INTRODUCTION

CAUTION: The equipment covered by this publication must be selected for a specific application and it must be installed, operated, and maintained by qualified persons who are thoroughly trained and who understand any hazards that may be involved. This publication is written only for such qualified persons and is not intended to be a substitute for adequate training and experience in safety procedures for this type of equipment.

S&C Pre-insertion Resistors are available, as accessories, for Integer Style Circuit-Switchers, upright-mounted Vertical-Break Style Circuit-Switchers rated 34.5 kv through 138 kv, and Center-Break Style Circuit-Switchers rated 115 kv through 345 kv, powered by S&C Switch Operators—for reduction of noise, inrush current, and transient voltage disturbances in capacitor switching applications. S&C Pre-insertion Resistors are designated by the addition of the suffix “-P3” to the Circuit-Switcher catalog number.

These instructions are for field assembly and installation of S&C Pre-insertion Resistors, whether added to an existing Circuit-Switcher or furnished as original equipment. In the latter case, some of the following procedures (those marked with a *) are not required since they have been performed at the factory.

Resistors and arcing rods (arms) are packed separately.

ASSEMBLY PROCEDURE FOR VERTICAL-BREAK STYLE AND INTEGER STYLE CIRCUIT-SWITCHER PRE-INSERTION RESISTORS

Install pre-insertion resistors only after Circuit-Switcher has been completely assembled and adjusted. Prior to assembly of component parts, thoroughly wire-brush the aluminum mating surfaces. Immediately coat these surfaces with Penetrox A (available from Burndy Corporation). Repeat the following steps for each pole-unit.

Step 1
* Attach the resistor mounting bracket to the left side (as viewed from the interrupter end) of the terminal adapter on the front insulator stack, using two ½”—11 X 1½” hex-head stainless-steel bolts and lockwashers provided.

* For Circuit-Switchers rated 115 kv and 138 kv, a brace is attached to the resistor mounting bracket.

Fasten the free end of this brace to the upper end of the terminal adapter, using the ½” inch spacer and the ½”—13 X 2½” hex-head stainless-steel bolt provided. See Figure 1.

Step 2
For Circuit-Switchers rated 34.5 kv through 69 kv, attach the resistor and spacer assembly to the resistor mounting bracket, using four ½”—13 X 1½” hex-head stainless-steel bolts, lockwashers, and nuts.

For Circuit-Switchers rated 115 kv and 138 kv, attach the resistor assembly to the resistor mounting bracket, using four ½”—13 stainless-steel hex nuts and lockwashers.

Make sure that the pressure-relief plug in the bottom of the resistor assembly is aligned over the opening in the mounting bracket.

* Paragraph applies only if pre-insertion resistors are being added to an existing installation.

† The instructions herein are also applicable to Mark II, Mark III, and Mark IV Circuit-Switchers.
Step 3
Insert the stationary arcing rod into its support at the top of the resistor assembly. Rotate the stationary arcing rod until its long, straight portion is vertical. Fully tighten the arcing-rod clamp bolts.

Step 4
Manually operate Circuit-Switcher to position the disconnect blade so that its circuit-closing tongue-contact member is at the level of the nearest circuit-closing jaw-contact member (Point X, Figure 1).

*Mount the moving arcing-rod support on the disconnect blade in accordance with the 2 1/2-inch dimension shown. Make sure the set screw does not protrude through the body of the support. Rotate the arcing-rod support to the horizontal position and fully tighten the socket-head clamp screws. Then remove the set screw, which is used to secure the moving arcing-rod support to the disconnect blade. Using the tapped hole as a guide, drill a 7/32”-diameter hole in the disconnect blade. See Detail A, Figure 1. Apply Loc-tite “A” to the set screw, replace it, and tighten until its point enters the hole in the disconnect blade and its shoulder is seated firmly against the blade.

Step 5
Loosen and withdraw the hex-head clamp bolt at the end of the moving arcing-rod support. Then insert the arcing rod with its notch positioned to permit reinsertion of the hex-head clamp bolt. Fully tighten the clamp bolt.

Step 6
With the Circuit-Switcher disconnect blade in the position described in Step 4, loosen (at the top of the resistor assembly) the stationary arcing-rod support mounting screws. Shift the arcing-rod support to attain the clearance between the moving and stationary arcing rods specified by Dimension A in Figure 1. Fully tighten the mounting screws.

Step 7
Manually operate the Circuit-Switcher to recheck the alignment between the moving and the stationary arcing rods. During closing, the clearance between the moving and stationary arcing rods should be equal to Dimension A in Figure 1—until final disconnect-blade movement rotates the moving arcing rod upward.

Readjust, if necessary, as described in Step 6.

Step 8
Make a final check of each Circuit-Switcher pole-unit for correct alignment of the disconnect blade with the jaw-contact assembly. As each Circuit-Switcher disconnect blade is closed, the circuit-closing tongue-contact member should engage each of the circuit-closing jaw-contact members with equal pressure, and the current-carrying tongue-contact member should enter between the current-carrying jaw-contact members with equal clearance on each side. The silver-surfaced area of the current-carrying tongue-contact member should center laterally with the silver-surfaced current-carrying jaw-contact members, and the blade should rotate with slight pressure against the blade bumper stop and come to rest either on the stop or slightly above it.

If adjustment of the position of the jaw-contact assembly is necessary to obtain the described alignment, refer to the instruction sheet furnished for the specific Circuit-Switcher involved and proceed as outlined therein. Then recheck alignment of moving and stationary arcing rods as directed earlier in Step 7.

* Paragraph applies only if pre-insertion resistors are being added to an existing installation.
Figure 1. Assembly details for Vertical-Break Style and Integer Style Circuit-Switchers.
Install pre-insertion resistors only after Circuit-Switcher has been completely assembled and adjusted. Prior to assembly of component parts, thoroughly wire-brush the aluminum mating surfaces. Immediately coat these surfaces with Penetrox A (available from Burndy Corporation). Repeat the following steps for each pole-unit.

**Step 1**

*With the Circuit-Switcher in the fully closed position, attach the resistor mounting adapters as follows, using the \( \frac{3}{4}" - 11 \times 4" \) stainless-steel bolts, flat washers, lockwashers, and nuts furnished:

**(a)** Draw guide marks at the juncture of the tongue-contact disconnect blade and its associated blade-hinge assembly to use as a reference so that, during this step, the disconnect-blade contact alignment (longitudinal and rotational) can be maintained. Next, remove the tongue-contact disconnect-blade clamp and replace it with a resistor mounting adapter. Make sure that the resistor mounting surface of the adapter is level (parallel to the pole-unit base), and that the disconnect blade is aligned with its blade-hinge assembly in accordance with the guide marks previously drawn. Then fully tighten the clamp bolts. (For 345-kv Circuit-Switchers, repeat this procedure for the jaw-contact disconnect blade.)

**(b)** For 115-kv through 230-kv Circuit-Switchers, attach the second resistor mounting adapter to the jaw-contact disconnect blade—using the blade clamp which was removed as directed in (a) above—positioned as shown in Figure 2. Make sure that the resistor mounting surface of the adapter is level. Then fully tighten the clamp bolts.

*Manually open and then reclose Circuit-Switcher and verify, during the closing stroke, that the circuit-closing contact members are in proper mesh and the current-carrying tongue contact enters the current-carrying jaw contact evenly with no tendency to clash against either side. Should adjustment be necessary, realign the tongue-contact disconnect blade only, as directed in the instruction sheet furnished for the specific Circuit-Switcher involved.

* Paragraph applies only if pre-insertion resistors are being added to an existing installation.

**Step 2**

Mount the two resistor assemblies on the resistor mounting adapters, using the \( \frac{1}{4}" - 13 \) hex nuts and lockwashers furnished. Make sure that the pressure-relief plug in the bottom of each resistor assembly is aligned over the opening in the adapter. Fully tighten all nuts.

Verify that the resistor assemblies are vertical (perpendicular to the pole-unit base). If adjustment is necessary, loosen the clamp bolts at the resistor mounting adapter(s) and reposition the resistor assembly (assemblies). Fully tighten the clamp bolts. Use care, during this procedure, to avoid disturbing the disconnect-blade alignment (refer to Step 1).

**Step 3**

Attach the arcing-arm assemblies to the resistor assemblies, with the upturned arm positioned at the tongue-contact end. (As a matter of information, for Circuit-Switchers rated 161 kv only, a spacer is attached to the top of each resistor assembly to act as a bolt-circle adapter and also to provide for additional angular adjustment of the arcing arms.) Use the \( \frac{1}{2}" - 13 \times 1\frac{1}{4}" \) hex-head stainless-steel bolts, lockwashers, and serrated flat washers furnished for attachment of the arcing-arm assemblies. Note that the mounting holes in the arcing-arm assemblies are slotted to permit angular adjustment of the arms. Place the serrated side of the flat washers toward the slotted holes. Tighten the attachment bolts at the slotted holes firmly enough to maintain positioning of the arcing arms. Repositioning will be likely during performance of Step 4.

**Step 4**

Manually open Circuit-Switcher to the point where the arcing-arm tips are aligned vertically, i.e., tip over tip. At this point of minimum separation, adjust the arms to obtain clearance equal to Dimension A in Figure 2. If necessary, use the special shims (furnished) between the arcing-arm assemblies and the resistor assemblies to attain this clearance.

Continue opening Circuit-Switcher until reaching the point where the metal-to-metal separation between the disconnect blades is equal to Dimension B. Then, while maintaining this disconnect-blade positioning, adjust the angle of both arcing arms by equal amounts to obtain the separation equal to Dimension C. (For the 161-kv rating, for which Dimensions A and C are equal, this separation occurs when the arcing-arm tips are aligned vertically, i.e., tip over tip.)
Recheck to make sure Dimension A has been maintained and, if necessary, repeat the above procedure. Then fully tighten the mounting bolts which fasten the arcing-arm assemblies to the resistor assemblies.

**Step 5**

*At the location indicated in Figure 2, remove one of the clamp bolts from the blade clamp at the jaw-contact end of the disconnect blade (not applicable to 345-kv Circuit-Switchers). At the inside corner of the bolt cavity, drill a $\frac{7}{16}$"-diameter hole through the clamp and the wall of the disconnect blade—aim the drill to enter the blade on center. Insert the $\frac{5}{16}$"-diameter Spirol pin furnished. Replace and fully tighten the clamp bolt.

* Paragraph applies only if pre-insertion resistors are being added to an existing installation.*

---

**Figure 2. Assembly details for Center-Break Style Circuit-Switchers.**
DUTY-CYCLE OPERATING LIMITATIONS FOR CIRCUIT-SWITCHERS WITH PRE-INSERTION RESISTORS

To provide sufficient cooling time for the resistors between operations, do not exceed the following duty cycles:

<table>
<thead>
<tr>
<th>For Circuit-Switcher</th>
<th>Maximum Capacitor-Bank Size, Mvac</th>
</tr>
</thead>
<tbody>
<tr>
<td>Style</td>
<td>One closing operation every 2 hours; Two consecutive closing operations, followed by one closing operation every hour</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>34.5</td>
<td>33</td>
</tr>
<tr>
<td>46</td>
<td>36</td>
</tr>
<tr>
<td>69</td>
<td>42</td>
</tr>
<tr>
<td>115</td>
<td>66</td>
</tr>
<tr>
<td>138</td>
<td>75</td>
</tr>
<tr>
<td>115</td>
<td>66</td>
</tr>
<tr>
<td>138</td>
<td>75</td>
</tr>
<tr>
<td>161</td>
<td>63</td>
</tr>
<tr>
<td>230</td>
<td>105</td>
</tr>
<tr>
<td>345</td>
<td>138</td>
</tr>
</tbody>
</table>

‡ A sequence consisting of two consecutive closing operations, followed by one closing operation every 2 hours, is also permissible on an occasional non-duty-cycle basis.

INSPECTION RECOMMENDATIONS

The operating life of the resistor assemblies—especially those installed on Circuit-Switchers rated 230 kV or 345 kV—is dependent upon the number of switching operations performed, the capacitor-bank size, and the inrush-current magnitude. A resistor assembly which is nearing the end of its operating life may exhibit a significant change in resistance. It is thus recommended that each resistor assembly be checked every 250 closing operations or annually, whichever occurs more often, to determine whether the assembly resistance has increased or decreased from that measured at the time of manufacture. This latter value is stamped into the assembly housing end-flange on pre-insertion resistor assemblies manufactured January 1983 or later; for pre-insertion resistor assemblies manufactured prior to January 1983, the nominal resistance value should be used. If the field-measured value varies by more than ±20% from the original value, the resistor assembly should be replaced. Contact the nearest S&C Sales Office.

Each pre-insertion resistor assembly should also be checked to determine whether the pressure-relief plug is present. See Figure 3. If the pressure-relief plug is not present, the pre-insertion resistor assembly has...
Inspection Recommendations — Continued

Vented and should be replaced. Contact the nearest S&C Sales Office.

Note: Pre-insertion resistor assemblies manufactured prior to September 1983 utilize pressure-relief plugs which are normally nearly flush with the bottom of the assembly housing end-flange, so careful observation will be necessary on these units to determine whether the resistor assembly has vented; these units should also be checked to verify that the plug is aligned over the opening in the resistor mounting bracket (on Vertical-Break Style and Integer Style Circuit-Switchers) or the mounting adapter (on Center-Break Style Circuit-Switchers). If the pressure-relief plug is not aligned over the opening in the mounting bracket or mounting adapter, the resistor assembly should be taken down and carefully inspected. If the plug protrudes ¼-inch or more from the bottom of the resistor assembly housing end-flange, a resistor block has likely been damaged and the resistor assembly should be replaced. Contact the nearest S&C Sales Office.

Finally, the moving and stationary arcing rods of Vertical-Break Style and Integer Style Circuit-Switchers and the arcing-arm assemblies of Center-Break Style Circuit-Switchers should be inspected to verify their proper setting. These components should be replaced if they show significant wear or erosion.

---

Figure 3. Pressure-relief plug alignment with opening in mounting bracket or mounting adapter.