Installation/Maintenance Instructions
IB TTR6 GTS-B

Type TTR6, Gear Drive
Group-Operated, Vertical Break
550kv Max. Design

IMPORTANT

Make absolutely sure applicable equipment is de-energized and properly grounded before proceeding with any installation or maintenance.

These instructions do not propose to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes the matter should be referred to the factory.

RECEIVING INSPECTION

Check the total shipment for completeness against the bill of material and installation drawings. If the switch shipping crate or the switch show evidence of shipping damage note the damage on the bill of lading.

HANDLING AND STORAGE

Trucking and handling of power switching equipment, after being received at its destination, should be done with the consideration that porcelain is frequently included and can be broken by sudden jarring or careless handling. Therefore, care should be exercised to prevent breakage or distortion of parts which could cause subsequent trouble, delay or inconvenience in installation. Switching equipment should be properly stored prior to installation to protect it from damage.

WARNING WARNING WARNING WARNING WARNING WARNING

Before any installation is started, make absolutely sure that applicable equipment is de-energized and properly grounded. Protect the installers adequately from adjacent electrically energized parts by using barriers, screens, etc.

Factory installation drawings should be followed during installation. It is recommended that, insofar as it is possible to do so, that switching equipment be fully assembled and adjusted at ground level before it is placed into position. This should minimize final adjustments.

Rigging, which is used for erecting the switching equipment, must be adequate for the switching equipment involved. Attachments for hoisting should be made to the switch bases unless otherwise instructed. Lifting of switches by the insulator units, contacts, or live parts must be avoided, because of possible damage to these parts.

Step 1—Check Bases

Check bases to make sure that insulator supports, spacers and rotor bearing tops are square and level. The tops of the two supports on the hinge end must be exactly the same height. If necessary, make adjustments with leveling screws.

Step 2—Assemble Insulators

Assemble the insulator stacks to switch base. In some cases, involving higher voltage switches, the installer may choose to mount the switch bases on the structure before assembling the insulators. In such cases the switch bases should be mounted on the supporting structure in the positions shown on the installation drawing. The bases should be level and parallel to each other. Make sure that the base for the drive phase is in the correct location. After placing the hardware into the insulator through the rotor stem flange, twist the porcelain back toward the open stop position until the stop crank is against the stop bolt (figure 1). Doing this at each phase provides a consistent starting point and is important to final three-phase adjustment.

Step 3—Insulator Stack Alignment Insulator stacks of switches can be aligned using leveling screws as shown in Fig. 1.

Step 4—Removing and Installing Current Carrying Parts

CAUTION: When removing blade and hinge assembly, make sure shipping bracket remains in place. Otherwise, the counterbalance springs may collapse the hinge end toggle, possibly causing injury to workmen. Make certain that the stop crank is in the proper position when mounting current carrying parts, i.e. stop crank rotated to the maximum counterclockwise position with the blade closed. Care should be exercised when hoisting the blade hinge and jaw assemblies into position to prevent scratches or damage to these current-carrying parts. When assembling the jaws on the insulator columns, leave the jaw base hold down bolts finger tight. This will permit the jaw base to be rotated and shifted slightly for subsequent contact alignment. This alignment will be discussed later under blade entry (Step 6).

Step 5—Mount Switches

Assemble the switches on the supporting structure in accordance with the positions shown on the installation drawing. The switches should be mounted level and parallel with each other. In case of a warped structure, shimming under the switch bases may be required.

Step 6—Switch Blade Adjustment

When looking down on the switch rotating insulator column, rotation of the column is clockwise to open the switch and counterclockwise to close. First, make sure that stop bolts (Fig. 1) at base of rotating insulators do not prevent switch from traveling to the complete open and closed positions, then check each pole unit for the following items:

Figure 1

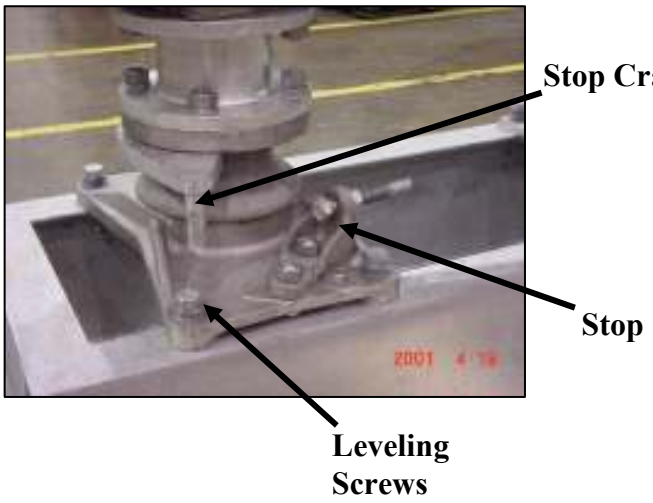
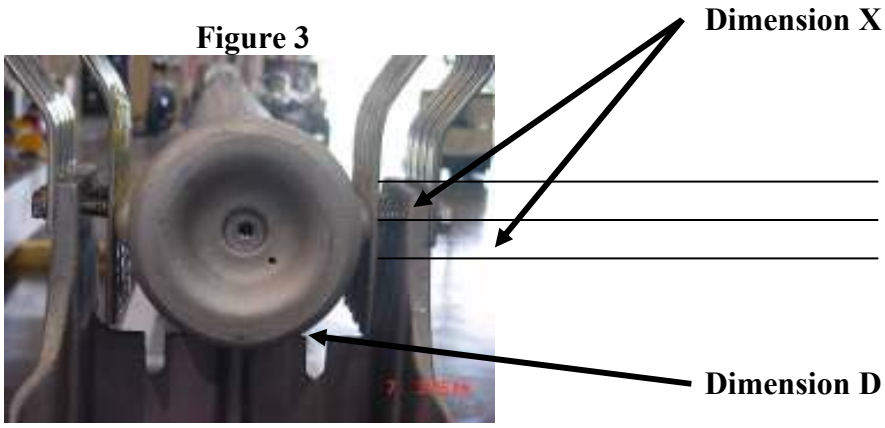


Figure 2

Blade entry—Lower the blades slowly to the closed position to see if blade contact enters the jaw in a central position. See figure 2. If it does not, loosen the hinge assembly mounting bolts on stationary insulator stack and with blade just out of jaw, shift blade into alignment and tighten hinge assembly mounting bolts. Should this fail to give proper blade entry, the jaw insulator stack should be shimmed or adjusted to suit. When central entry is achieved, rotate the blade into contact and tighten jaw base mounting bolts.

Also make certain the jaw fingers are nearly centered on the blade end contact. If it is expected that the conductors to be attached to the switch jaw will impose an appreciable horizontal force, it is recommended that the jaw insulator column be adjusted so that the jaw fingers are slightly off center on the blade contact, in a direction toward the hinge end. The blade must rotate on opening and closing to relieve the jaw contact pressure.

Figure 3



Blade contact angle—(Fig. 3) The allowable difference in elevation from one side of the blade contact to the other (dimension X) is 1/16" for each 1" of contact width. Example: If contact width (A) is 3", then dimension (X) can be as much as 3/16" and still be within the plus or minus 4 degree tolerance.
Also, Fig. 3 shows blade contact high on the right and low on the left. The reverse is also acceptable, high on the left and low on the right. It is common to have both situations on one three-pole switch. In fact, after all three poles have been adjusted in the open position, and then closed, you may find that one pole will be high on the right, one fairly level and one high on the left. This is due to many variables and tolerances plus the free play or clearance in pin connections of all the switches and control parts.
Variance in contact angle is not significant because no reduction in contact pressure occurs until the blade exceeds +/-8 degrees above the horizontal.

Blade height in jaw—In Fig. 3 dimension (D) can vary from 0" to 1/4" with the switch in the closed position. Be careful not to allow the blade to sit too firmly on the stop; this will cause drag and adjustment difficulties. It is not usually possible to get this dimension to be equal on all three poles of a three-pole switch. If it's necessary to adjust this dimension, remove connecting pin (A) and screw clevis (B) in or out ½ turn then reconnect and try switch (Fig. 4). Screwing clevis in will move the blade away from the pry-out fulcrum. Conversely, screwing the clevis out will move the blade closer to the fulcrum in the switch closed position.

Open blade stop—There are stops for the blade in the open position, as shown at (C), Fig 5. Some of these stops have flat washers that can be relocated to raise or lower this stop, while other voltage rated switches use threaded bolts with lock nuts. In either case, raising the stop surface (C) will reduce blade opening angle; lowering the stop surface (C) will increase blade opening angle. After each pole has been adjusted, set the open and closed stop bolts at base of each rotating insulator.

Figure 4

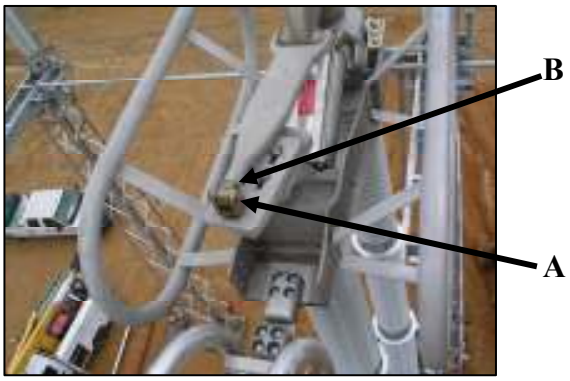
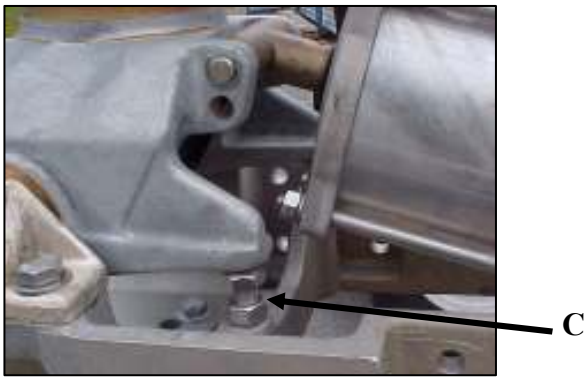


Figure 5



Step 7—Mount T-Box

In most cases the T-Gear Box will be mounted to the operating pole. If the T-box is not installed, it is universal to each phase. First step is to connect the T-box to the worm gear shaft of the operating pole with the connecting linkage and four pins provided (fig. 6). Then mount the T-box and its supporting base on the structure in the position shown on the installation drawing. Figure 6 & 7 shows a typical arrangement using the T-Box.

Figure 6

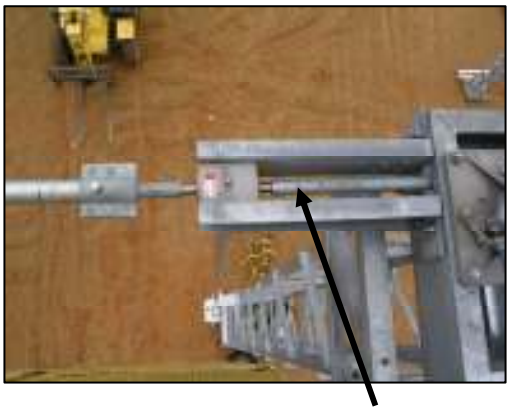


Figure 7

Step 8—Install Operating Mechanism and Vertical Operating Pipe

Either MO-10 or a worm gear mechanism is supplied.

Install Vertical Operating Pipe

Attach vertical operating pipe to T-box shaft with coupling pins supplied (Fig. 7). At this point, check drawings for accessory equipment (auxiliary switches, mechanical interlocks, position indicators, ground straps, etc.) which mounts on vertical operating pipe and install before continuing the installation. The vertical pipe is predrilled at one end for a 5/8" diameter pin, two of which are shipped together with a coupling in a bag for connection to the T-box shaft.

Install Pipe Splice and Guide Plate

When structure height exceeds 23 feet, a pipe splice and guide plate are furnished and should be installed.. The pipe splice and both pieces of pipe are drilled to receive the 5/8" diameter pins. The guide plate should not be solidly mounted until after the vertical pipe has been completely installed. Then bolts holding the guide plate on the structure should be tightened so the hole in the guide plate lines up with the normal position of the pipe so that no binding occurs.

CAUTION CAUTION CAUTION CAUTION CAUTION CAUTION

When installing motor operators, be sure the drive motor circuit is de-energized by motor limit switches just before the switch and offset bearing stops make contact.

Motor Operator

For remote operation, a motor operator is supplied and it should be installed per the instructions supplied with it. For lubrication of pins and bearing areas of switch operators, see Table 1 page 10.

Step 9—Interphase Shaft Installation and Switch Adjustment:

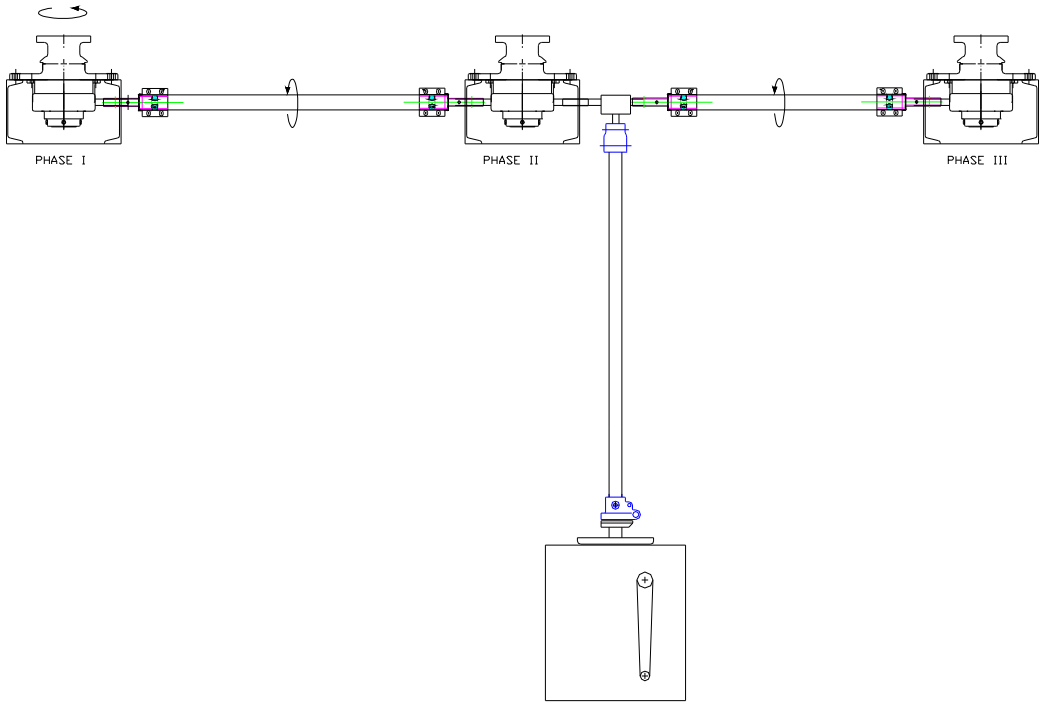
Close each phase by turning the worm shaft. Install couplings to the worm shaft under each phase and at the end of the T-box (Fig. 8). Then install the interphase shaft as shown on the control drawing. Tighten bolts on the couplings and snug piercing bolts at this time. Manually operate switch in the open and close positions. The "gooseneck" crank in the live parts should be in the toggle position when fully closed and open (Fig. 9 & 10). **IMPORTANT: The toggle position locks each phase in the open and closed positions.** If one phase is not timed with the others, simply loosen the coupling bolts and rotate the worm shaft of the phase that needs adjustment. Example: if phase "A" is lagging while opening, rotate worm shaft approximately (1/2) turn counter-clockwise, then tighten bolts and check for adjustment.

Figure 8

Figure 9 Open Position

Figure 10
Closed Position

Typical Control Configuration



Step 10—Arcing Horn Installation (when supplied)
When arcing horns are used on switches, they should be installed and adjusted after mounting the switches on the structure. Arcing horns are furnished only when horn gap switches are ordered. The stationary horn is positioned properly on the jaw with the saddle clamp, and bolted (see arcing horn drawing provided). This stationary horn should be adjusted or even bent slightly to give light contact pressure between the two horns over the entire length of the stationary horn. Arcing horns for switches 362 thru 800kv do not use a movable horn. Instead, the stationary horn makes contact with the rear surface (corona-protected surface) of the corona ball.
Note: Always check switch operation mechanism drawing for type of arcing horns supplied.

Step 11—Installation of Corona Rings and Balls
Corona rings and balls, when supplied, should be installed as shown on the single-pole drawings. Prepare areas where ring supports contact switch parts per instructions for aluminum connections at right. A 362 kV switches and above use rings at both ends and a large ball on the end of the blade. After these are installed, the switches should now be ready for service.

Step 12—Final Checks

The completed 3-pole installation should be checked for the following:

a. In the open position, the blades should stand essentially vertical.
b. In closing, blades should make central entry into their jaws at approximately the same time.
c. In the closed position, all blades must be in full contact and horizontal within tolerances, see page 4.
d. In opening, the blades should rotate to relieve the jaw contact pressure. (If the blade remains flat, the blade beaver tail will engage the stops formed on the jaw fingers and further operating effort can result in mechanical damage.) Recheck base crank orientation per step 4.

TERMINAL CONNECTIONS

Because of the wide acceptance and use of aluminum conductors, the terminal surfaces are aluminum to provide an easy current transfer surface. (In cases where a copper conductor is used, it is recommended that a tinned terminal clamp be bolted to the aluminum switch terminal pad.) However, if a non-tinned clamp is used, a liberal amount of grease should be used at the joint and all over the pad of the fitting.

Make aluminum connections as follows: (1) Clean all contact surfaces of conductors and fittings with a stiff wire brush to remove heavy oxide coatings until they become a typical fresh aluminum color. (2) Immediately coat these contact areas with a liberal amount of corrosion inhibitor such as NO-OX-ID "A special" or NO. 2 EJC. (3) Abrade the contact surface again, this time through the applied compound with a stiff wire brush. (4) Make connections and tighten bolts.

CAUTION CAUTION CAUTION CAUTION CAUTION CAUTION

Do not remove the compound.

In making copper-to-aluminum connections: (1) Prepare all aluminum contact surfaces as described below. (2) Prepare any bare copper surfaces in the usual manner. (3) Do not abrade or wire brush any plated surfaces; a few light rubs with fine steel wool before greasing is sufficient. (4) Make connections and tighten bolts.

RECOMMENDED TORQUE FOR ALUMINUM BOLTS

Bolt Diameter, Inches	Lubricated Threads		Dry Threads	
	In. – Lbs.	Ft. – Lbs.	In. – Lbs.	Ft. – Lbs.
½	240	20	420	35
5/8	480	40	720	60
3/4	720	60	1140	95

MAINTENANCE

WARNING WARNING WARNING WARNING WARNING WARNING

Before servicing the switch, be sure it is disconnected from all electric power sources and properly grounded.

A certain amount of care and inspection is recommended. The frequency of inspection depends on the atmospheric conditions at a given switch location and the frequency of operation. This service interval must be determined by the user. Recommended maintenance is similar to that listed in the latest industry standards.[1] First, it is important that the insulators are always clean. It is also important that the contacts be examined to see that they are aligned, clean, and have a firm uniform pressure. If the contacts are pitted, or burned to some extent, they should be removed and replaced. Under normal service conditions, the jaw contacts should be examined and maintained at least once a year, depending upon the type of atmosphere to which they are exposed.

Periodic maintenance should consist of cleaning the contact surfaces thoroughly by carefully scraping off any contamination or deposit. With the contact surfaces entirely clean, a coating of lubricant should be applied. Suggested lubricants are DARINA 2 grease or NO-OX-ID "A Special". DARINA 2 is a Shell Oil Company product. NO-OX-ID is made by SANDCHEM INC.

In general, operating linkages require virtually no maintenance. However, in contaminated atmospheres or where operation under sleet conditions is common, some lubricant at pivot points may be desirable. The grease used should be durable even when exposed to the elements, and should retain its viscosity over a wide temperature range.

Table 1
Field Lubrication of Outdoor Switches

Part Name	Type Lubricants Recommended	Amount Applied	Qty. Req'd. for (6) Three-pole Switches
Jaw Fingers	Mobil 28 NO-OX-ID Grade "A" Special	Medium Coat	
Blade Ends	Mobil 28 NO-OX-ID Grade "A" Special	Medium Coat	(1) Quart
Pins (On current carrying parts)	Mobil 28 Dow Corning 4	*	
Pins (On control parts)	Mobil 28 Dow Corning 4	Light Coat	(1) Quart
Bearing Areas (On control parts)	Mobil 28 Dow Corning 4	Medium Coat	
Terminal Connections	NO-OX-ID Grade "A" Special or NO 2 EJC	Heavy Coat	(1) Quart

[1] ANSI C37.35 (American National Standard Guide for the Application, Installation, Operation and Maintenance of High-Voltage Air Disconnecting and Interrupter Switches)

*None required at installation unless switches were exposed to abnormal conditions for a considerable length of time. During regular cleaning, give them a light coat of grease.

Summary on total grease requirements for (6) three-pole switches.
(2) Quarts of Darina #2 Grease or (1) quart of Darina and
(1) Quart of DC-4.
(1) Quart of NO-OX-ID Grade "A" Special.

NOTE:
NO-OX-ID Grease may be obtained from:
SANDCHEM INC.
1600 South Canal St.
Chicago, IL 60616

Darina #2 Grease from:
Shell Oil Co. New York, NY

DC-4 Grease from:
Dow Corning Corporation
Midland, Michigan

NO 2 EJC-Electrical Joint Compound
Alcoa Conductor Products Co.
Division of Aluminum Company of America
Pittsburgh, PA 15212
(Local distributors usually stock some of the above lubricants)

BEARINGS

The bearing of each switch is a greaseless type (Fig. 1) shows the location of stop bolts and switch cranks on all switch bearings.

INSTRUCTIONS FOR SPECIAL SWITCHES

For switches specifically designed to operate under abnormal ice conditions, it is important that they be adjusted to assure the switch blade (on a closing operation) exerts force on the jaw stop.

FORCE VALUES

Switch Voltage	Force on Stop
8.25 thru 169kv	80 lbs.
242 thru 840kv	40 lbs.

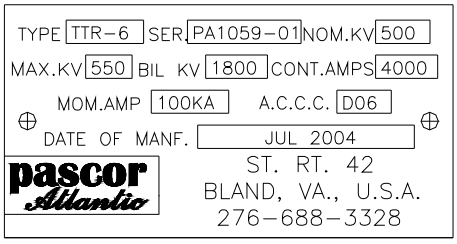
The blade force adjustment should be made after the switch installation is complete, as described previously in this instruction manual, except for the corona rings.
The blade force adjustment is made as follows:
Start with the three pole switch in a position so that the blade end contacts are at least 1 foot from the stationary contact fingers.

Using the manual operator, and observing one switch pole, lower the blade into the finger contact assembly and continue to close the switch to the point where it rests on the stop and there is approximately 1/8" clearance between the blade end contact and the stationary contact fingers on each side, see Fig. 19. This is the point at which the blade force is to be measured. It is important that the 1/8" clearance is obtained as the switch is being operated toward the closed position as described and never as the switch is being opened. This would cause an improper adjustment. Using a force gauge, measure the force exerted by the blade on the jaw stop by either pushing the blade up from below and noting the lbs. at which the blade is lifted off the jaw stop, or by putting a wire loop around the blade and lifting it with the gauge and noting the lbs. required. The place on the blade at which the force is measured should be just outside the finger contact assembly, see Fig. 18. If the force required is not proper, an adjustment must be made at the hinge end of the switch. To make the necessary adjustment, move the switch blade to a convenient point near the full open position and remove crank pin (B), Fig. 18, then move and twist blade or forked link (K) to disengage clevis (C) from crank.
If the force measured was too high, turn the clevis (C) ½ turn into the forked link (D). But if the force measured was too low, turn the clevis (C) ½ turn out of the forked link and re-connect the clevis. Check the threads on the clevis, some switches have right hand threads and some have left hand threads. Close the switch to the point previously described and again measure the force. If the force still does not measure properly, another adjustment must be made. Repeat the procedure as previously described. After one switch pole is satisfactorily adjusted, the other two poles should then be adjusted in the same manner.

RENEWAL PARTS

To order renewal parts, refer to the switch nameplate (Fig. 11). This nameplate is attached to the base assembly of each switch pole. The same data is shown on "record" engineering drawings and many installation files. The master file at the factory for renewal parts is "keyed" to the serial number on the nameplate.

Figure 11



Renewal Parts Ordering Information

Switch Type
Part Name
Quantity Required
Serial Number
Max. KV
B.I.L. KV
Cont. Amps

Mom. Amps
Refer your requests for renewal parts to the Factory.