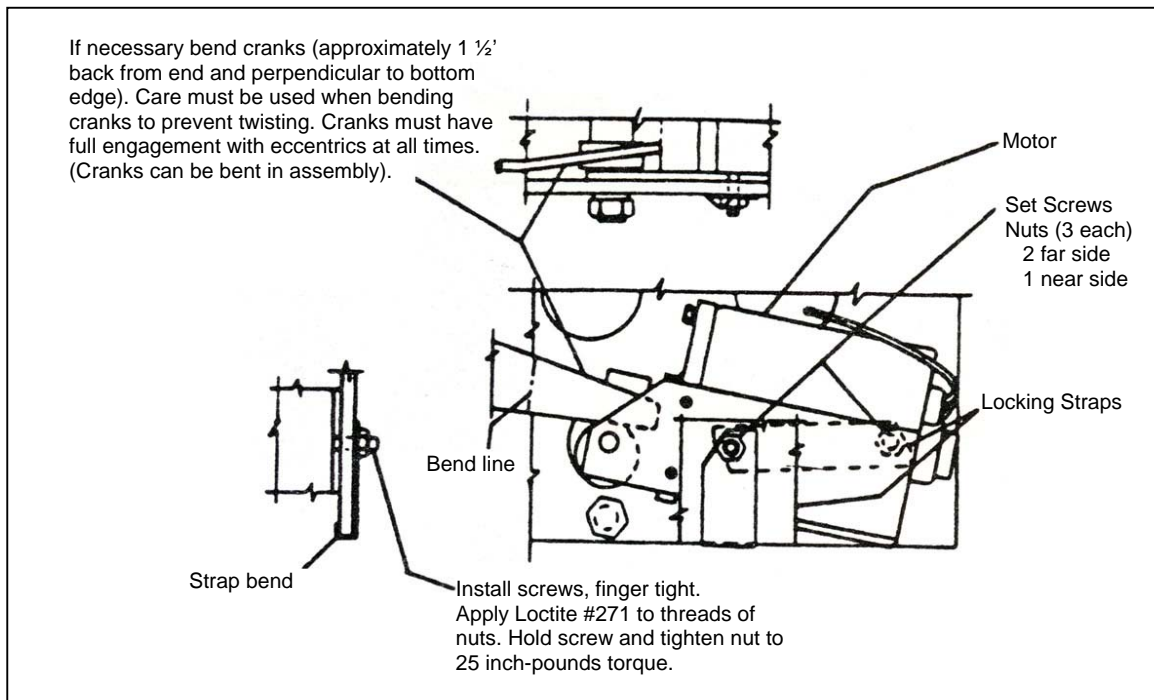


Figure 17: Removal of Motor

d. Motor

Not all motors are identical. When ordering replacement motors, the catalog number from the VBM nameplate must be supplied. New control panel may be required for obsolete motors.

1. Remove two set screws (if present)
2. Disconnect push-on connectors of motor leads from relay.
3. Deform locking strap and remove two bolts.
4. Remove motor.
5. Install motor using set screw.
6. Install locking straps and nuts using Loctite #271 on threads.
7. Bend corners of locking straps.
8. Bend both cranks.
9. Connect push-on connectors of motor leads to relay.

MECHANICAL

If a malfunction of the motor operator linkage occurs, replace the entire operator assembly (Figure 18). Two spring compressor devices are needed to hold and relieve pressure from the two main spring assemblies (S1 in Figure 12). Figure 16 shows where motor operator assembly is attached at points (L), (M) and (N).

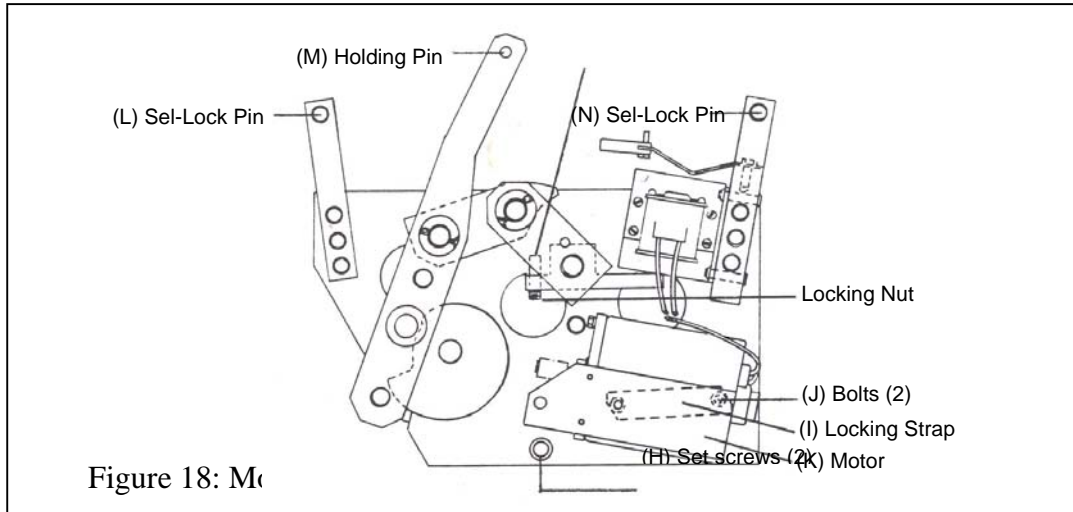


Figure 18: Motor Operator Assembly

- a. Remove entire controls assembly (A) by removing the mounting bolt (B) and disconnecting cable connector (C), and install new control assembly.
- b. Remove two cotter pins (not shown) holding pin (M). Remove pin (M).
- c. Remove Sel-Lock pins in holds (L) and (N) by driving them with an appropriate rod.
- d. Install new motor operator in reverse order. Re-use Sel-Lock pins.
- e. Adjust the motor operator as required.
- f. Verify position of the “close” and “open” stops of the VBM per the Synchronization of Replacement Module Assembly section with special attention to the “closed position initial reference”.
- g. Adjust main operating lever assembly stops of motor operator assembly (Figure 11). With VBM fault interrupter in the closed position, the pin “R” (Figure 14) should turn freely. There should be no contact between the pin “R” and the stops. A separation of 0.015” ± 0.005” between the pin “R” and the bolt heads should be achieved by adjusting the bolts. The separation should be equal on both sides so that symmetrical forces are imparted to the motor operator assembly as the VBM fault interrupter is opened.

- h. Adjust toggle link assembly stop (Figure 15) as follows:
1. Close VBM fault interrupter.
  2. Verify proper “closed position initial reference” is achieved per the Synchronization of Replacement Module Assembly section.
  3. Screw in toggle link assembly stop Q until VBM fault interrupter trips.
  4. Back the screw  $\frac{3}{4}$  turn.
  5. Close the VBM fault interrupter. Unit should not trip free. If it does, back screw out an additional  $\frac{1}{4}$  turn.
  6. The screw Q should not be backed out more than one turn from the reference point at which the VBM fault interrupter trips, as described in Step 2 above.
  7. After proper operation has been achieved, apply “C” grade Locktite to fix screw setting and tighten locking nut.
  8. Verify that operation of all vacuum modules are synchronized. Refer to Synchronization of Replacement Module Assembly under Servicing Section IV.

**Auxiliary Switch Adjustment**

Auxiliary Switch Adjustment (Switches Made After 1997)

While the switch is in the open position, place a shim with 0.100" thickness up between the close bumper stop and casting. Close the switch using the manual operating handle so shim is firmly held in place.

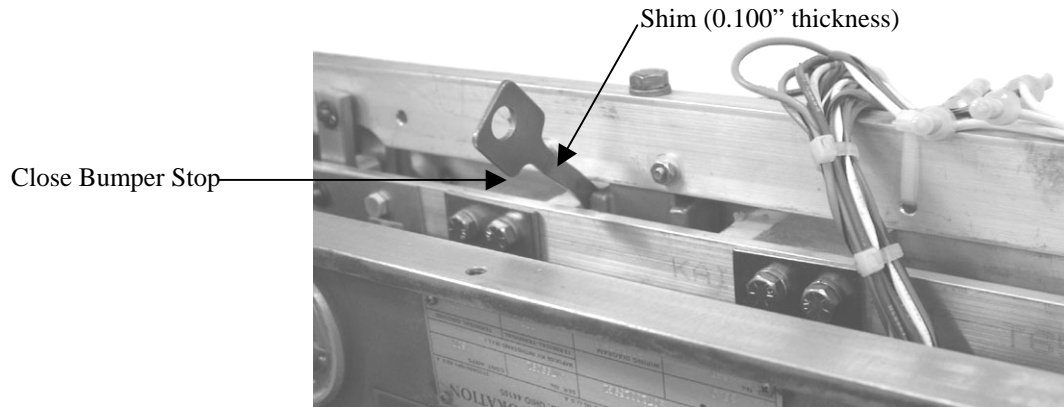


Figure 19: Shim Placement

Move auxiliary switch contact bracket so the spring is completely depressing plungers of auxiliary switch. Adjust the angle between spring and actuating bar to 88° to 90°. Tighten bolts on contact bracket. Open switch with the manual operating handle and remove the shim.

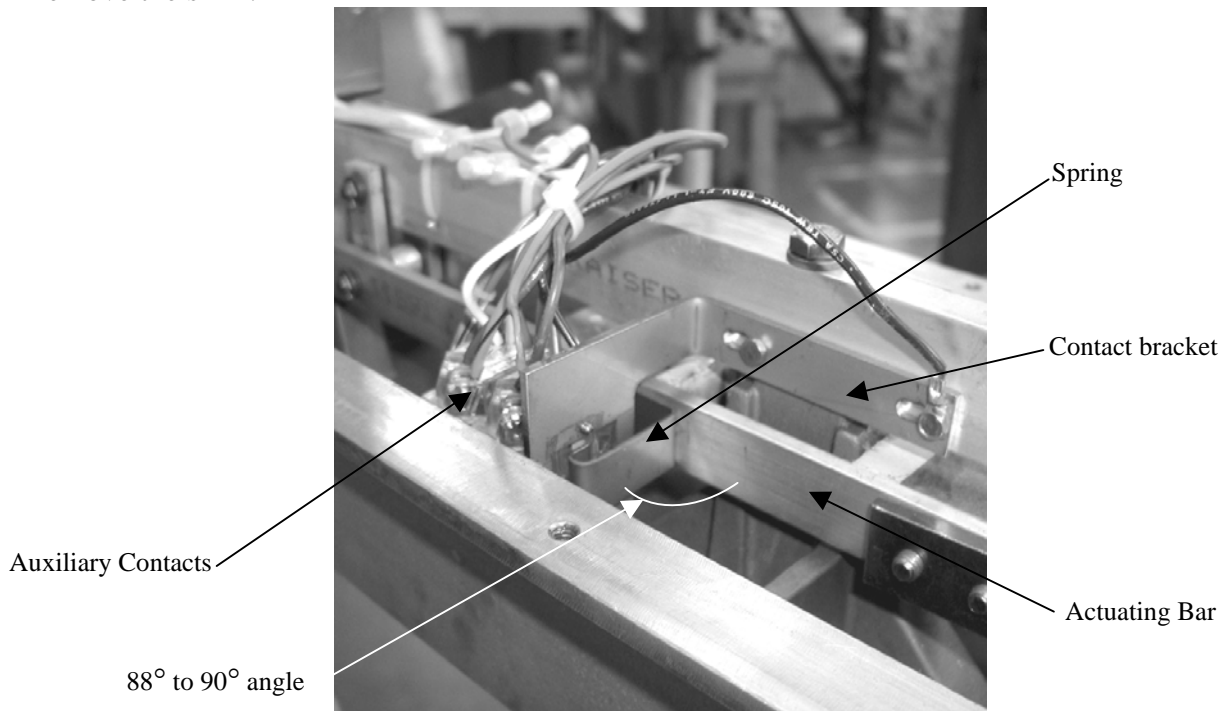


Figure 20: Auxiliary Switch Adjustment



Auxiliary Switch Adjustment (Switches Made Prior to 1997)

With mechanism in closed position, use a C-clamp to hold the operating crank to its cover, so the crank cannot move from the closed position. Attach dial indicator and set at zero. With a wrench on toggle link move the mechanism toward the open position. The auxiliary switch should operate at or before 0.175" vertical movement is indicated. Slowly return mechanism to closed position. The auxiliary switch should operate before the mechanism has returned to within 0.025" of the fully closed position. If adjustment is not correct, release bolts and reposition bracket in appropriate direction. Retighten the bolts and recheck operation. Repeat until auxiliary switch operations occur within the allowable range. Tighten bolts to 70 inch-pounds.

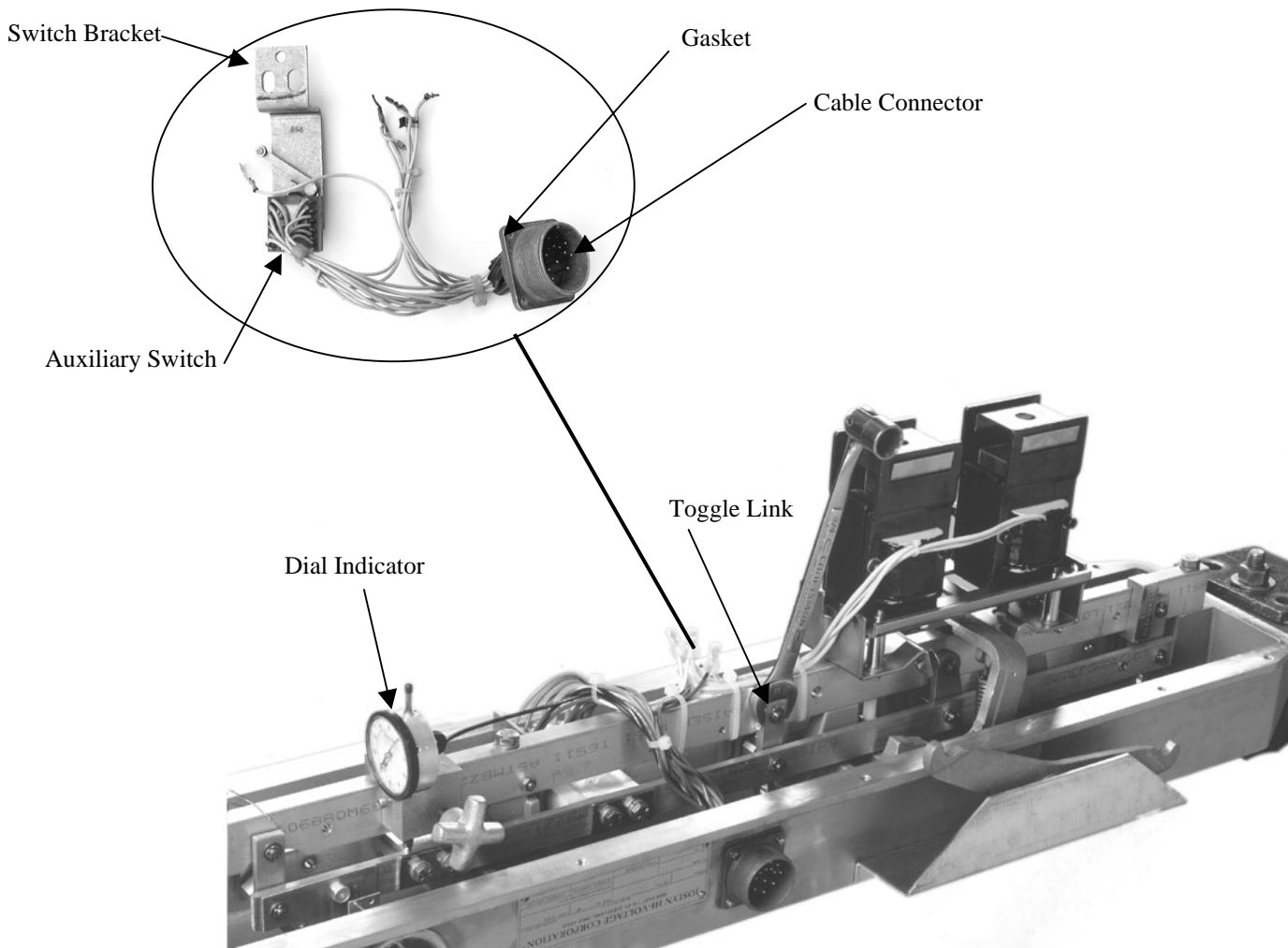


Figure 21: Auxiliary Switch Adjustment (Prior to 1997)

### Wiring Harness and Auxiliary Contact Replacement (Switches Made Prior to 1997)

The auxiliary switch (8) and cable connector (9) are integral parts of the wiring harness assembly. The entire assembly must be removed as a unit. Open splicing connectors on the four black solenoid wires. Remove the auxiliary switch bracket (10) from the support bar (11). Remove four screws (12) which hold the environmental control cable connector and pull wiring harness assembly out of housing.

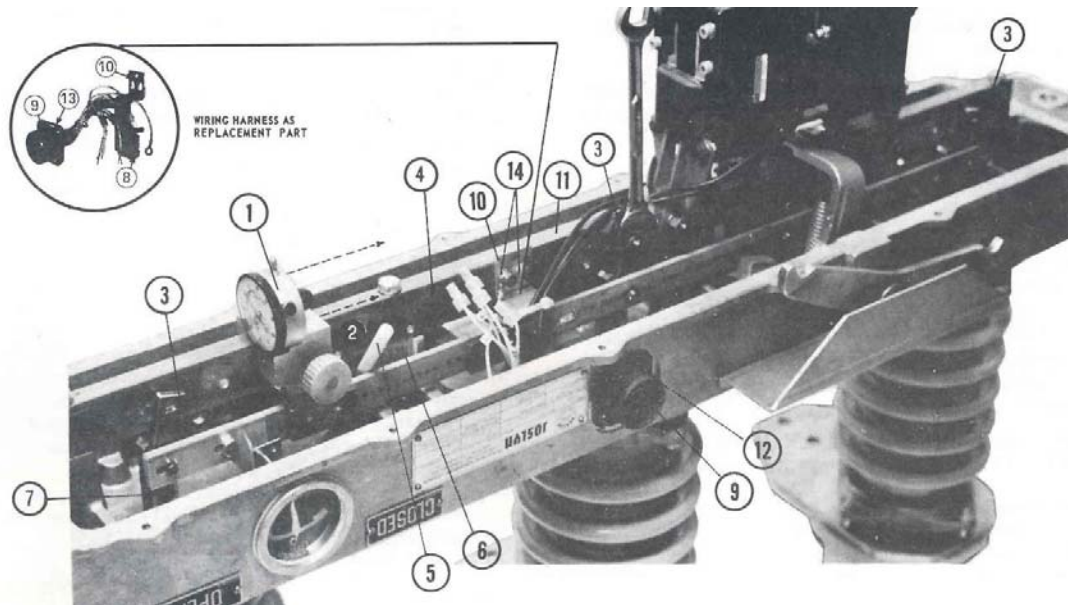


Figure 22: Wiring Harness and Auxiliary Contact Adjustment

To install wiring harness, clean surfaces of casting where connector mounts. Apply a small amount of silicone grease (Dow Corning DC III or equivalent) to gasket (13) of new connector. Install harness assembly, remount and adjust the auxiliary switch and rewire.

See Auxiliary Switch Adjustment section to adjust properly.

## V. Switches Rated 1,000 Amperes and Higher

These switches utilize modules connected in parallel. For some ratings more than mechanism per pole is used. They are installed per instructions in Installation Section III and connected per Joslyn Hi-Voltage drawings and control schematic for the particular switch.

All servicing and testing is performed on separate mechanisms by removing the connecting bus and referring to the appropriate section of these instructions.