

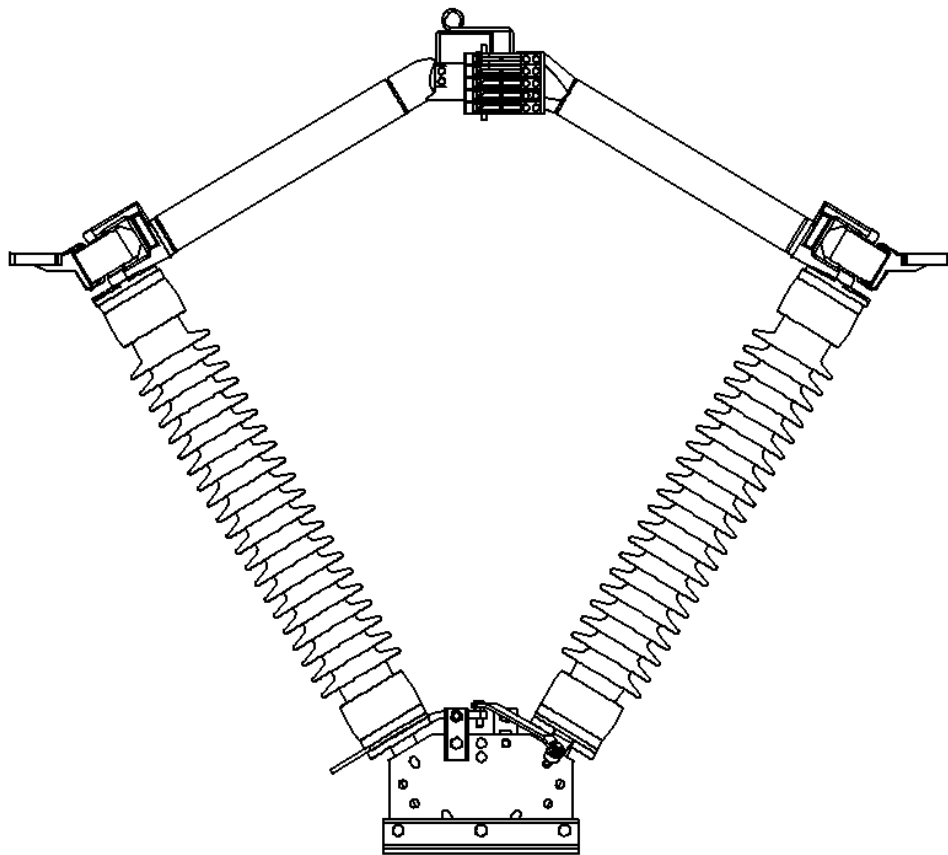


Royal Switchgear Manufacturing Co.

**INSTALLATION, OPERATION AND MAINTENANCE MANUAL**

**TYPE AV  
CENTERBREAK VEE SWITCH**

**3 PHASE, GROUP OPERATED (SUBSTATION CLASS)  
15 THROUGH 230 KV  
1200A, 2000A, 3000A, & 4000A**



**-IMPORTANT-**

**READ THIS MANUAL AND ATTACHED DRAWING PACKET BEFORE INSTALLING AND  
MAINTAINING EQUIPMENT. FOLLOW ALL APPLICABLE SAFETY PRACTICES BEFORE  
PERFORMING ANY INSTALLATION OR MAINTENANCE.**

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## TABLE OF CONTENTS

Receiving inspection .....	3
Unpacking Switches .....	3
Mounting Switches .....	4
Copper Tubular Blade Contact Adjustment .....	5
Aluminum Blade Contact Adjustment .....	6
Copper Flat Blade Contact Adjustment .....	6
Assembly of Switches Shipped Without Insulators .....	7
Installation of Insulators .....	7
Installation of Control Mechanism .....	8
Worm gear mounting instructions.....	9
Test operations & adjustment .....	10
Final checklist.....	11
Troubleshooting.....	11
Care of outdoor air switches.....	11

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## **RECEIVING INSPECTION**

Group operated V type center-break switches are normally shipped as follows:

One (1) crate containing three (3) switch units, (single pole assemblies), a box of control parts, plus accessories

One (1) bundle of operating and interphase pipe.

Some optional equipment, such as motor operators or special mounting steel, may require a third package.

Received material should be checked against the packing list (in water proof package attached to the crate) to insure shipment is complete. Inspect the entire shipment for damage which may have occurred in transit. If there is damage, immediately file a claim with the carrier and notify Royal Switchgear.

A plastic envelope attached to switch unit will contain these Installation Instructions, the Equipment Summary and the Control Mechanism and Switch Drawings. It should not be removed from the switch until the switch is ready for installation. The same information is included in the water-resistant box.

The Equipment Summary and Control Mechanism Drawings identify all the parts that make up the switch. Each piece of the Control Mechanism has identifying numbers marked on it to match it with its location on the drawing.

## **UNPACKING SWITCHES**

The switch units are normally shipped assembled and adjusted. However, if your order has been shipped without insulators, refer to the section "ASSEMBLY OF SWITCHES SHIPPED WITHOUT INSULATORS" for assembly instructions.

- After uncrating, remove the tie wires and blocks from the base and test operate each unit several times on a level surface from fully closed to fully open.
- Make sure the switch does not tip over due to the weight of the blades.
- Each switch unit should operate smoothly and be in alignment.
- With the switch unit closed the blades should be slightly over toggle against the close stop.
- With the switch unit open the blades should be parallel to each other.
- If adjustment is required on open or closed stops please consult factory (Fig 1).

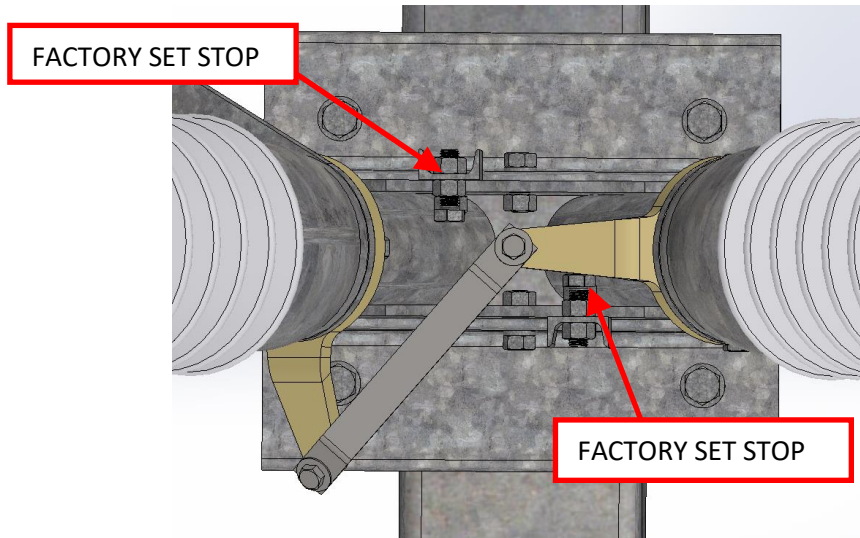


Figure 1 – DO NOT ADJUST

## MOUNTING SWITCHES

1. Rewire and block the switch units in the closed position.
2. Mount the switch units to the structure as shown on the Control Mechanism Drawing.

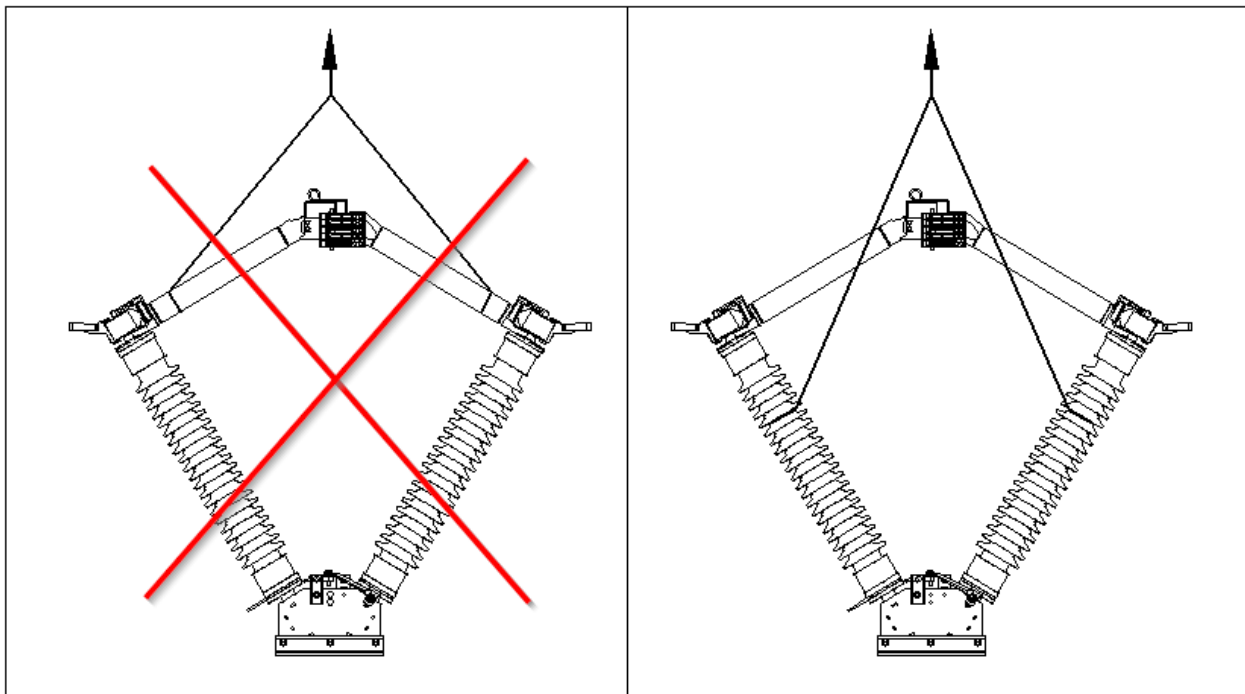


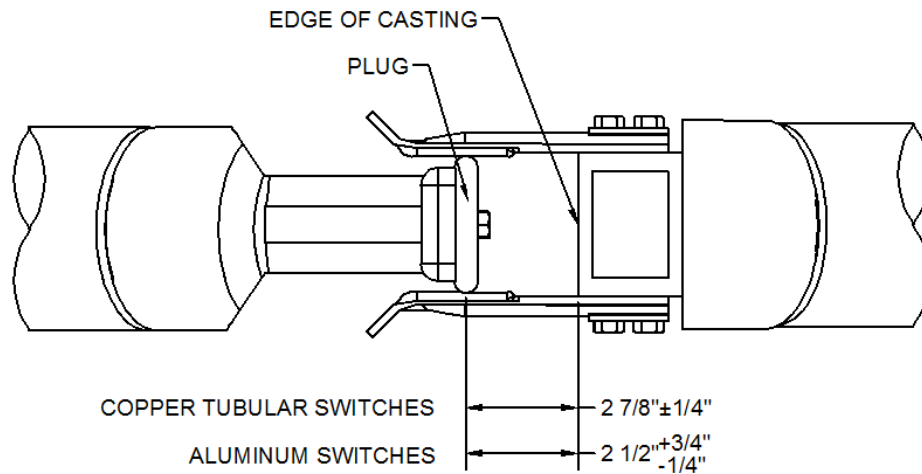
Figure 2 – Single Pole crane rigging with nylon slings

3. Remove the tie wires and blocks and check the switch blades for proper alignment as described above. Each switch unit should be checked individually, preferably with the line conductor (or bus) connected.

## **COPPER TUBULAR BLADE CONTACT ADJUSTMENT**

1. With the switch in the closed position, check for proper contact insertion.
2. The contact line of the plug (male end) should be  $2\text{-}7/8'' \pm 1/4''$  from the finger contact casting (female end) (Fig. 3).
3. If adjustment is required on a switch with copper live parts, loosen the blade clamping bolts on the plug or finger contact castings and slip the castings into the proper position.

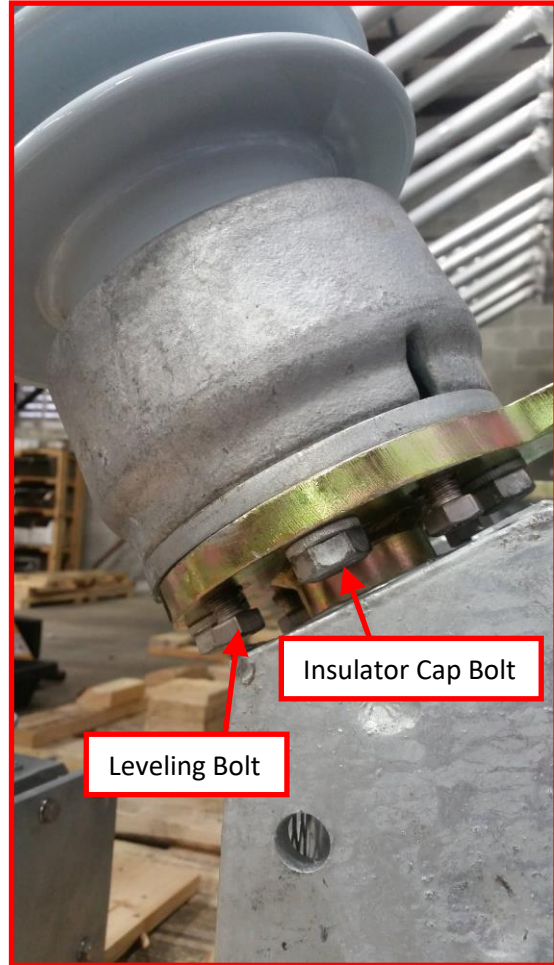
**DO NOT** loosen the blade clamps on both castings at the same time as the castings may rotate out of alignment. Also, **DO NOT** loosen the blade clamps at the terminal hinges as there is no adjustment provided at that end of the blade.



**Figure 3**



**Figure 4** – Hinge Support Bolt Adjustment



**Figure 5** – Leveling Bolt Adjustment (some switches)

### **ALUMINUM BLADE CONTACT ADJUSTMENT**

The tubular contact adjustment for aluminum V switches is limited. The contact line of the plug (male end) should be 2-1/2" + 3/4"/-1/4" from the finger contact casting (female end) (Fig. 3).

Adjustment is achieved by loosening the hinge support bolts at the insulator and shifting the blade assembly as shown in figure 4. DO NOT loosen hinge support bolts at both ends at the same time. Some switches are equipped with leveling bolts at the bottom of the insulator as shown in figure 5. Loosen the insulator cap bolts and make adjustments with the leveling bolt as needed.

It is important to establish dimensional continuity at this point between the single pole assemblies of each switch. Significant variation can affect the operating speed of the individual switch units.

### **COPPER FLAT BLADE CONTACT ADJUSTMENT**

With the switch in the closed position, the end of the plug (male) blade should be 1/4" to 3/4" from the end of the clip (female) contact blade (Fig. 6).

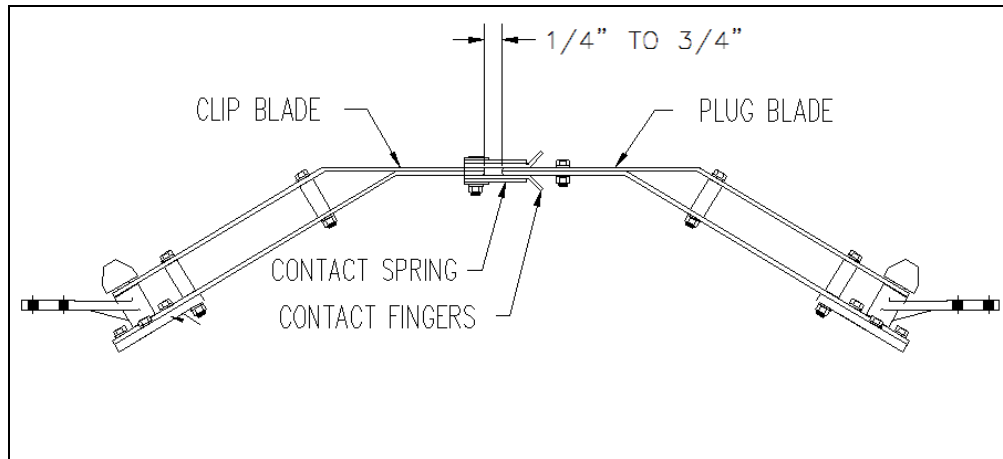


Figure 6

### **ASSEMBLY OF SWITCHES SHIPPED WITHOUT INSULATORS**

Group operated V type center-break switches shipped without insulators are normally packaged in one(1) crate that consists of the following items:

- 3 bases
- 3 clip (female) blade assemblies
- 3 plug (male) blade assemblies
- 1 box of control parts plus accessories if applicable

Pipe bundles are packaged separately but marked per switch. Some optional equipment, such as motor operators or special mounting steel, may require a third package.

### **INSTALLATION OF INSULATORS**

Remove the base and live parts from the crate. Painted match marks on the live parts and the base will help to assemble the switch units.

1. First, attach the insulators to the base spindles and tighten the bolts.
2. Rotate the insulators to the open position by aligning the match marks on the bearing housing and the spindle.
3. Attach the live parts on top of the insulators with the bolts snug but not tight. The marks on the live parts should align with the marks on the spindles and base.
4. Finally, rotate the insulator assembly to the closed position and, with the assembly firmly against the close stop, tighten the bolts.
  - For tubular blades, the live parts should be slightly over toggle when the switch is in the closed position.
  - For flat blade assemblies, the live parts should be in-line with each other in the closed position.

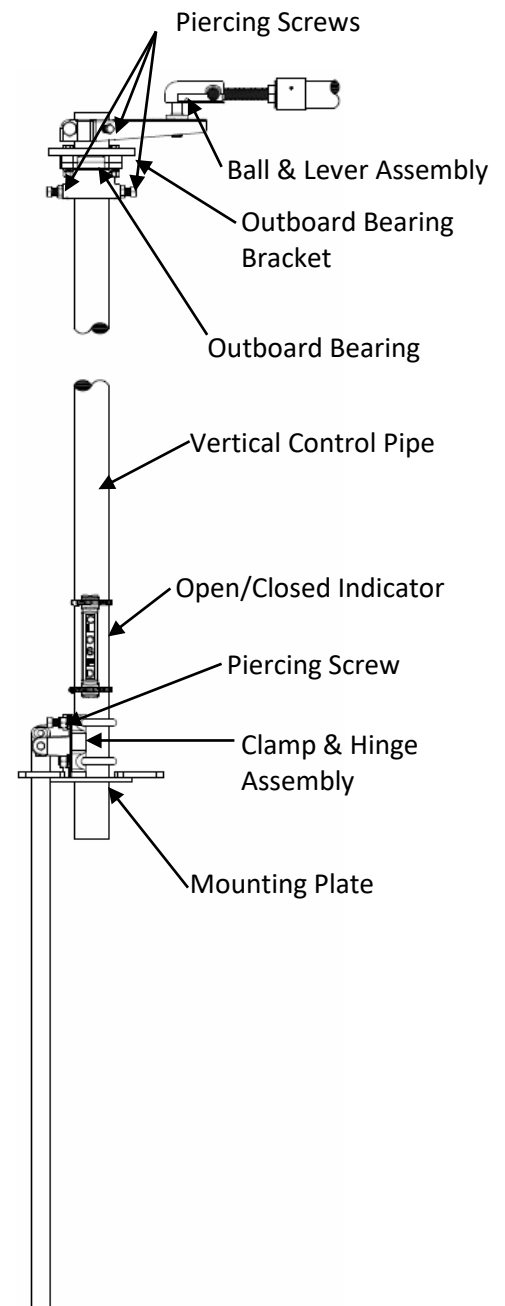
Operate the switch units several times from completely open to completely closed while checking for proper contact alignment and switch operation.

# REPLACING INSULATORS

## **INSTALLATION OF CONTROL MECHANISM**

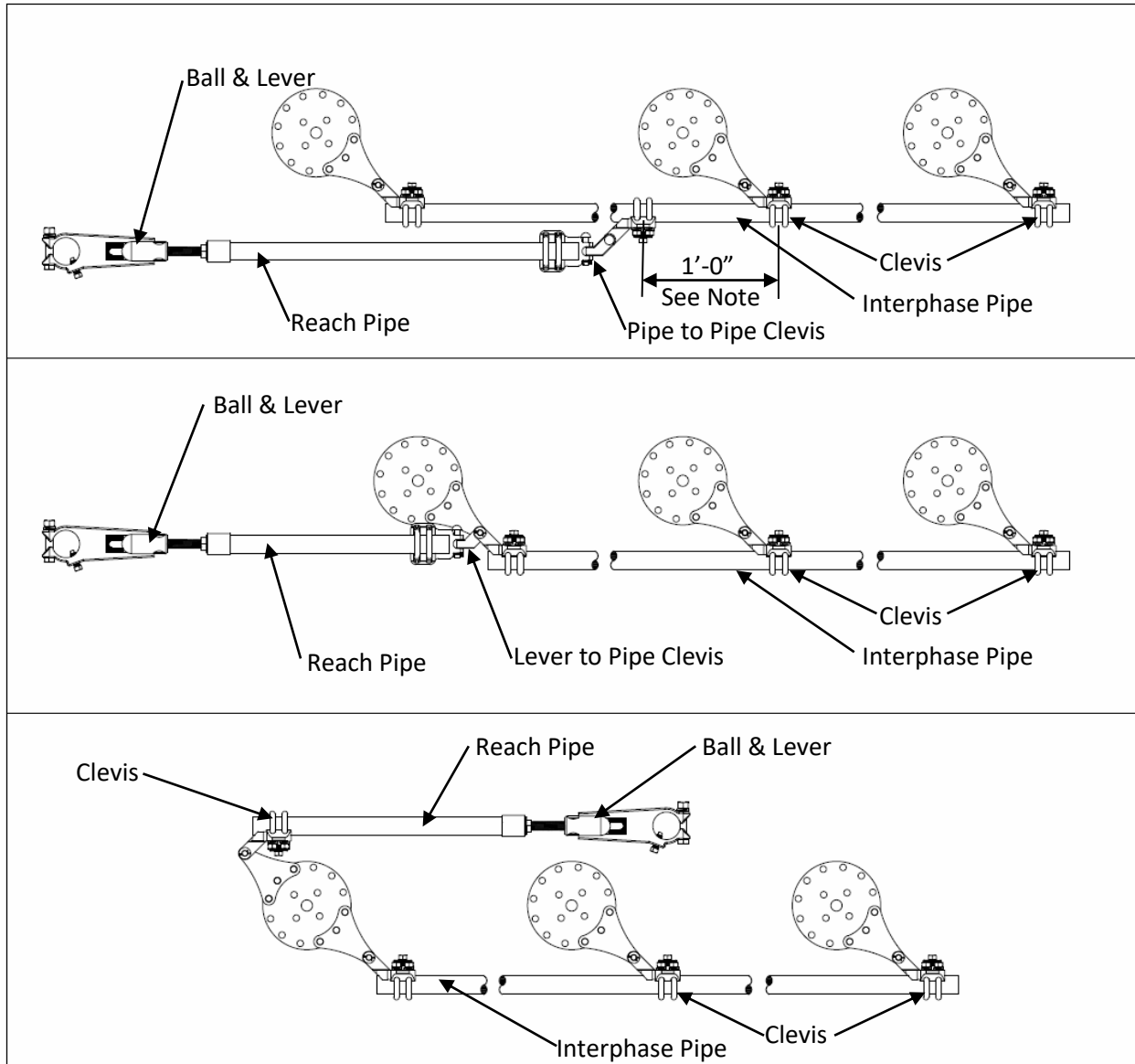
Please also refer to control mechanism drawing in the drawing packet.

1. Install the vertical section of the operating mechanism to the switch structure. This includes the outboard bearing and bracket, the intermediate guides and brackets. Additional items such as rod insulators, insulating sections, and auxiliary switches should be installed if specified on the control mechanism drawing.
2. The vertical control pipe should be inserted through the outboard bearing and intermediate guides with enough pipe above the outboard bearing to attach the ball and lever assembly.
3. Tighten the outboard bearing setscrews only enough to hold the pipe in position -- **DO NOT** pierce the control pipe at this time.
4. Clamp the ball and lever assembly to the top end of the control pipe directly above the outboard bearing. Mark the position of the ball and lever relative to the pipe with a permanent marker to indicate slippage during operation.
5. Cut off any excess pipe to ½" above the lever assembly to provide clearance as the lever is rotated.
6. Mount the switch operator to bottom end of vertical pipe. If using a swing handle, the orientation of the clamp and hinge should be such that the piercing screw is at the top of the casting.
7. Attach the switch clevis assemblies to each of the three switch poles per the configuration specified on the control mechanism drawing (Figure 8).
8. Insert the interphase pipe through the clevises and insure all phases are firmly closed against their stops.
9. Tighten all of the U-bolts against the interphase pipe. **DO NOT** pierce the pipe at this time.
10. Remove piercing bolts from the clevises attached to the interphase pipe to prevent interference during the adjustment process.
11. Connect the reach pipe as specified on the control mechanism drawing. Figure 8 shows typical arrangements of reach pipe connections.
12. Clamp & hinge must sit on top of mounting plate in order for mechanical stops to be engaged.



**Figure 7 – Typical Vertical Pipe Arrangement**





**Figure 8 – Typical Reach Pipe Arrangements**

**Note:** Royal recommends keeping the pipe to pipe clevis within 1'-0" of interphase clevis to reduce pipe deflection.

## **WORM GEAR MOUNTING INSTRUCTIONS**

Mount the worm gear to the structure as shown on the control mechanism drawing. DO NOT install the indicator bolts at this time. Install the vertical operating pipe and adjust the switches as detailed in the appropriate section of this instruction packet. Once adjustment is complete, install the indicator bolts as follows:

1. With switch firmly against its closed stops, thread the closed position indicator bolt through the bracket until it touches the casting.
2. Repeat step one with the switch firmly against the open stops.

**Note:** In some instances the worm gear u-bolts may need to be loosened and the pipe rotated so the casting squarely engages the indicator bolts.

## TEST OPERATIONS & ADJUSTMENT

1. Test operate the switch after all hardware is tightened, but before the setscrews pierce the pipe.
2. The lever should rotate just over 180° to achieve 2°-5° over-toggle in both the open and closed positions (see Figure 9). In the full toggled positions, the single poles should rest firmly against the stops. **Do not use excessive force to operate the control mechanism, this is an indication that adjustment is needed.**
3. Adjustment point number ① will increase the amount of switch travel when lengthened and decrease the amount of switch travel when shortened. To adjust, loosen the nut that retains the ball assembly. Shift the ball assembly on the serrated lever surface, and retighten the nut (See Figure 10). This adjustment will increase or decrease the travel equally in both the open and closed directions.
4. Adjustment point number ② is used to balance the travel. If the travel is unbalanced (example: the mechanism travels too far in the closed position and not far enough in the open position or vice versa) then the threaded adjustment should be used to balance the travel.
5. Repeat steps 3 & 4 until mechanism is adjusted to where all three phases are hitting the open & closed stops and there is overtoggle in both the open and closed positions.

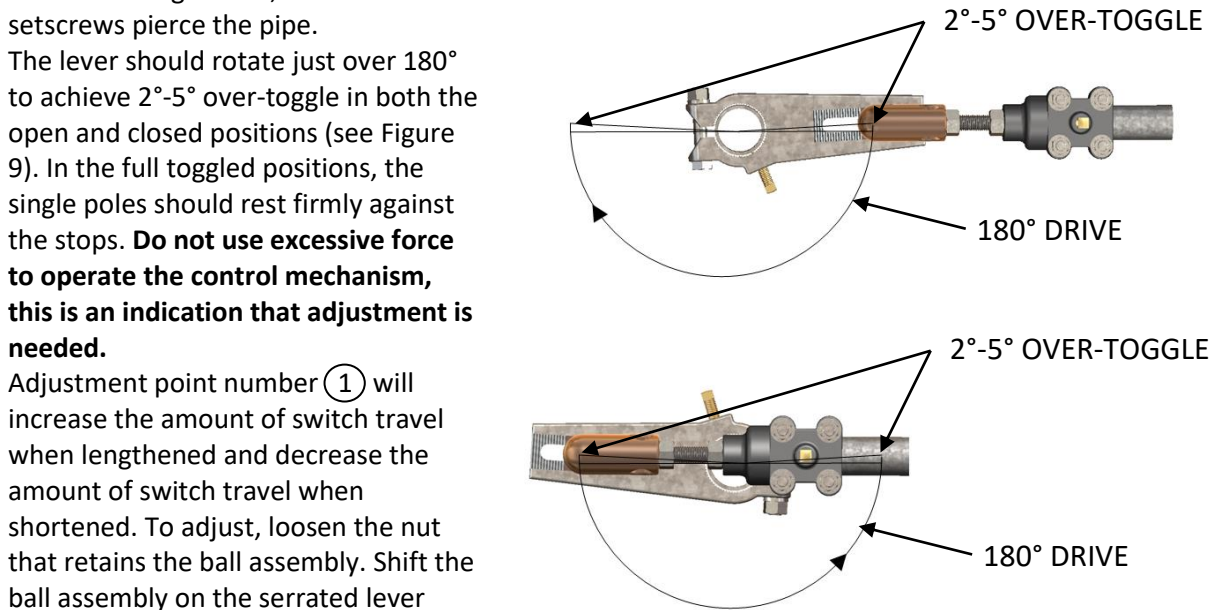


Figure 9 – Lever Over-Toggle

**Note: It may take several iterations to fine tune the switch operation.**

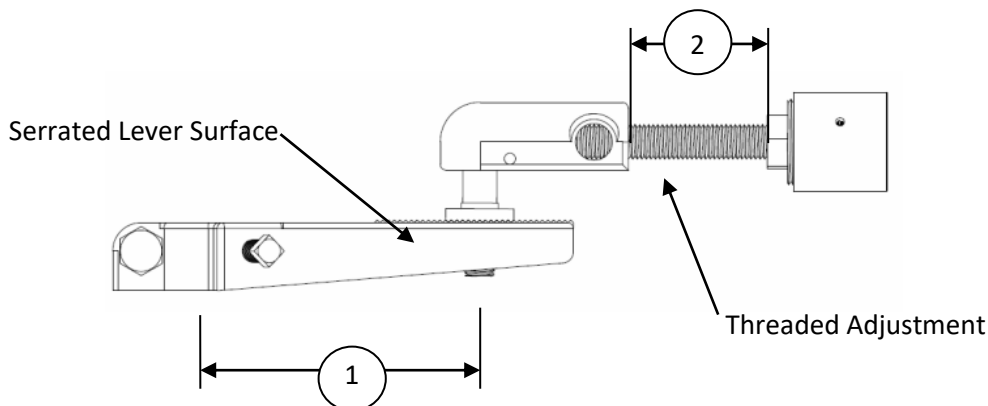


Figure 10 – Control Mechanism Adjustment Points

## **FINAL CHECKLIST**

Once final adjustments are complete, operate the switch and ensure the following:

- The blades are within the specified tolerance (fig. 3) in the open position.
- The blades enter the contacts at approximately the same time when closing.
- The blade contact block is rotated level or just past level when fully closed.
- The switch fully opens and fully closes against the switch stops.
- Tighten all piercing screws on clevises when completed.
- Check all bolts, nuts, screws and cotter pins for security.

## **TROUBLESHOOTING**

**Concern:** One of the blades operates out of sync with the other two blades.

**Solution:** The clevis attaching the out of sync single pole to the interphase pipe should be adjusted. Mark the position of the clevis on the interphase pipe for reference with a permanent marker. Loosen the u-bolts to slide the clevis and retighten. A small adjustment (typically 1/8" max) is needed to achieve proper timing.

**Concern:** The switch alignment seems to change. The switch will be properly adjusted, but will be out of alignment on the next operation.

**Solution:** If the alignment changes from operation to operation the most likely cause is a loose connection. Check U-bolt connections to all interphase pipes to ensure they are secure. Also, make sure all connections to the vertical control pipe are tight and do not slip during operation. Overall, check all the bolted connections and make sure that they are all fastened securely.

**Concern:** The switch does not hit the open or closed stops when operating

**Solution:** The adjustment point is on the ball and lever assembly. Loosen the ball and slide out to increase travel in both the open and closed positions.

**Concern:** The switch is hard against the open stops but does not hit the closed stops

**Solution:** The adjustment point is on the ball and lever assembly. Disconnect the ball from the lever and rotate assembly to lengthen or shorten the threaded adjustment. The threaded adjustment is used to balance the travel between the open and closed stops.

## **CARE OF OUTDOOR AIR SWITCHES**

The frequency of inspection will necessarily be a function of the atmospheres, a switch may operate satisfactorily for many years without care, while in a severe atmosphere such as is encountered at power plants and industrial sites, maintenance may be required in a matter of months. This service interval must be determined by the user. Royal Switchgear recommends operating the switch at least once per year.

The following points require special attention:

1. **BE SURE THAT THE SWITCH IS DISCONNECTED FROM ALL ELECTRIC POWER BEFORE IT IS SERVICED.**
2. After power has been disconnected from the switch, ground leads or their equivalent should be attached to both sides of the switch.

3. Where abnormal conditions, such as salt deposits, cement dust or acid fumes prevail, clean the insulators in order to avoid flashover, which might result from the accumulation of foreign substances.
4. **EXAMINE THE CONTACTS.** Check to determine that they are aligned and that the contact surfaces bear with a firm uniform pressure. Check the contact surfaces. If it is known that the switch carried a heavy short-circuit, a special effort should be made to inspect the switch at the earliest possible time. This is especially important if the switch contacts are badly corroded since the ability of the switch to carry rated short-circuit currents is seriously impaired if the contacts are not properly maintained. Replace any pitted or burned contacts. If the pitting is of a minor nature, smooth down the surfaces of the contacts with clean, fine sandpaper.
5. See that bolts, nuts, washers, cotter pins and terminal connections are in place and tight. If the switch is group operated, interphase linkages, live operating parts, rods, levers, bearings, etc., should be cleaned as required and the switch checked for the simultaneous closing of all blades and for complete contact in the closed position.
6. When the switch cannot be disconnected from power, hot stick servicing should be used to as great an extent as possible.
7. Where periodic maintenance of any kind cannot be made, it should be recognized that the life of the switch contacts may be affected. In these cases, when a switch operation is made, it is recommended that the switch be opened and closed several times instead of just once to clean the contacts more effectively.
8. Since the switches are built with either self lubricating or sealed bearings, periodic lubrication is not needed except for the bearings on ground switches which are provided with a grease fitting and which should be filled annually or in accordance with established maintenance routine.