Installation

This green leaf icon designates information specifically for Vista® Green Underground Distribution Switchgear that uses a CO_2 mix insulating gas. Unless otherwise designated, instructions provided apply to all manual Vista switchgear products.

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Qualified Persons

⚠ WARNING

Only qualified persons knowledgeable in the installation, operation, and maintenance of overhead and underground electric distribution equipment, along with all associated hazards, may install, operate, and maintain the equipment covered by this publication. A qualified person is someone trained and competent in:

- The skills and techniques necessary to distinguish exposed live parts from nonlive parts of electrical equipment
- The skills and techniques necessary to determine the proper approach distances corresponding to the voltages to which the qualified person will be exposed
- The proper use of special precautionary techniques, personal protective equipment, insulated and shielding materials, and insulated tools for working on or near exposed energized parts of electrical equipment

These instructions are intended only for such qualified persons. They are not intended to be a substitute for adequate training and experience in safety procedures for this type of equipment.

Read This Instruction Sheet

NOTICE

Thoroughly and carefully read this instruction sheet and all materials included in the product's instruction handbook before installing or operating the S&C System VI Switchgear. Become familiar with the "Safety Information" section on page 4 and "Safety Precautions" section on page 5 and page 6. The latest version of this publication is available online in PDF format at **sandc.com/en/product-literature/**.

Retain This Instruction Sheet

This instruction sheet is a permanent part of your S&C System VI Switchgear. Designate a location where you can easily retrieve and refer to this publication. An assembly of S&C System VI Switchgear may incorporate many types of components, such as interrupter switches, power fuses, switch operators, source-transfer controls, voltage sensors, current sensors, meters, and Vista Underground Distribution Switchgear tanks, etc., depending on user requirements. These components may be manufactured by S&C or by others. Operational instructions for each S&C-manufactured component are provided in separate S&C instruction sheets. For each switchgear assembly, the applicable instruction sheets, drawings, and wiring diagrams are in an envelope entitled "Installation and Operation Information Kit." This envelope is located in a holder inside the appropriately marked switchgear-bay door. Instructions for components not manufactured by S&C are provided only when furnished by the original manufacturer.

The Instruction Handbook may include:

- S&C Instruction Sheet 681-510, "Vista® Underground Distribution Switchgear UnderCover™, Vault-Mounted, and Pad-Mounted Styles: *Operation*" will be provided for bays containing manual Vista switchgear bays.
- S&C Instruction Sheet 682-510, "Remote-Supervisory Vista® Underground Distribution Switchgear UnderCover™, Vault-Mounted, and Pad-Mounted Styles: *Operation*" will be provided for bays containing remote-supervisory Vista switchgear bays.
- S&C Instruction Sheet 683-510, "Source Transfer Vista® Underground Distribution Switchgear UnderCover™, Vault-Mounted, and Pad-Mounted Styles: *Operation*" will be provided for bays containing source transfer Vista switchgear tanks.
- S&C Instruction Sheet 681-530, "Vista® Underground Distribution Switchgear: *Programming*" will be provided for all Vista switchgear bays containing fault interrupters.
- Reference drawings detailing the installation of cable support brackets and wiring diagrams for the current transformers (provided if the switchgear assemblies contain at least one factory-installed motor operator or if catalog number suffix "-Sx" has been specified where "x" is the way on which the auxiliary contacts are installed.)
- If metal-enclosed switchgear bays contain fuses, circuit breakers, meters, or other components, the appropriate S&C or original equipment manufacturer instruction sheets will be supplied.

Proper Application

⚠ WARNING

The equipment in this publication is only intended for a specific application. The application must be within the ratings furnished for the equipment. Ratings are on each bay's nameplate.

Understanding Safety-Alert Messages

Several types of safety-alert messages may appear throughout this instruction sheet and on labels and tags attached to the product. Become familiar with these types of messages and the importance of these signal words:

⚠ DANGER

"DANGER" identifies the most serious and immediate hazards that will likely result in serious personal injury or death if instructions, including recommended precautions, are not followed.

⚠ WARNING

"WARNING" identifies hazards or unsafe practices that can result in serious personal injury or death if instructions, including recommended precautions, are not followed.

⚠ CAUTION

"CAUTION" identifies hazards or unsafe practices that can result in minor personal injury if instructions, including recommended precautions, are not followed.

NOTICE

"NOTICE" identifies important procedures or requirements that can result in product or property damage if instructions are not followed.

Following Safety Instructions

If any portion of this instruction sheet is unclear and assistance is needed, contact the nearest S&C Sales Office or S&C Authorized Distributor, or call the S&C Technical Assistance Center at 1-888-762-1100. Telephone numbers are also listed on S&C's website, **sandc.com**.

NOTICE

Read this instruction sheet thoroughly and carefully before installing the System VI Switchgear.



Replacement Instructions and Labels

If additional copies of this instruction sheet are required, contact the nearest S&C Sales Office, S&C Authorized Distributor, S&C Headquarters, or S&C Electric Canada Ltd.

It is important any missing, damaged, or faded labels on the equipment be replaced immediately. Replacement labels are available by contacting the nearest S&C Sales Office, S&C Authorized Distributor, S&C Headquarters, or S&C Electric Canada Ltd.

⚠ DANGER



System VI Switchgear operates at high voltage. Failure to observe the precautions below will result in serious personal injury or death.

Some of these precautions may differ from your company's operating procedures and rules. Where a discrepancy exists, follow your company's operating procedures and rules.

When access to high-voltage bays is required, it should be restricted to qualified persons who observe the following procedures:

1. **QUALIFIED PERSONS.** Access to S&C System VI Switchgear must be restricted only to qualified persons. See the "Qualified Persons" section on page 2.
2. **SAFETY PROCEDURES.** Always follow safe operating procedures and rules.
3. **PERSONAL PROTECTIVE EQUIPMENT.** Always use suitable protective equipment, such as rubber gloves, rubber mats, hard hats, safety glasses, and flash clothing, in accordance with safe operating procedures and rules.
4. **SAFETY LABELS.** Do not remove or obscure any of the "DANGER," "WARNING," "CAUTION," or "NOTICE" labels.
5. **OPERATING MECHANISM AND BASE.** S&C System VI Switchgear contains fast-moving parts that can severely injure fingers. Do not remove or disassemble operating mechanisms or remove access panels unless directed by S&C Electric Company.
6. **ENERGIZED COMPONENTS.** Always consider all parts live until de-energized, tested, and grounded. Voltage levels can be as high as the peak line-to-ground voltage last applied to the unit. Units that have been energized or installed near energized lines should be considered live until tested and grounded.
7. **GROUNDING.** The S&C Metal Enclosed Switchgear must be connected to a suitable earth ground at the base of the utility pole, or to a suitable building ground for testing, before energizing the switchgear, and at all times when energized.

   The ground wire(s) must be bonded to the system neutral, if present. If the system neutral is not present, proper precautions must be taken to ensure the local earth ground, or building ground, cannot be severed or removed.
8. **SWITCH POSITION.** Always confirm the **Open/Closed** position of each switch.
   - Switches and terminal pads may be energized from either side.
   - Switches and terminal pads may be energized with the switches in any position.
9. **MAINTAINING PROPER CLEARANCE.** Always maintain proper clearance from energized components.
10. **PADLOCKS.** Non-removable manual handles in high-voltage compartment doors and hinged-padlockable covers, as well as hinged-bolted panels, have provisions for padlocks that must be in place and secured at all times unless work is being performed inside the enclosure. Padlocks must be installed and secured on manual switch operating handles at all times unless the switch is being operated.
11. **SNAPLOCKS.** Snaplocks must be in place and the keys must be removed.
12. **KEY INTERLOCKS.** Key interlocks (if applicable) must be in place. Check the operating sequence of key interlocks to verify proper sequencing. After the switchgear is installed, destroy all duplicate keys or make them accessible only to authorized persons so the key interlock scheme will not be compromised. Key interlocks are not security locks.
13. **MECHANICAL CABLE INTERLOCKS.** Mechanical cable interlocks are provided to prevent access to fuses unless the switch is open and to prevent operation of stored-energy switch operators when the enclosure door is open. Do not attempt to operate any switch when the enclosure door is open. Periodically, verify these interlocks are functional. Refer to the "Interlocks" section starting on page 52.
14. **EXCESSIVE FORCE**. Do not apply undue force to any handle when attempting to open or close a door or cover. The use of undue force may damage the handle or latching mechanism, or an interlock mechanism may be jammed. Do not attempt to close doors to reset interlocks. Instead, follow the instructions in the "Interlocks" section starting on page 52.
15. **PANELS AND SCREENS.** Make sure screens and hinged-bolted panels are bolted closed unless work is being performed inside the enclosure.
16. **FUSES.** Make sure fuses are disconnected from all power sources (including backfeed) before inspection or replacement.
17. **VOLTAGE TRANSFORMERS.** Disconnect all voltage transformers and voltage sensors when external voltage is used to test any secondary-side wiring or when heaters are energized for temporary storage. Do not disconnect voltage limiters from voltage sensors when the switchgear is energized.

⚠ DANGER



System VI Switchgear with Vista Underground Distribution Switchgear tanks operate at high voltage. Failure to observe the precautions below will result in serious personal injury or death.

Some of these precautions may differ from your company's operating procedures and rules. Where a discrepancy exists, follow your company's operating procedures and rules.

1. **QUALIFIED PERSONS.** Access to Vista Underground Distribution Switchgear must be restricted only to qualified persons. See the "Qualified Persons" section on page 2.
2. **SAFETY PROCEDURES.** Always follow safe operating procedures and rules. Always maintain proper clearance from energized components.
3. **PERSONAL PROTECTIVE EQUIPMENT.** Always use suitable protective equipment, such as rubber gloves, rubber mats, hard hats, safety glasses, and arc-flash clothing in accordance with safe operating procedures and rules.
4. **SAFETY LABELS.** Do not remove or obscure any of the "DANGER," "WARNING," "CAUTION," or "NOTICE" labels.
5. **DOORS.** High voltage compartment doors must be securely closed and latched, with padlocks in place at all times unless work is being performed inside the enclosure.
6. **KEY INTERLOCKS.** Optional key interlocks, if furnished, must be in place. Check the operating sequence of key interlocks to verify proper sequencing. After the switchgear is installed, destroy all duplicate keys or make them accessible only to authorized persons so the key-interlock scheme will not be compromised.
7. **OPENING DOORS.** Do not apply any undue force when attempting to open a door. The use of undue force may damage the door-latching mechanism.
8. **ENERGIZED BUSHINGS.** Always assume the bushings are energized unless proven otherwise by test, by visual evidence of an open-circuit condition at the load-interrupter switch or fault interrupter, or by observing that the load-interrupter switch or fault interrupter is grounded.
9. **BACKFEED.** Bushings, cables, load-interrupter switches, and fault interrupters may be energized by backfeed.
10. **GROUNDING.**
    - Vista switchgear must be connected to a suitable earth ground before energizing and at all times when energized.
    - The ground wire(s) must be bonded to the system neutral, if present. If the system neutral is not present, proper precautions must be taken to ensure the local earth ground cannot be severed or removed.
    - After the switchgear has been completely disconnected from all sources of power and tested for voltage, properly ground the load-interrupter switches and fault interrupters before touching any bushings or components that are to be inspected, replaced, serviced, or repaired.
11. **LOAD-INTERRUPTER SWITCH OR FAULT-INTERRUPTER POSITION.**
    - Always confirm the **Ground/Open/Closed** position of the load-interrupter switch or fault interrupter by visually observing the position of the isolating disconnect.
    - Be aware that the load-interrupter switch or fault interrupter may be energized by backfeed.
    - Be aware that the load-interrupter switch or fault interrupter may be energized in any position.
12. **MAINTAINING PROPER CLEARANCE.** Always maintain proper clearance from energized components.

Inspection

All assemblies of S&C System VI Switchgear are fastened to wood skids for shipment as individual bays or multi-bay units. Certain items, such as fuse components, current sensors, surge arresters, key interlocks, etc., may be packed separately and, insofar as practicable, are shipped within the enclosure.

Examine the shipment for external evidence of damage. Check the bill of lading to make sure all listed shipping skids, crates, and containers are received.

If there is visible loss and/or damage:

1. Notify the delivering carrier immediately.
2. Ask for a carrier inspection.
3. Note condition of shipment on all copies of the delivery receipt.
4. File a claim with the carrier and notify S&C Electric Company.

If concealed damage is discovered:

1. Notify the delivering carrier within 15 days of receipt of shipment.
2. Ask for a carrier inspection.
3. File a claim with the carrier and notify S&C Electric Company.

Storage

S&C System VI Switchgear should preferably be immediately installed in its permanent location. The space heaters for outdoor switchgear (and indoor switchgear, if so equipped) should be activated at once even though the switchgear itself may be energized later. See Figure 1. This is especially important for bays containing meters and relays, which are particularly susceptible to damage from moisture.

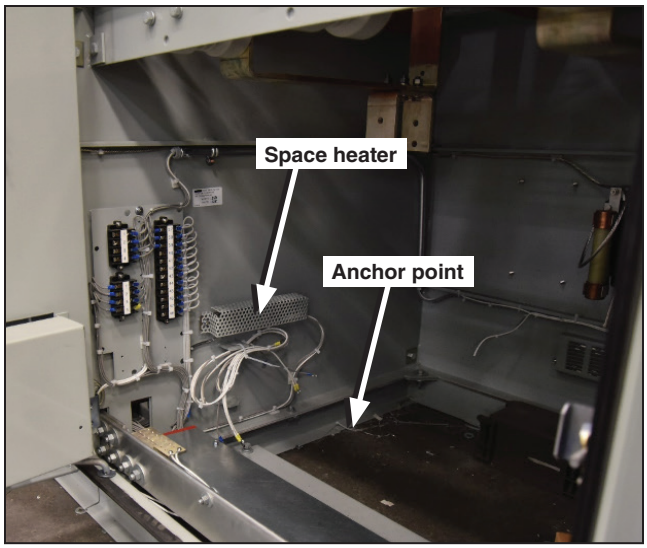


Figure 1. The space heater is behind a perforated sheath. Installation location of the anchor clips and nuts is also shown.

⚠ DANGER

If the space heaters are wired to be normally served through the secondary windings of voltage transformers located in the switchgear assembly, do not energize the space heaters from a temporary source until the following precautionary measures have been taken:

- Disconnect the secondary leads or remove the secondary fuses, and remove the primary fuses from the voltage transformers.
- If secondary connections are disconnected, tape the ends of the leads to prevent inadvertent short circuits or contact with the transformer secondary terminals.
- Connect the temporary source to the space heaters.

These precautionary measures must be taken to avoid energizing (backfeeding) the switchgear conductors at high voltage through the voltage transformers, which will result in serious injury or death.

When the switchgear cannot be immediately installed, storage in a clean, warm and dry room is recommended, especially for indoor switchgear. It should be protected from condensation, harmful gases, cement dust, and physical damage. If outdoor storage is a necessity, the following precautions should be taken:

Indoor Metal-Enclosed Switchgear Bays

If the switchgear was shipped with an outer protective wrapping, this covering should be removed. Shelter the switchgear with a tent-like covering, which will allow adequate ventilation but prevent entry of rain, snow, and contaminants through any openings. If the switchgear is not equipped with space heaters, install temporary electric heaters (250 to 500 watts per bay) to promote circulation to keep the interior dry.

Outdoor Metal-Enclosed Switchgear Bays

If the switchgear was shipped with an outer protective wrapping, this covering should be removed. Shelter the switchgear with a tent-like covering, which will allow adequate ventilation but prevent entry from rain, snow, and contaminants through any openings in the switchgear. If the switchgear is to be stored for a considerable time, connect and energize the space heaters to minimize condensation.

If the switchgear is to be stored, and it is impossible to connect and energize space heaters or temporary heaters, remove all meters, whether installed or separately boxed, and store the meters in a clean, dry room.

If the switchgear includes batteries, additional storage requirements apply. The battery charger should be disconnected from the battery, the battery should be charged periodically to avoid deep discharge that could damage the battery, and the battery should be charged for 24 hours following any extended storage.

Vista Switchgear Bays

Vista switchgear bays can be stored outdoors on their shipping skid until installation. The tank should never be removed from the enclosure.

At the first opportunity after receipt, remove all packing materials (cardboard, paper, foam padding, etc.) from the outside of the pad-mounted enclosure. This will prevent the finish from being damaged by rainwater absorbed by the packing materials and will also prevent wind-induced abrasion from loose cardboard.

Handling

Handling Metal-Enclosed Switchgear Bays

⚠ WARNING

When handling a metal-enclosed switchgear bay with an overhead hoist, observe standard lifting practices as well as the general instructions below.

Failure to follow these precautions can result in serious personal injury or equipment damage.

Follow these steps to avoid damaging the metal-enclosed switchgear bays when handling with an overhead hoist, and observe normal recommended procedures:

STEP 1. Arrange the lifting slings to distribute the lifting forces equally on all eyebolts. See Figure 2.

STEP 2. Do not apply lifting force to any eyebolts at an angle less than 60° from the horizontal. See Detail A, Figure 2.

STEP 3. If it is not possible to adhere to Step 2, wedge a timber between the eyebolts or slings as shown in Detail A, Figure 2.

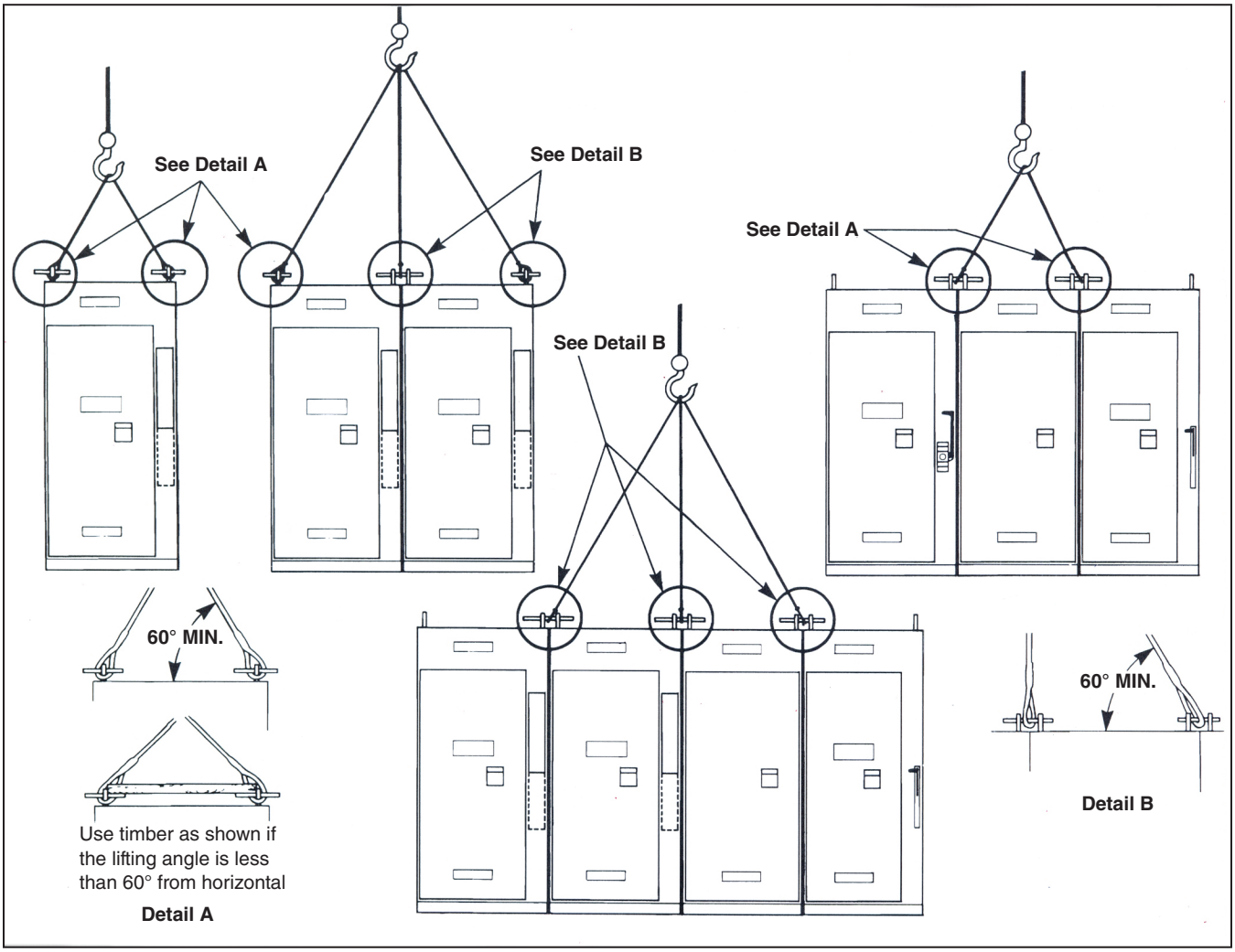


Figure 2. Hoist-sling arrangements and door-latching-mechanism references for S&C System VI Switchgear.

STEP 4. Be sure the eyebolts are screwed down to the shoulder before lifting the gear.

STEP 5. Avoid sudden starts and stops.

Note: It is not necessary to remove the eyebolts after the switchgear has been installed. If the eyebolts are removed, however, the holes must be plugged using galvanized bolts and washers, and sealing mastic.

Handling Vista Switchgear Bays

⚠ WARNING

When handling a Vista switchgear bay with an overhead hoist, observe standard lifting practices as well as the general instructions below.

Failure to follow these precautions can result in serious personal injury or equipment damage.

NOTICE

Refer to the nameplate affixed to exterior of switchgear assembly for the net weight.

To lift a Vista switchgear bay, complete the following steps:

STEP 1. Remove the bushing shield. See Figure 3.

STEP 2. Attach the hoist slings to the lifting tabs. See Figure 4.

STEP 3. Arrange the hoist slings to distribute lifting forces equally between the lifting tabs.

STEP 4. Lift the Vista switchgear bay into position per the appropriate installation section. Avoid sudden starts and stops.

Note: The lifting tabs can be left in place after installation.

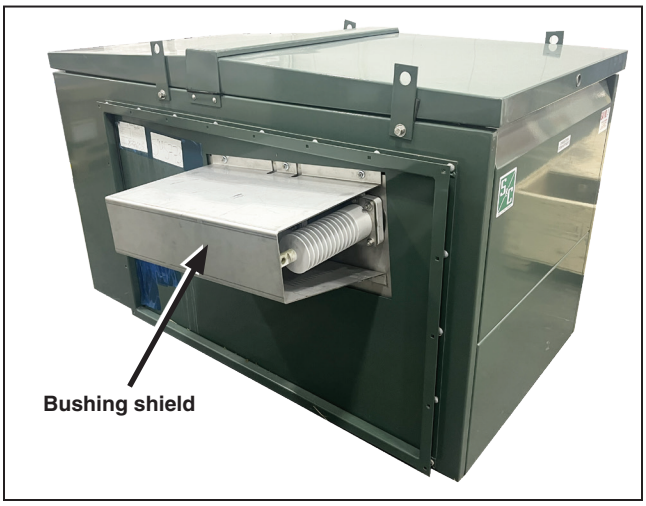


Figure 3. Bushing shield.



Figure 4. Lifting a Vista switchgear bay.

Metal-Enclosed Switchgear Bay Security

S&C System VI Switchgear incorporates many provisions to minimize hazards to qualified persons and to the general public. Each metal enclosed bay is fabricated from an 11-gauge steel sheet and is a free-standing, self-supporting unit with:

- ***For switchgear installed in the United States***: An integral channel base of a thicker-gauge material than used for the enclosure and shall extend completely around all four sides of each bay
- ***For switchgear installed in Canada***: Continuous 90-degree flanges, turned inward and welded at the corners, for bolting to the concrete pad

With this unitized design, there are always double walls between the adjoining bays. Externally removable side sheets, rear sheets, or roofs can be provided in rare situations to access components, if necessary. However, standard designs of S&C System VI Switchgear are normally not provided with parts that can be removed externally. Even provisions for future bus extension are closed with a panel secured internally. Access is from the front only, through wide bulkhead-type doors having concealed cam-type, high-strength latches that seal the doors shut. Each full-length door has a minimum of three concealed, extra-heavy-duty hinges with stainless steel pins. All doors and covers are padlockable and have top and side flanges with double 90-degree bends (except hinged bolted panels), which overlap the door openings, adding rigidity and discouraging tampering.

Vista Switchgear Bay Security

Vista switchgear bay opening mechanism includes a Penta-Latch® Mechanism operated by a Pentahead wrench. After the hinged-roof sections are fully lowered they can be secured with Pentahead bolts and then a padlock. See Figure 5.

Access Control

Switch operators and controls in are isolated from high voltage in grounded, metal-enclosed compartments. Access to these components is controlled by padlockable covers, which incorporate a non-removable manual handle. Other low-voltage components, such as meters, selector switches, toggle switches, etc., are similarly isolated. Interlocks and padlocks help control access to high-voltage compartments.

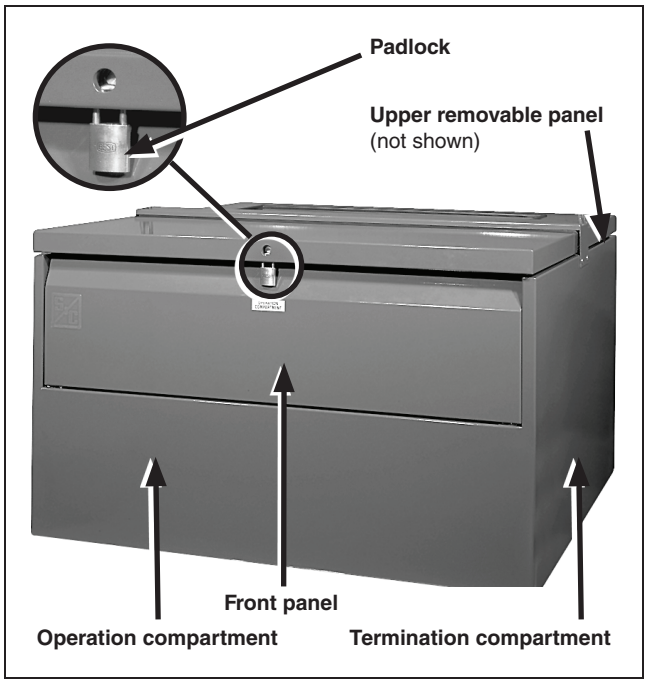


Figure 5. Vista switchgear bay secured with a padlock.

For metal-enclosed switchgear bays installed in the United States: Flush-mounted key-operated snap locks on doors and hinged-bolted panels providing access to high-voltage components.

A protective screen is furnished behind metal-enclosed bay doors that provide access to high-voltage components. These screens, when bolted closed, serve as a second barrier to guard against inadvertent entry. Switch-operating handles are padlockable in the **Open** or **Closed** position. On outdoor style switchgear, baffles and screens mounted inside the enclosure cover all vents, discouraging wire poking.

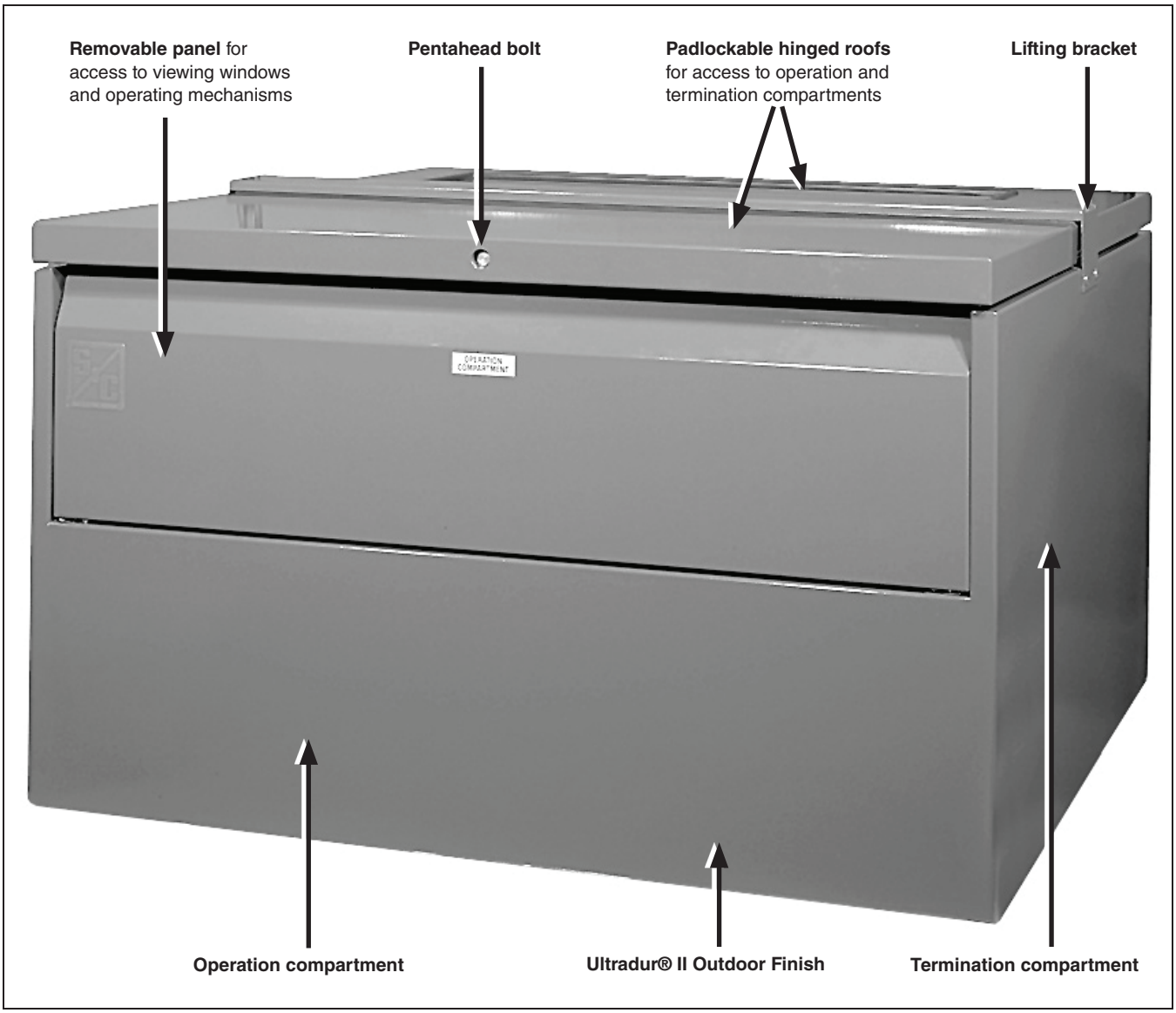


Figure 6. Vista switchgear bay overview.

Because this gear is often located in areas accessible to the general public as well as authorized but unqualified persons, care must be taken to alert such persons to the presence of high voltage within the enclosure. Therefore, do not remove any of the "Warning—Keep Out—High Voltage" or "Danger—High Voltage—Qualified Persons Only" signs attached to the gear. Any organization altering or removing these hazard altering signs must assume full responsibility for such actions.

Vista switchgear bays feature load-interrupter switches for switching 600-ampere main feeders. The switchgear also features microprocessor-controlled, resettable vacuum fault interrupters for switching and protection of 600-ampere main feeders and 200-ampere taps, laterals, and subloops. These elbow-connected components are enclosed in a submersible, gas-insulated, and hermetically sealed welded-steel tank. All components are secured with a padlock. See Figure 6 on page 12, Figure 7, and Figure 8.

Take particular care to make sure all screens and hinged-bolted panels are bolted closed and all doors, handles, and covers are securely padlocked before leaving the gear unattended, even momentarily.

⚠ WARNING

When optional key interlock schemes have been furnished, duplicate keys are provided for use during installation. To maintain the integrity of the key interlock scheme, the duplicate key must be destroyed or made accessible only to authorized persons. **Failure to do so can result in serious personal injury or death.**

Note: Key interlocks and snaplocks are not security locks and are not substitutes for padlocks.

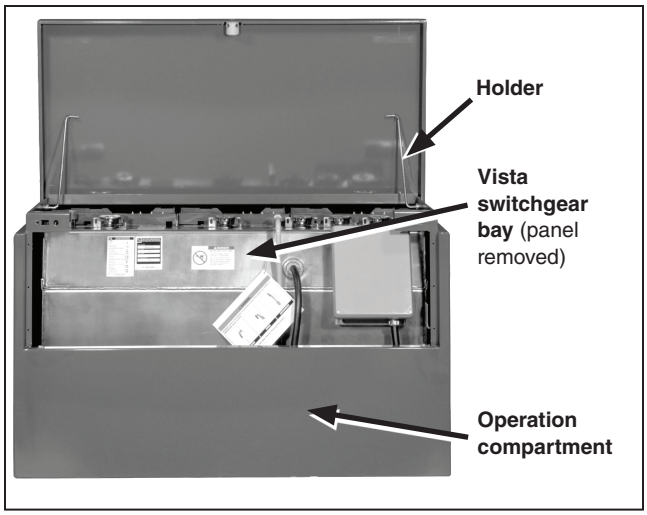


Figure 7. Vista switchgear bay, operation compartment.

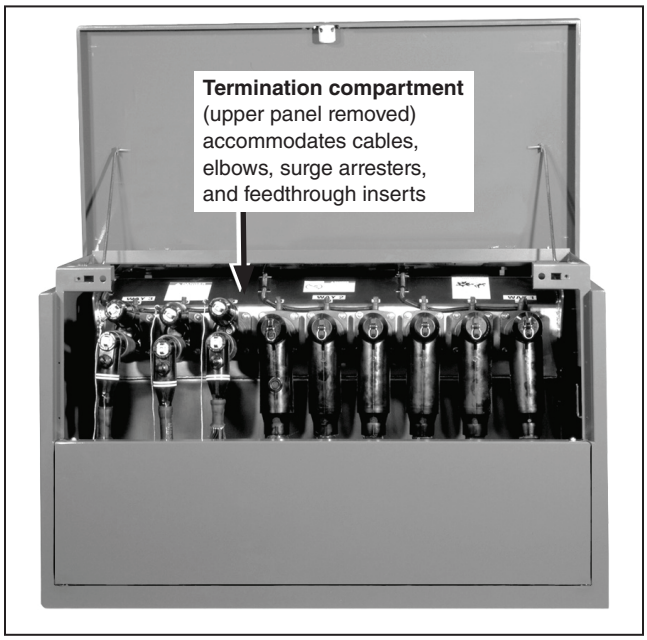


Figure 8. Vista switchgear bay, termination compartment.

Understanding the Gas-Pressure Gauge

Vista switchgear bays incorporate a temperature-compensated gas-pressure gauge inside the tank to provide indication of the insulating gas pressure. The gas-pressure gauge includes four distinct color-coded zones.

If the needle is within a particular zone as described below, it indicates the following:

Green zone:

The Vista switchgear unit is OK to operate.

Green/Yellow zone:

The Vista switchgear unit may have lost some gas but is still OK to operate.

For SF_6 models: The unit should be evaluated to determine whether it needs to be refilled with SF_6 gas via the field-accessible fill port and repaired accordingly. Contact S&C for assistance.

Vista Green switchgear models (CO_2-mix) are hermetically sealed. The gas-fill port is not accessible in the field as standard. Contact S&C for assistance.

Red zone:

The insulating gas may be below the minimum operating pressure for the gear. **Vista switchgear should not be operated if the needle is in the red zone.** Contact S&C for assistance.

Orange zone:

The Vista switchgear tank has been overfilled in the field or has a defective pressure gauge. For SF_6 Vista switchgear with field-accessible ports, an external gauge can be used instead to verify the gas pressure before operation of the device. Contact S&C for assistance.

Vista Green switchgear models (CO_2-mix) are hermetically sealed. The gas-fill port is not accessible in the field as standard. Contact S&C for assistance.

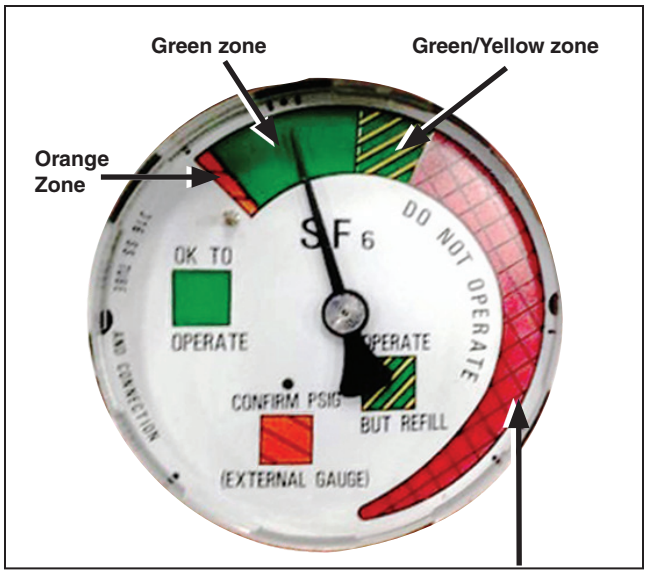


Figure 9. The internal gas-pressure gauge for most Vista switchgear models.

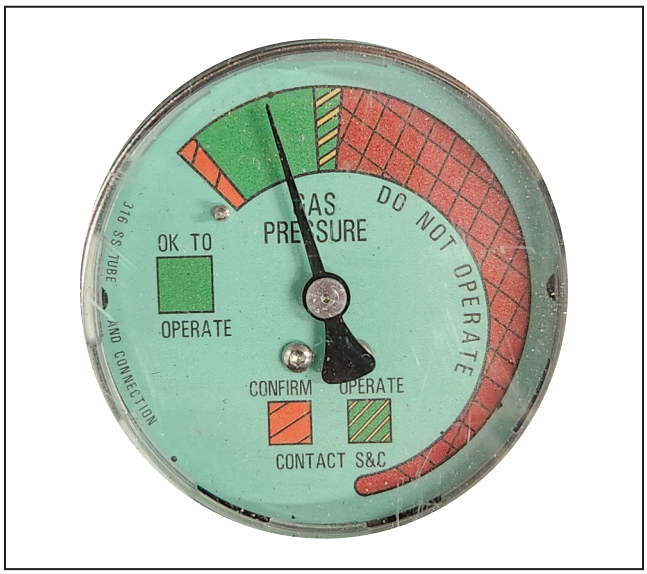


Figure 10. The internal gas-pressure gauge for Vista Green switchgear models (CO_2-mix), "-GRN" catalog numbers.

Gauge Needle Fluctuations from Rapid Ambient Temperature Changes

When the Vista switchgear tank experiences rapid changes in ambient temperature, the gas-pressure gauge needle may temporarily move to indicate a higher gas pressure when the tank is rapidly cooled or a lower gas pressure when the tank is rapidly heated. This phenomenon may occur, for instance, with sudden, direct exposure to intense sunlight.

The gas-pressure gauge uses a small reference gas chamber filled with helium to compensate for ambient temperature and altitude without applying correction factors. The gauge indicates tank pressure by measuring the pressure differential between the gas in the tank and the gas in the gauge.

When the tank experiences rapid ambient temperature changes, the smaller volume of gas inside the gauge can change temperature more quickly than the larger volume of gas in the tank, which can lead to temporary movement of the needle. When the temperature stabilizes, the needle will return to its previous position within 1–2 hours.

For SF_6 units: If the gauge shows a sudden drop or increase in pressure, S&C recommends checking with an external gauge or waiting for ambient temperature conditions to stabilize to confirm the needle has returned to its normal position.



Vista Green switchgear models (CO_2-mix) are hermetically sealed. The gas-fill port is not accessible in the field as standard. Contact S&C for assistance.

Access to the interior of the switchgear bays can be obtained through three types of entrance ways: high-voltage compartment doors, hinged-bolted panels, or removable plates. See Figure 11 on page 17.

Opening Exterior Doors, Covers, and Panels

⚠ WARNING

Do not apply excessive force to any door handle when attempting to open a door. The use of excessive force may damage the door handle and latching mechanism, or an interlock may be jammed. Verify opening the door is in the sequence dictated by the interlock scheme provided. Trying to force open an interlocked door, or damaging the door mechanism, may make it difficult to secure the door of the switchgear. **This may lead to unauthorized entry into the gear that can cause serious personal injury or death.**

For switchgear installed in the United States: Verify the snaplocks are unlocked and then verify opening the door is in the sequence dictated by the interlock scheme provided.

High-voltage compartment doors and hinged padlockable covers use non-removable padlockable manual handles that pivot for door and cover opening. Most high-voltage compartment doors are secured closed by a three-point latching mechanism and may be equipped with a key-operated snaplock, key-operated interlock, and/or a mechanical cable interlock. If the bay includes fuses, a mechanical interlock or key interlock is provided, so the associated switch must be in the **Open** position before the door can be opened. Only operate switches when the associated door is closed.

To open the high-voltage compartment door or hinged, padlockable cover, remove the padlock from the hasp and firmly pull outward and downward on the handle. If the high-voltage compartment door is equipped with a self-latching door holder, pull the door open until it is secured in place by the holder.

Hinged bolted panels on switchgear bays or bus ducts may include captive bolts, key-operated snaplocks and provisions for padlocks. To open these panels, remove the padlock, disengage the snaplock, and then loosen all bolts.

Closing Exterior Doors, Covers, and Panels

High-voltage compartment doors and hinged padlockable covers are closed as follows: For doors, release the door holder if so equipped. Then, push the doors or covers so they are fully closed. While holding the door or cover closed, pivot the handle to engage the latches. Pull outward on the edge of the door (or cover) to verify it has latched securely. Insert a padlock into the hasp when the switchgear is energized.

Hinged bolted panels are closed by pushing the panel closed to engage the snaplock and then tightening all bolts securely. Verify the panel is fully closed and bolted. Insert a padlock into the hasp when the switchgear is energized.

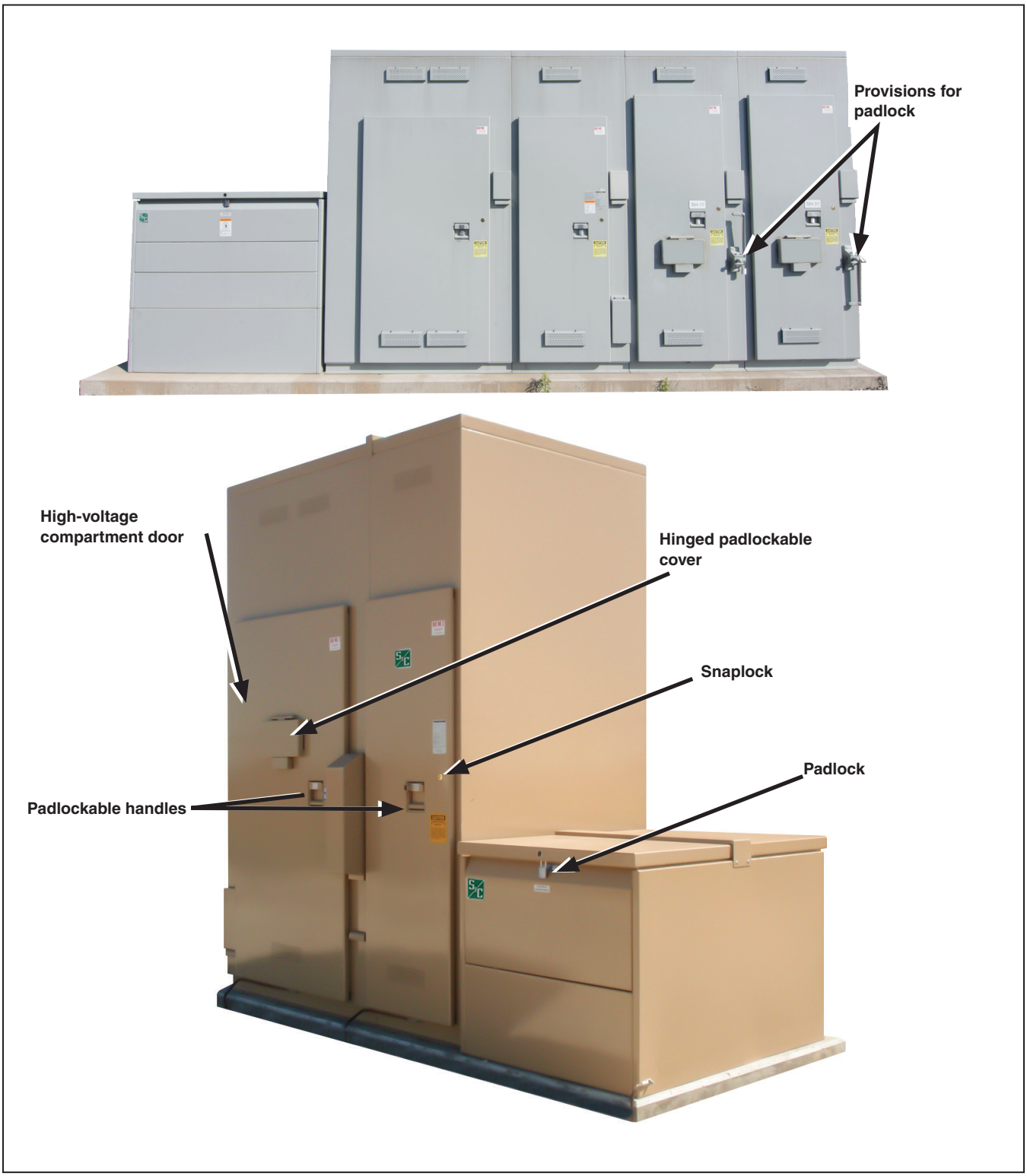


Figure 11. Two samples of switchgear showing the high-voltage compartment door, hinged padlockable cover, and hinged bolted panel.

Follow these steps to place the switchgear:

STEP 1. Transport the switchgear to the installation site, observing the precautions given in the "Shipping and Handling" section on page 7.

STEP 2. At the installation site, remove all the separately packaged components shipped within the enclosure and set them aside in a protected area.

STEP 3. Each bay of a multi-bay assembly is identified by a number on the front of the bay. Proper positioning of the switchgear is indicated by corresponding numbers on the anchor-bolt plan shown in the "CDA/CDT" drawing enclosed in the waterproof envelope labeled "Installation and Operation Information Kit."

On multi-bay assemblies shipped in individual units consisting of bays, or groups of bays, the unit whose working clearance will be most affected by adjacent walls or structures should be placed first.

(a) Unbolt the unit from its skid and lift it over the anchor bolts, observing the precautions in the "Shipping and Handling" section on page 7.

(b) Align the bottom of the bay so it is square with, and centered on, the anchor bolts.

(c) When power and control cables will enter the enclosure through trench or conduit in the mounting pad, check these locations for alignment with the terminating facilities provided in the switchgear.

Note: If excess lengths of direct-buried cable are in place and it is desired to feed them into the bay as the unit is being lowered, the doors must be opened (with door holders latched to allow any excess cable to be fed over the door stiles). See Figure 11 on page 17. If the interphase insulating barriers are removed to facilitate this procedure, note their positioning to ensure correct reinstallation. It should not be necessary to remove any end barriers.

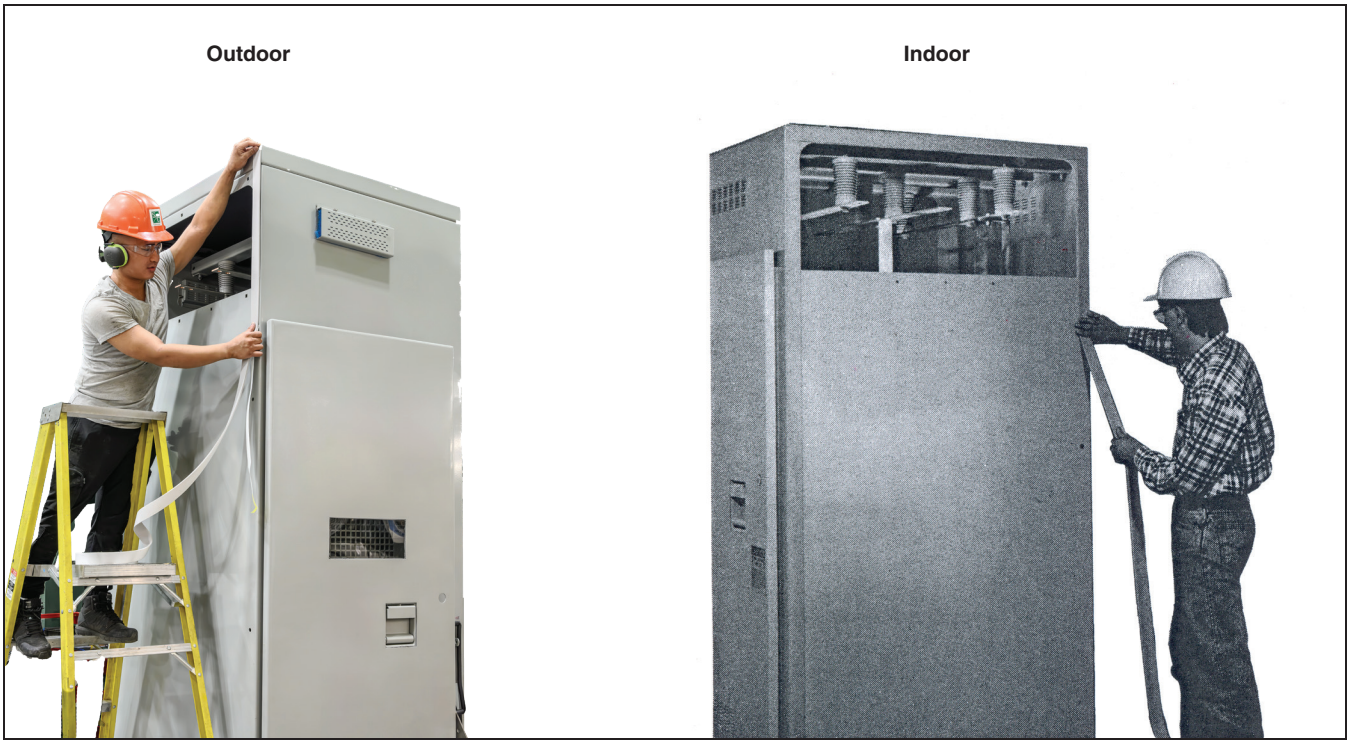


Figure 12. Applying gasket tape. Indoor units with optional dust-proof or drip-proof construction are pictured on the left. Outdoor units, pictured at right, require two strips of gasket tape at the top of the enclosure.

STEP 4. ***On indoor metal-enclosed switchgear bays furnished with optional drip-proof or dust-proof construction and on outdoor multi-bay assemblies***: Obtain a weather-tight seal between units by applying adhesive-backed foam-gasket tape (provided) around exposed edges and roof section between adjoining units. See Figure 12 on page 18.

On outdoor switchgear: Two strips of gasket tape are used at the top of the enclosure. See Figure 12 on page 18. Strips of gasket at the top of the roof section should be installed the full depth of the enclosure with strips at side edges starting below the top strips. Remove any bus-opening support straps before applying the gasket.

On Vista switchgear bays: Apply a strip of gasket tape along the collar of the Vista switchgear bay or transition bay. See Figure 13 and Figure 14.

Use extra care when aligning the collar with the connecting bay. There will be a positioning bold on the collar to help with alignment. Avoid sudden starts and stops of the lifting mechanism during alignment to avoid scratching the switchgear finish or damaging the positioning bolt or bushings.

After alignment, to complete the connection, the interconnecting ⅜-16 × 1-inch carriage bolts and ⅜-inch stainless steel washers should be fed through the back of the collar on one side similar to the way the positioning bolt is installed. The holes in the collar are square to capture the bolt heads. They should be secured on the mating side with one ⅜-inch galvanized flat washer, and a ⅜-inch galvanized lockwasher under the ⅜-16-inch stainless steel hex jam nut.

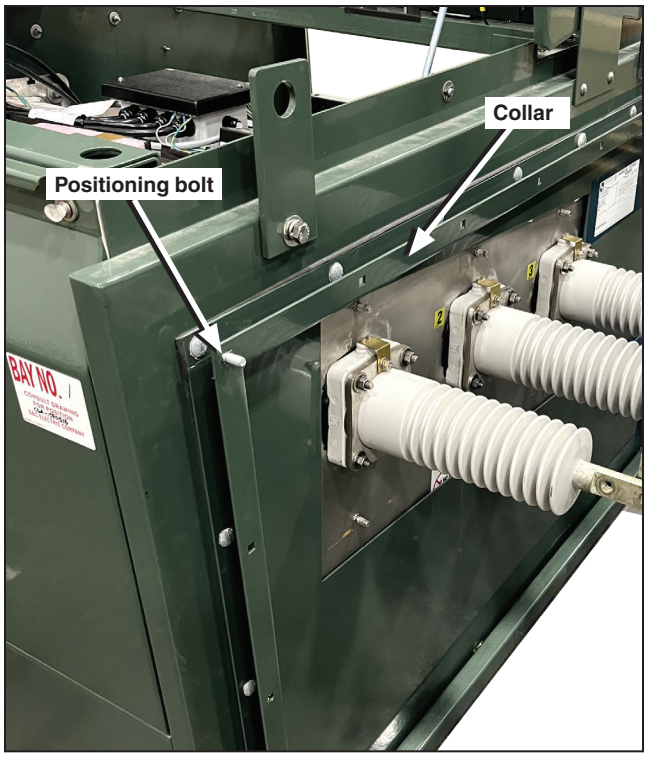


Figure 13. Positioning bolt. Gasket tape should be applied to the collar of the Vista switchgear or transition bay.



Figure 14. Applying gasket tape to low-rise transition bay before connecting the Vista switchgear bay.

STEP 5. Level each bay using metal shims as required. Secure each bay to the pad with the anchor clips provided by tightening the anchor-bolt nuts. See Figure 1 on page 7.

Make sure the switchgear-bay doors open and close without binding. Binding indicates enclosure distortion, which must be corrected by additional shimming.

STEP 6. Apply grout at the bottom of the enclosure to prevent entry of rodents, insects, or weeds. On outdoor assemblies, S&C recommends the grouting be recessed sufficiently from the exterior exposure to permit caulking with a weatherproof compound applied with a standard caulking gun. A room-temperature vulcanizing (RTV) silicone rubber compound is recommended. Figure 15.

NOTICE

A resilient closed-cell gasket on the bottom flange of Vista switchgear bay enclosures protects the finish from being scratched during installation, and isolates it from the alkalinity of a concrete foundation. This gasket also helps to seal the enclosure to the foundation, to guard against entry of wildlife, insects, or weeds, and to discourage tampering. If the gasket cannot compensate for an uneven foundation, grout the bottom of the enclosure as necessary. Any grout applied should be recessed enough to permit caulking.

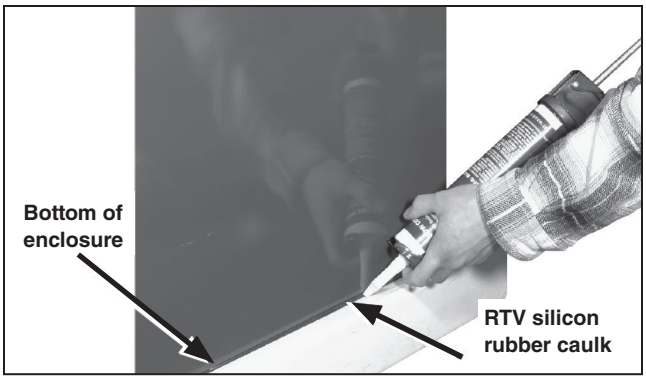


Figure 15. Caulk along the bottom of the enclosure.

On multi-bay assemblies shipped in individual units: Align, level, anchor, check door operation, grout, and caulk succeeding units in turn, and join units with the ½—13-inch galvanized bolts provided. See Figure 16. The bolts may be easily pressed through the gasket tape. Do not attempt to draw misaligned units together with these bolts. See Figure 17.

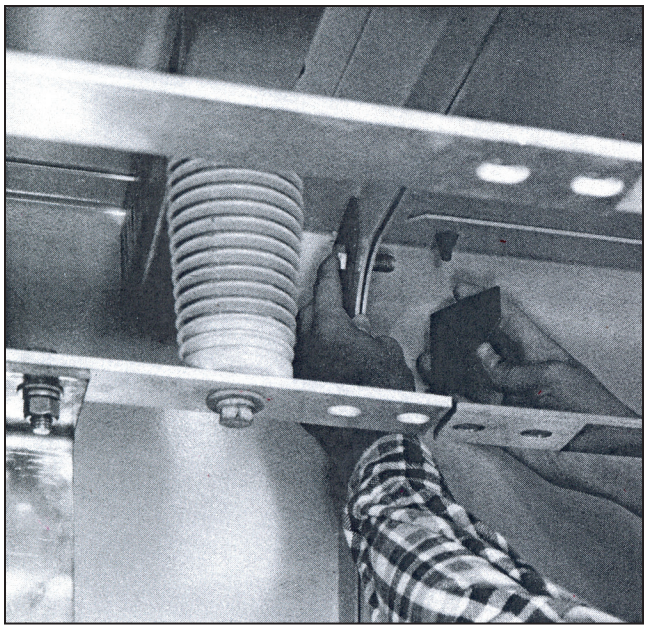
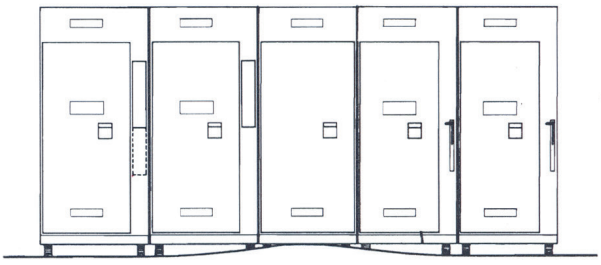
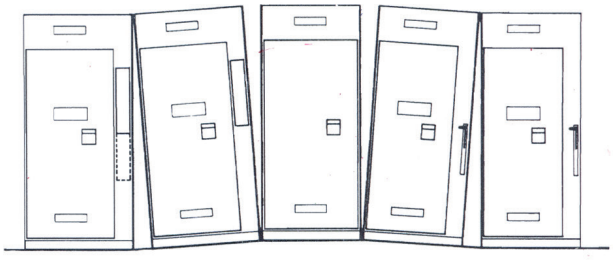


Figure 16. Joining units together.

Note: On multi-bay assemblies, avoid misalignment, which may result in improper operation of the switchgear and ineffective weather sealing between bays. Before installing the switchgear, determine where shimming will be necessary, and have the required shims on hand.



This!



Not This!

Figure 17. Alignment of multi-bay switchgear assemblies.

Completing Bay Interconnections

For Metal-Enclosed Switchgear Bays

STEP 1. ***For Metal-Enclosed Switchgear Bays Rated 15.5 kV***: On outdoor switchgear (as well as indoor switchgear with optional dust-proof or drip-proof construction), after all bays are in place and bolted together, sides and top edges of through-bus openings between bays should have the supplied extruded rubber channel gasket installed.

(a) To facilitate installation of the channel gasket, install and tighten bolts and nuts at the edges of the through-bus openings on adjacent bays using the 5/16-inch hardware provided. See Figure 18.

(b) Stir the special adhesive provided until the color is the same throughout. Cement the channel gasket in place with the adhesive. Apply this adhesive evenly to the two sides and top of the bus opening flange in both bays, and to all inside surfaces of the channel gasket. After allowing the adhesive to become tacky (i.e., does not transfer to a knuckle when touched), start the channel gasket at the bottom front corner of the bus opening and, while verifying the gasket is seated completely over the opening flange, install the gasket at the front, top, and back of the bus opening. See Figure 19, which illustrates the last length of gasket being set in place at the bottom-rear corner of the bus opening.

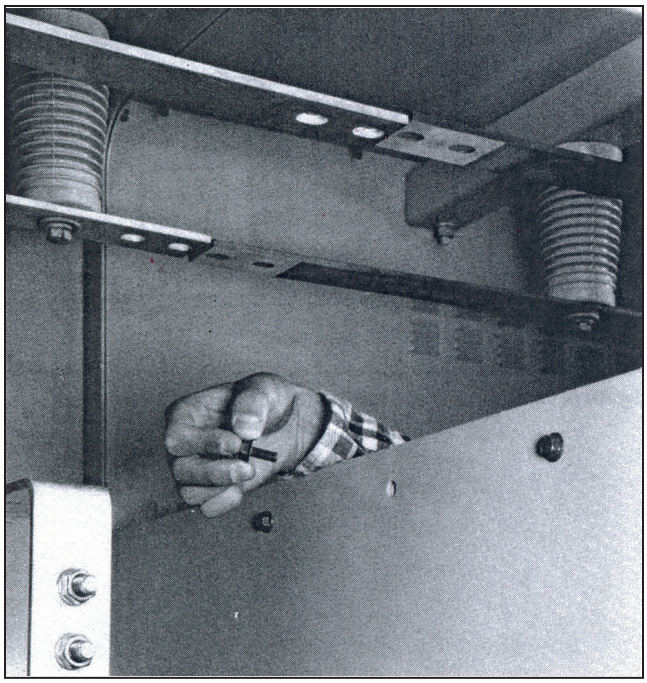


Figure 18. Draw edges of bus openings together, if necessary.

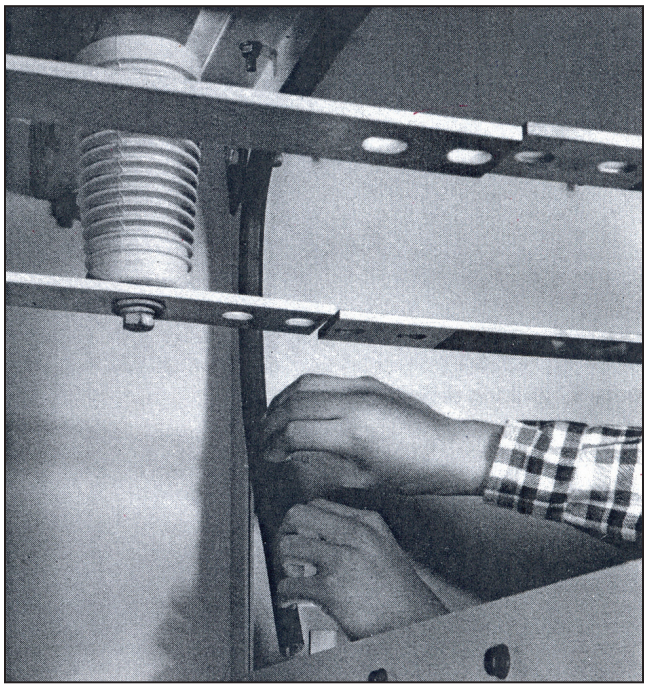


Figure 19. Installing a rubber channel gasket in the through-bus opening on switchgear rated 4.16 kV or 13.8 kV. Start the gasket at the bottom front corner and end (as illustrated above) at the bottom-rear corner.

(c) Install gasket-support straps (provided) at locations along the top of each bus opening. Each end of the strap is to be placed against the nut on a roof-attachment bolt and secured in place with a 5/16-inch flat washer and a 5/16-inch locknut (provided). See Figure 20. Do not loosen any roof-attachment bolts.

For Metal-Enclosed Switchgear Bays Rated 27 kV or 38 kV: Install and tighten bolts and nuts at the edges of through-bus openings on adjacent bays using the 5/16-inch hardware furnished.

On outdoor metal-enclosed switchgear bays: After all bays are in place and bolted together, install roof caps over roof flanges between bays and bolt them into place using the hardware furnished. See Figure 21 on page 24.

STEP 2. Remove from metal-enclosed switchgear bays (where applicable) all barrier braces and switch-blade tie cords installed to restrain movement of these parts during shipping and handling.

NOTICE

To ensure adequate electrical clearances, splice plates and hardware must be installed in the manner described and illustrated in the following text and figures. Failure to comply with these instructions may reduce the BIL capability of the switchgear assembly.

For switchgear equipped with insulating through-bushings, semiconducting grommets must be installed on the bushings before installing splice plates. See Figure 24 on page 27. Failure to install grommets may cause corona discharge between the bus splice plates and the bushings.

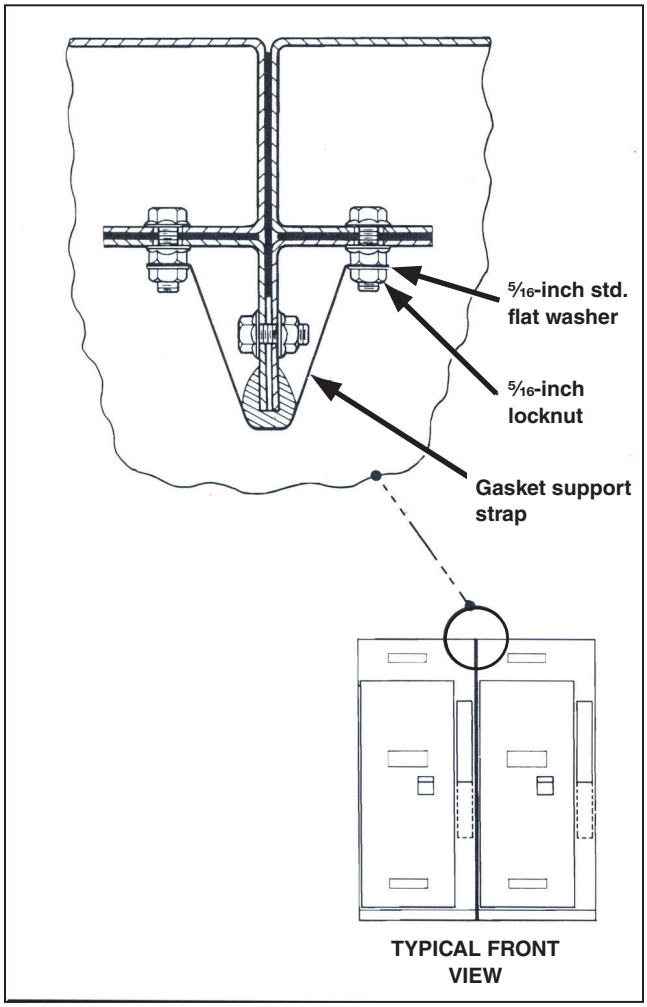


Figure 20. Installation of gasket-support straps in switchgear rated 4.16 kV or 13.8 kV.

STEP 3. The bus construction in S&C System VI Switchgear is aluminum and copper. Terminal pads on components may be aluminum, copper, or copper alloy. Therefore, bus and terminal connections are typically aluminum-to-aluminum or aluminum-to-copper. These connections use Belleville (formed spring-steel) washers. Do not tighten factory-made connections using Belleville washers unless they are visibly loose because they have been correctly torqued to 50 foot-pounds at the factory.

Note: In cases involving copper bus construction or flexible laminated-copper connecting straps, copper-to-copper, copper-to-silver, or silver-to-silver connections may be found. These connections use flat stainless steel washers instead of Belleville washers (and stainless steel or Everdur hardware instead of galvanized hardware) and should be torqued to 35 foot-pounds because they may have loosened during shipment. Check bus connections and where necessary correctly tighten the connecting hardware.

STEP 4. For the inter-unit splices in the main-bus and ground-bus runs of metal-enclosed switchgear bays, splice-plate kits have been provided. These kits contain splice plates, bolts, nuts, washers, a sheet of abrasive paper, a tube of anti-oxidant compound, and instructions.

For aluminum bus, both the bus ends and splice plates have been pre-abraded and coated with a thin layer of oxidation-inhibiting grease at the factory.

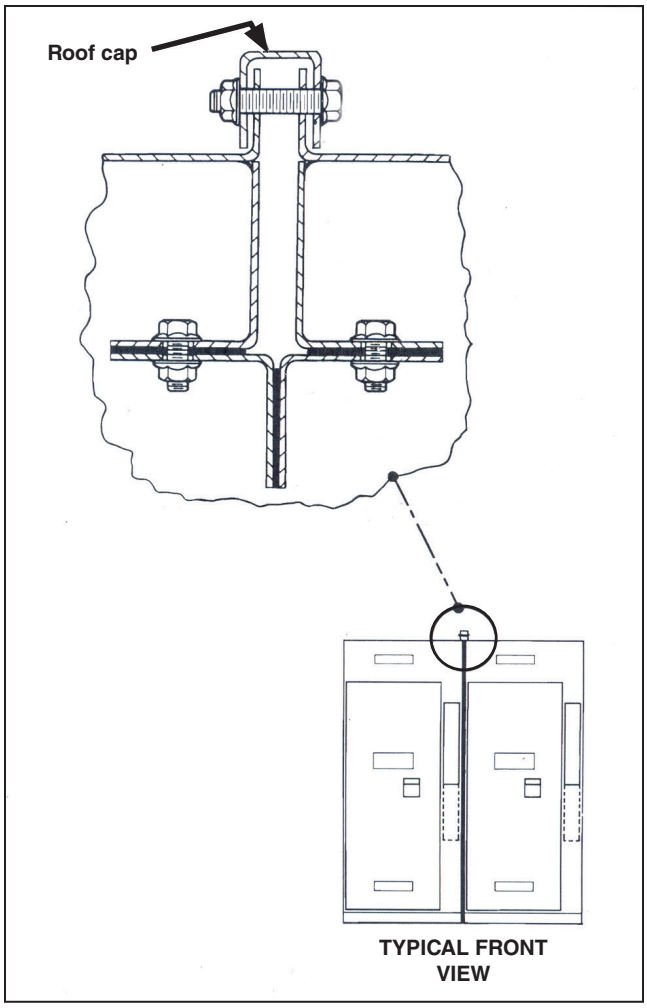


Figure 21. Installation roof caps over the roof flanges on outdoor switchgear rated 25 kV or 34.5 kV.

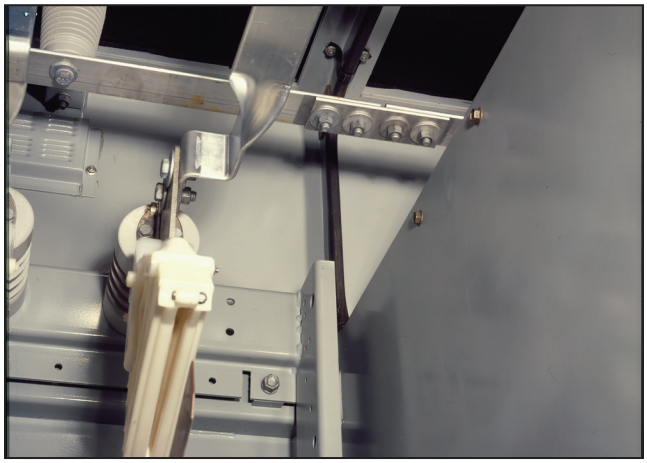


Figure 22. If one or two Belleville washers are used with galvanized hardware, tighten to 50 ft-lbs. If no Belleville washers are used or if stainless steel or Everdur hardware is used, tighten to 35 ft-lbs.

To ensure the highest quality joints, the mating surfaces of aluminum bus ends and splice plates should be re-abraded with the abrasive paper provided and immediately coated with a uniform layer of anti-oxidant compound just prior to making the bolted connections.

Note: For copper main bus and ground bus, joint surfaces may be silver-plated or tin-plated and would require no corrosion-inhibiting compounds. Therefore, before joining, clean the surfaces with a clean dry cloth or, if necessary, with a mineral-spirits solvent. Do not use abrasives of any kind to attempt to remove discoloration that may appear on the silver-plated surfaces. This discoloration is characteristic of silver and does not affect the performance of the bus splice.

To facilitate installation of bus splices into through-bushings, lubricate the opening in the semiconducting grommets with NYE Rheolube, Shell Gadus S2 U1000 2, Vaseline, liquid soap, or talcum powder. Make the bus splices, including those for optional insulating through-bushings, as follows (refer to Figure 22 on page 24, Figure 23 on page 26, and Figure 24 on page 27):

(a) ***For aluminum-to-aluminum bus connections:*** Place the splice plate on the bottom of the ends of main bus sections or on the side of the ground bus facing the interior of the bay. Make the connections using one Belleville washer under the head of each bolt and one Belleville washer under each nut. The bolts must be installed with the bolt head on the topside of the main bus. Belleville washers must be installed with the outer ring of the cup toward the bus. See Figure 23 on page 26 (Detail A) and Figure 22. Tighten all splice bolts and nuts to a torque of 50 foot-pounds, as indicated by a torque wrench. If a torque wrench is not available, tighten until the Belleville washers are flat, and then loosen one-half turn.

(b) ***For copper-to-copper bus connections (which include silver or tin-plated copper connections):*** Place the splice plate on the bottom of the ends of the main bus sections and on the side of the ground bus facing the interior of the bay. Make the connections using one stainless steel flat washer under the head of each bolt and one stainless steel flat washer plus one split lockwasher under each nut. The bolts must be installed with the bolt head on the topside of the main bus. See Detail B of Figure 23 on page 26. Tighten all splice bolts and nuts to a torque of 35 foot-pounds as indicated by a torque wrench. If a torque wrench is not available, tighten until the split lockwasher is flat.

(c) ***For copper-to-aluminum bus connections:*** Place the splice plate on the bottom of the ends of the main bus sections and on the side of the ground bus facing the interior of the bay. Make the connections using one stainless steel flat washer against the copper-bus section and one Belleville washer against the aluminum bus section. The bolts must be installed with the bolt head on the topside of the main bus. See Detail C of Figure 23 on page 26. Torque the bolts to 50 foot-pounds or, in the absence of a torque wrench, tighten each bolt until the Belleville washer is flat, and then loosen one-half turn. Do not use lockwashers with Belleville washers.

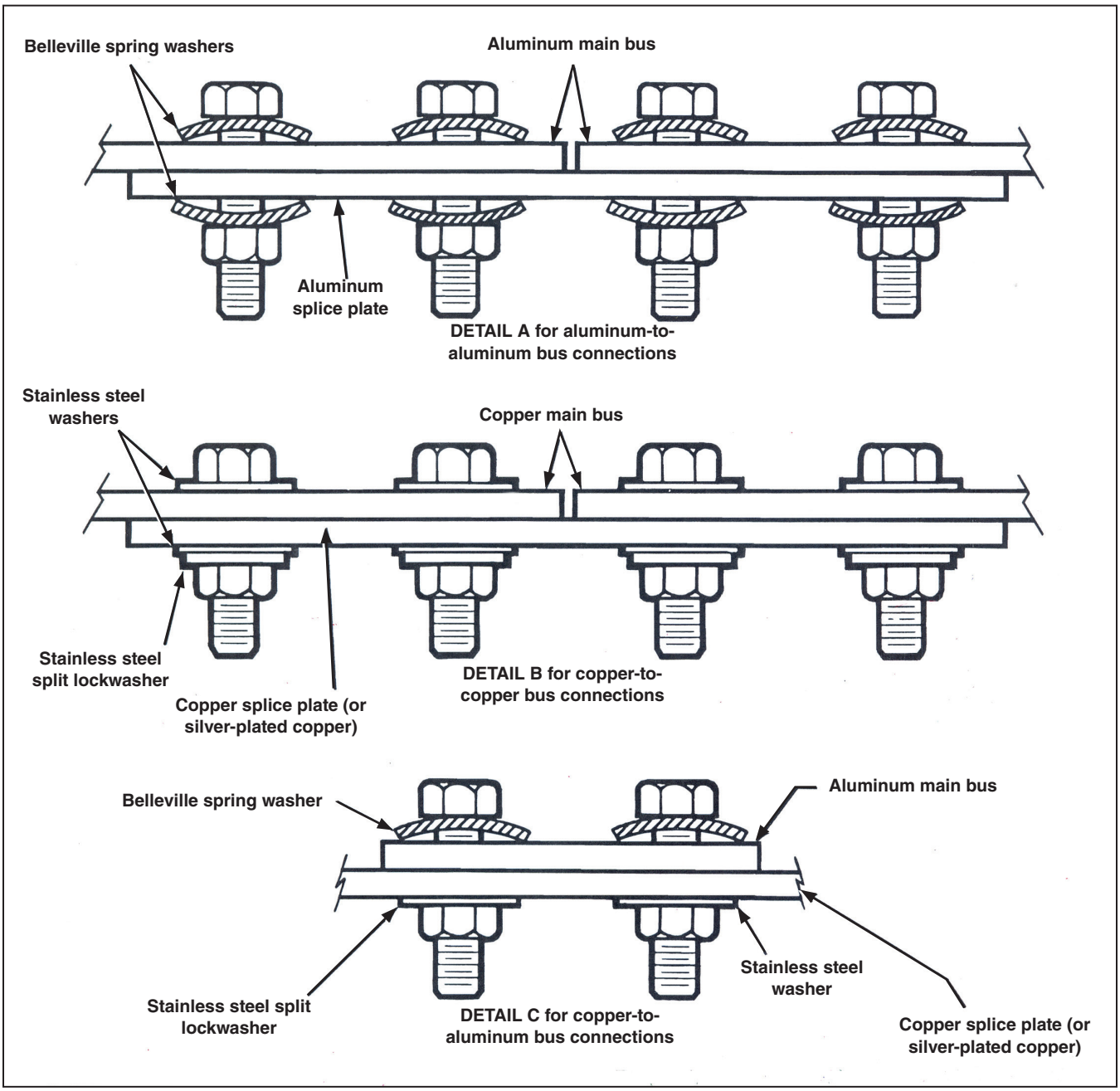


Figure 23. Installation of inter-unit bus splices.

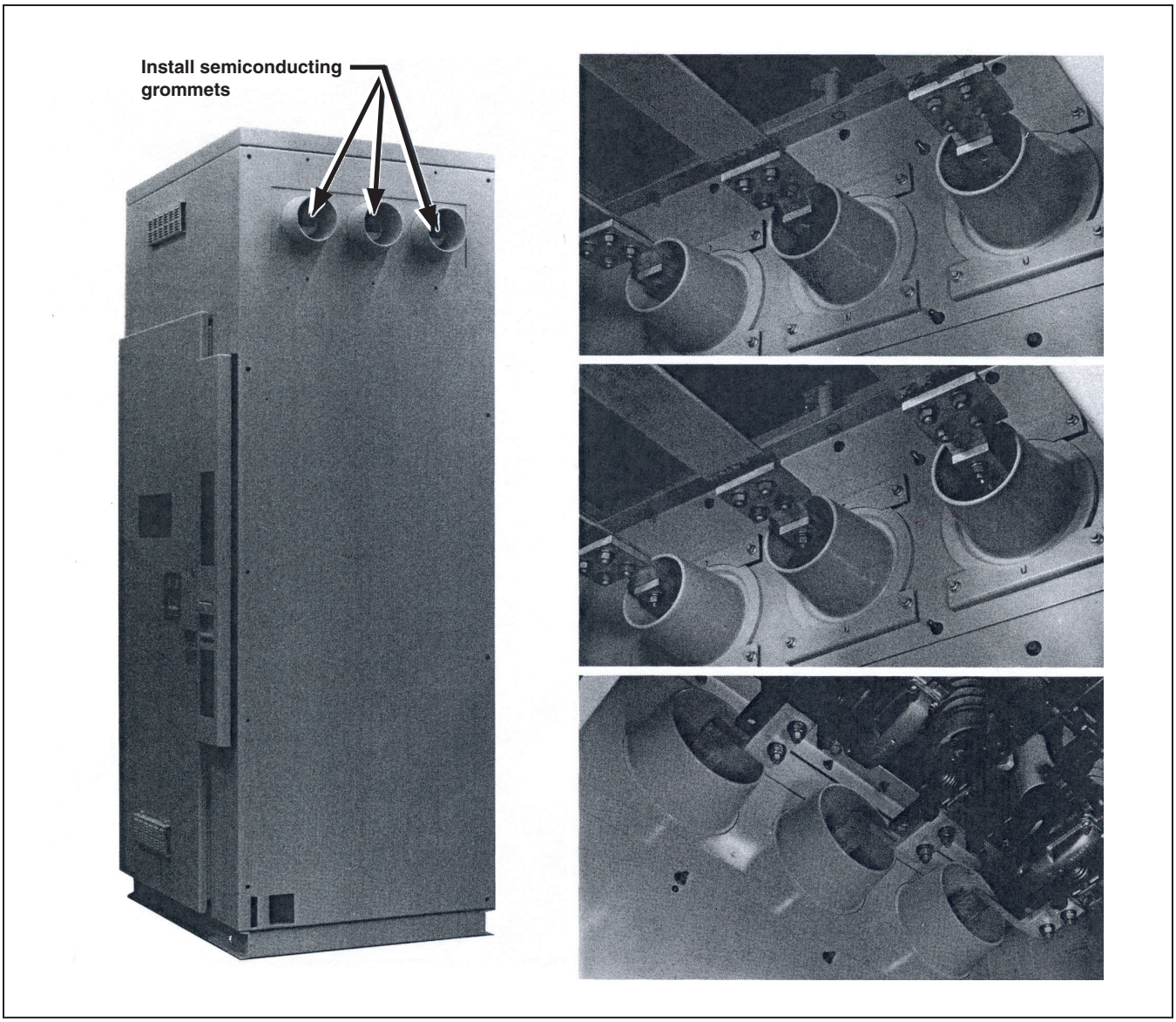


Figure 24. Installation of bus splice plates for through-bushings. The exterior view of the bay is illustrated on the left. The top view on the right illustrates the interior view of the same bay with the bus splice plates inserted through the semiconducting grommet of the bushing. The center view on the right shows the splice plates bolted in place. The bottom view on the right illustrates the interior view of the adjacent bay showing the bus-splice plates installed and bolted to the main bus. The through-bushings and the 1200-ampere main bus are pictured.

For Vista Switchgear Bays:

Once the connection between the bays is made buswork or connectors should be connected to the Vista switchgear bay's air bushings. See Figure 25.

Make the connections as follows:

STEP 1. The terminal pads on the Vista switchgear air bushings are tin-plated aluminum and require no corrosion-inhibiting compounds. Therefore, before joining, clean the surfaces with a clean dry cloth or, if necessary, with a mineral-spirits solvent. Do not use abrasives of any kind to attempt to remove discoloration that may appear on the silver-plated surfaces. This discoloration is characteristic of silver and does not affect the performance of the bus splice.

STEP 2. Depending on the design of the metal-enclosed switchgear bay, or transition bay, the Vista switchgear bay's air bushing terminal pads may connect to buswork or rigid or flexible connectors. (Check the CDA/CDT drawings included in the instruction kit.) Make the Vista switchgear bay connections as described in the following paragraphs:

(a) ***For aluminum terminal pads to aluminum connectors:*** Use ½-inch aluminum or galvanized steel hardware with two Belleville washers (not furnished), as shown in Detail A of Figure 26 on page 29. Torque aluminum bolts to the manufacturer's specifications. Torque steel bolts to 50 foot-pounds or, in the absence of a torque wrench, tighten each bolt until the Belleville washers are flat, and then loosen one-half turn. Do not use lockwashers with Belleville washers.

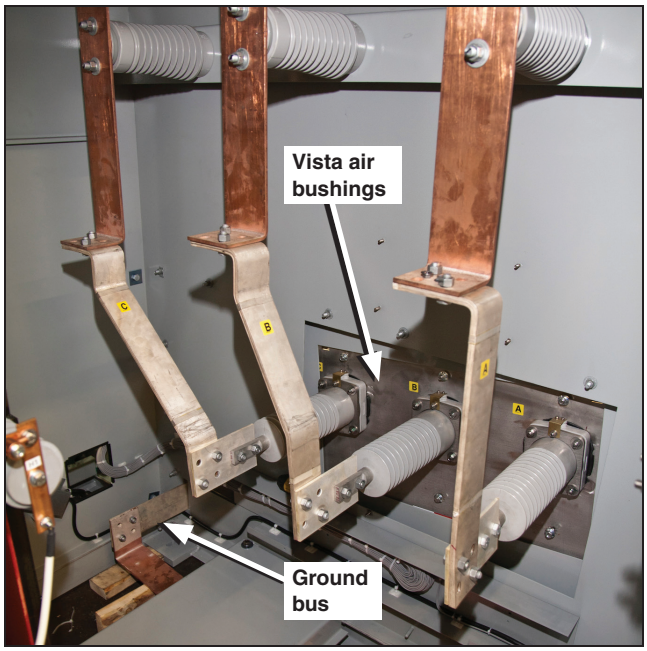


Figure 25. Joining Vista switchgear bay with metal-enclosed switchgear bay.

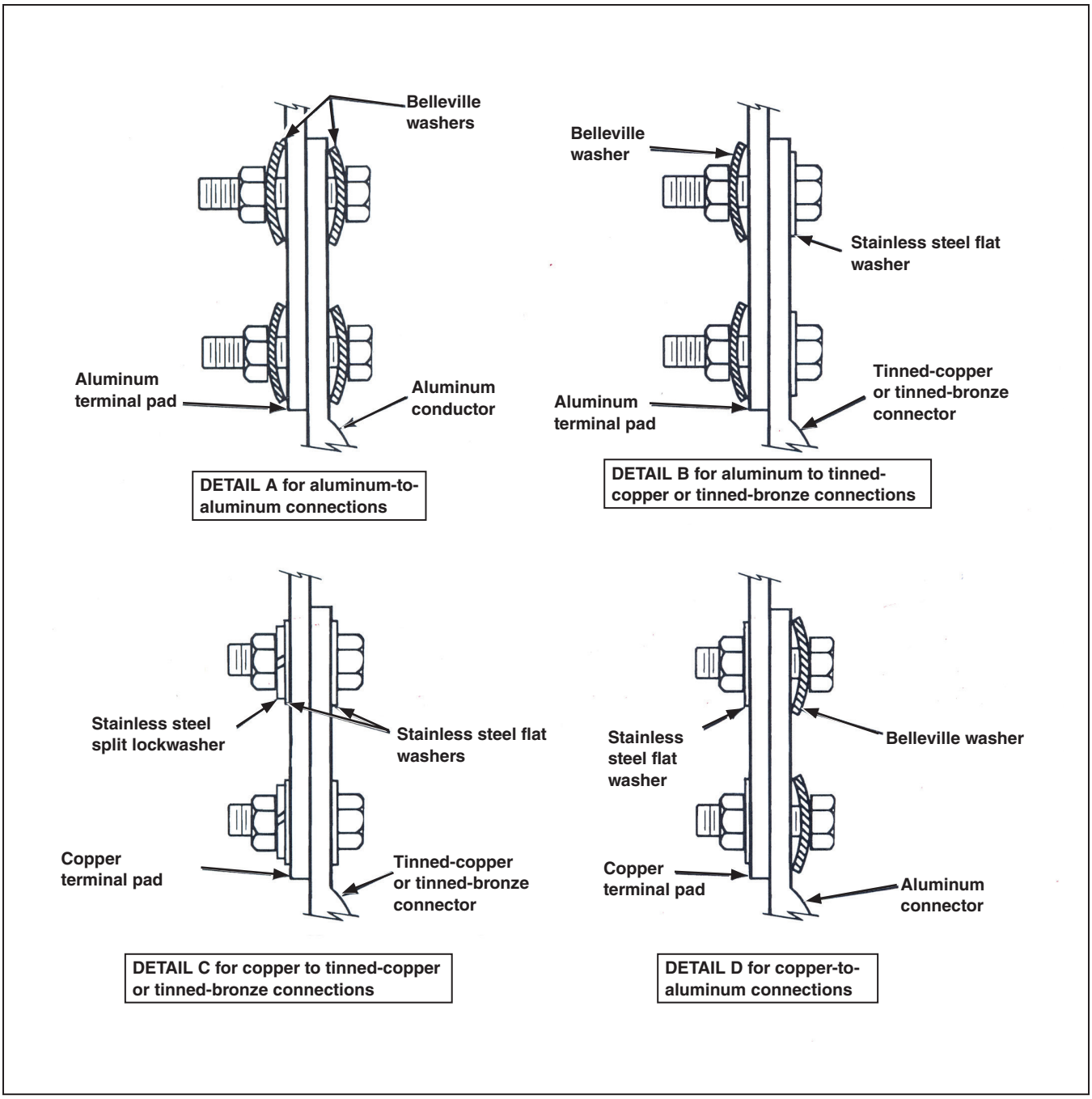


Figure 26. Terminal pad connections.

(b) ***For aluminum terminal pad to-aluminum bus connections:*** Make the connections using one Belleville washer under the head of each bolt and one Belleville washer under each nut. The bolts must be installed with the bolt head on the topside of the main bus. Belleville washers must be installed with the outer ring of the cup toward the bus. See Figure 23 on page 26 (Detail A) and Figure 22 on page 24. Tighten all splice bolts and nuts to a torque of 50 foot-pounds, as indicated by a torque wrench. If a torque wrench is not available, tighten until the Belleville washers are flat, and then loosen one-half turn.

(c) ***For aluminum terminal pads to tinned-copper or tinned-bronze connectors (untinned-copper or untinned-bronze connectors are not recommended)***: Use ½-inch galvanized steel hardware, with one Belleville spring washer (not furnished) against the aluminum terminal pad and one stainless steel flat washer against the tinned connector, as shown in Detail B of Figure 26 on page 29. Torque the bolt to 50 foot-pounds or, in the absence of a torque wrench, tighten the bolt until the Belleville washer is flat, and then loosen one-half turn. Do not use lockwashers with Belleville washers.

(d) ***For aluminum terminal pads to copper bus connections:*** Make the connections using one stainless steel flat washer against the copper-bus section and one Belleville washer against the aluminum bus section. The bolts must be installed with the bolt head on the topside of the main bus. See Detail C of Figure 23 on page 26. Torque the bolts to 50 foot-pounds or, in the absence of a torque wrench, tighten each bolt until the Belleville washer is flat, and then loosen one-half turn. Do not use lockwashers with Belleville washers.

Grounding

Make ground connections from the ground bus to the permanent station or system ground facility. S&C recommends cable not smaller than 1/0 copper, or equivalent, be used, and if the maximum momentary rating of the switchgear is to be realized, the equivalent of 500 kc mil of copper cable is required in either a single or multiple connection. See Figure 25 on page 28.

Checking Control Wiring

If secondary and control wiring are present, all terminals should be checked for tightness. Also, connect secondary and control wiring between adjacent bays at points where "shipping splits" occur. The individual wires at terminal blocks are marked to correspond with the adjacent terminal-block marking. Connection of the secondary and control wiring should be checked with reference to the applicable "CDR," "QCDR," or "CDT" wiring diagram included with the "Installation and Operation Information Kit."

NOTICE

Remove all temporary jumpers connected across the current-transformer secondaries, and remove all shorting screws from the shorting-type terminal blocks. For feeder bays equipped with voltage sensors and Type SPD Open-Phase Detectors, shorting-type terminal blocks are also provided on the left-hand side wall of the high-voltage compartment. Store all shorting screws for future use in the holes provided in the terminal blocks.

Failure to remove the shorting screws will make every scheme relying on output from the current transformers or voltage sensors inoperative.

Completing the Installation

STEP 1. Remove all restraining tape and blocking from the movable elements of the meters and relays (if included) used to prevent movement of these parts during shipment, and check the elements for freedom of movement.

NOTICE

Relays are not set at the factory, so they must be adjusted to the proper settings. Failure to do so can result in product or property damage.

⚠ WARNING

Switch operators and manual operating handles may be equipped with key and/or mechanical interlocks that guard against switch operation when the door of the bay containing the interrupter switch is open. Check the functional operation of mechanically interlocked doors and switch-operating mechanisms. Refer to the "Interlocks" section starting on page 52.

Failure to check and adjust interlocks may result in personal injury or death.

Key interlocks mounted externally and where the key is retained in the operated position are sometimes shipped separately to prevent key breakage during shipment. Install such interlocks with the bolts provided. The key sequence of the system is indicated on the one-line diagram on the "CDA/CDT" drawing. Where complex key interlock schemes are furnished, refer to the applicable "RD" or "CDT" drawing.

STEP 2. Fuse components (such as holders, fuse units, end-fittings, interrupting modules, etc.) are crated separately. Assemble these components following the fusing procedure described in the instruction sheet packed with the applicable fuse components. Install the fuses in the fuse mountings following the procedures described in the S&C instruction sheet about operation that is included with the switchgear for the particular fuse type being used. When installing fuses, make certain complete fuse closure is attained. Store spare refill units, interrupting modules, or fuse units in the container mounted on the inside of the doors to the bays containing fuses or fused voltage transformers.

STEP 3. Check operation of manually operated switches. Separate instruction sheets on manually operated interrupter switches are included in the "Installation and Operation Information Kit" provided with the switchgear.

⚠ WARNING

To avoid personal injury or damage to interlocks, before operating any switches, close and latch the associated door and verify the switch operation is in the sequence dictated by the key- or mechanical-interlock scheme provided. Before proceeding with these instructions, refer to the "Interlocks" section on page 52.

If the switchgear is power operated, the switch operators and automatic control equipment may now be checked. Separate instruction sheets for the switch operator(s) and for the source-transfer control are included in the "Installation and Operation Information Kit" provided with the switchgear.

NOTICE

If high-voltage AC dielectric tests are to be performed on this switchgear or if preliminary operational tests using an auxiliary control-voltage source are to be performed before the switchgear is energized, special precautionary measures must be taken to prevent damage to certain switchgear components or inadvertent energization of the switchgear main bus. Refer to the "Testing" section on page 43.

STEP 4. After all other connections have been completed and checked, make the medium-voltage cable terminations by following the cable-terminator manufacturer's instructions.

NOTICE

For switchgear equipped with a reverse-cable entrance or exit, the medium-voltage cable must be installed behind the reverse-cable bracket. These brackets are located inside the bay on the left side. Caution tags installed on the brackets are to be removed following installation of the cable. Failure to install the cable behind the bracket may result in reduced BIL rating for the switchgear.

Where field-assembled cable-terminating devices are used, terminations must incorporate adequate leakage distance between the exposed conductor and the stress-relief cone across a surface of nontracking material (or a surface rendered nontracking by properly taping with a suitable material).

To maintain the rated BIL capability of the switchgear, the following minimum clearances from energized parts (including unshielded portions of cable, such as terminator skirts) are required. See Table 1.

Table 1. Minimum Clearance for kV Rating

Rating, kV		Minimum Clearances Inches (mm)		
Nominal	BIL	Energized Parts to Barriers	Terminator Skirts to Barriers	Phase to Ground and Phase to Phase
4.16	60	0.5 (13)	0.5 (13)	3½ (89)
7.2	75	1 (25)	0.5 (13)	4½ (114)
13.8	95	1 (25)	0.5 (13)	6 (152)
25	125	2⅛ (54)	1¼ (32)	7½ (191)
25	150	2⅛ (54)	1¼ (32)	10½ (267)
34.5	150	3¼ (83)	3 (76)	10½ (267)
34.5●	150	3¼ (83)	3 (76)	11½ (292)
34.5	200	3¼ (83)	3 (76)	15 (381)

● When used with 34.5-kV current/voltage sensor EA-1474R2. Clearance to be maintained for bus work within 12 inches (305 mm) of either side of sensor, after which normal clearances can be used.

If necessary, interphase barriers can be removed to facilitate makeup and connection of cable terminations to the switch, fuse, or bus terminals. If the interphase insulating barriers are removed, note their position to ensure correct reinstallation later.

Following the user's established system operating safety procedures, check to make certain connection of the incoming-power source(s) to the switchgear terminals is in the proper phase sequence.

NOTICE

When making connections, care must be used to avoid placing intentional strain on any switch or fuse terminal. It is important each cable-terminator connector be flat against the corresponding switch or fuse terminal pad, with the bolt holes in alignment. Do not use the connecting bolts to pull the cables into alignment. Failure to comply with these precautions may cause misalignment of the switch or fuse.

Cable Terminations

⚠ DANGER

Before energizing the switchgear, replace the shipping covers on all bushing and bushing wells with elbows or insulated protective caps.

Failure to replace the shipping covers on all bushings and bushing wells with elbows or insulated protective caps can result in a flashover and serious personal injury or death.

⚠ CAUTION

ALWAYS follow proper cable installation practices. When installing cable that will be attached to the Vista switchgear bay tank, provide a strain relief segment to minimize the load on the bushings. Cables must be allowed to expand and flex without putting a significant load on the bushings. For a pit, either loop the cable in the pit or bring it into the pit horizontally and up to the gear at a 90° angle.

Failure to follow these precautions can result in minor injury as well as damage to the bushings and bushing wells and subsequent leakage of insulating gas.

STEP 1. Before connecting the cable terminators to the terminal pads, thoroughly wire-brush the aluminum contact surfaces to remove any dirt or foreign materials as well as the natural surface oxides. Immediately coat both contact surfaces to ½-inch (13 mm) beyond the joint with a uniform layer of antioxidant compound.

Note: Copper terminals have a thin layer of silver applied to contact surfaces, and the terminal surfaces must be prepared as described in the "Note" in Step 4 on page 24.

STEP 2. Make the metal-enclosed switchgear bay connections as described in the following paragraphs (refer also to Figure 26 on page 29):

Note: Torque values apply only to the ½-inch hardware described and not to connectors used to secure primary leads of voltage transformers or surge arresters to the bus.

(a) ***For aluminum terminal pads to aluminum connectors:*** Use ½-inch aluminum or galvanized steel hardware with two Belleville washers (not furnished), as shown in Detail A of Figure 26 on page 29. Torque aluminum bolts to the manufacturer's specifications. Torque steel bolts to 50 foot-pounds or, in the absence of a torque wrench, tighten each bolt until the Belleville washers are flat, and then loosen one-half turn. Do not use lockwashers with Belleville washers.

(b) ***For aluminum terminal pads to tinned-copper or tinned-bronze connectors (untinned-copper or untinned-bronze connectors are not recommended)***: Use ½-inch galvanized steel hardware, with one Belleville spring washer (not furnished) against the aluminum terminal pad and one stainless steel flat washer against the tinned connector, as shown in Detail B of Figure 26 on page 29. Torque the bolt to 50 foot-pounds or, in the absence of a torque wrench, tighten the bolt until the Belleville washer is flat, and then loosen one-half turn. Do not use lockwashers with Belleville washers.

(c) ***For copper terminal pads to tinned-copper or tinned-bronze connectors:*** Use ½-inch Everdur or stainless steel hardware, with one stainless steel washer against each terminal and one split lockwasher under the nut as shown in Detail C of Figure 26 on page 29. Torque the bolts to 35 foot-pounds or, in the absence of a torque wrench, tighten each bolt until the split lockwasher is flat.

(d) ***For copper terminal pads to aluminum connectors:*** Use ½-inch galvanized steel hardware with one Belleville spring washer (not furnished) against the aluminum connector and one stainless steel washer against the copper terminal pad as shown in Detail D of Figure 26 on page 29. If the Belleville washer extends beyond the edge of the aluminum connector, the positions of the Belleville washer and flat washer should be reversed, (i.e., place the Belleville washer against the copper terminal pad and the flat washer against the aluminum connector). Torque the bolt to 50 foot-pounds or, in the absence of a torque wrench, tighten each bolt until the Belleville washer is flat, and then loosen one-half turn. Do not use lockwashers with Belleville washers.

NOTICE

After attaching the cable terminals to the terminal pads, to maintain the short-circuit rating of the switchgear assembly, secure the cable to the cable support bracket, which is provided in all bays containing Fault Fiter® Electronic Power Fuses and all bays where the available cable space exceeds 24 inches (61 cm) for 4.16 kV, 30 inches (76 cm) for 13.8 kV, 36 inches (91 cm) for 25 kV, or 48 inches (122 cm) for 34.5 kV. Under momentary conditions, mechanical stresses caused by unsecured cables may damage switches and fuses.

NOTICE

For correct functioning of the automatic control equipment, the current sensors must be placed either against the cable concentric-neutral ground wires (in which case the ground wires must be brought back through the current sensor before grounding, as shown in Figure 28 on page 35 view (a) for S&C Closed-Gap Current Sensors, or against the cable semicon ducting jacket, as shown in Figure 28 on page 35 view (b). Also, “drain-wire” type grounds on cable terminators, if present, must be brought back through the current sensor before grounding.

STEP 3. ***For Vista Switchgear Bays:*** Remove the shipping covers from the bushings and bushing wells. See Figure 29 on page 35.

Terminate the cables with elbows, following the elbow manufacturer’s instructions. See Figure 27 on page 35.

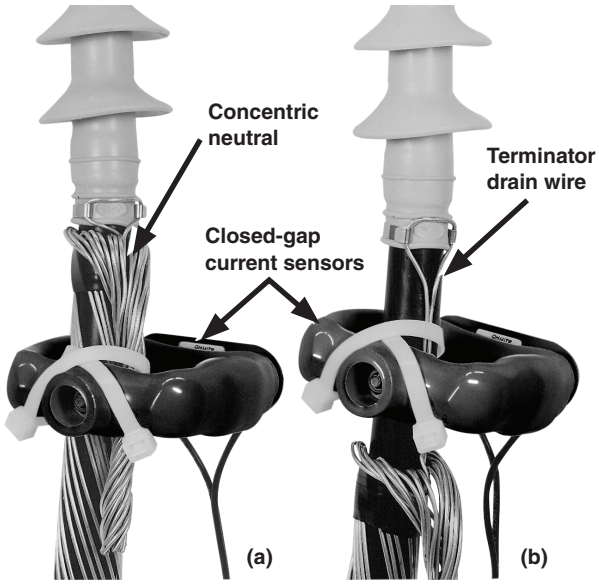


Figure 28. S&C Closed-Gap Current Sensors (included with the Overcurrent Lockout feature of the Micro-AT Source-Transfer Controls and with the Type ZSD Overcurrent Relay) can be placed (a) against the cable grounded-concentric neutral or (b) against the cable semiconducting jacket.

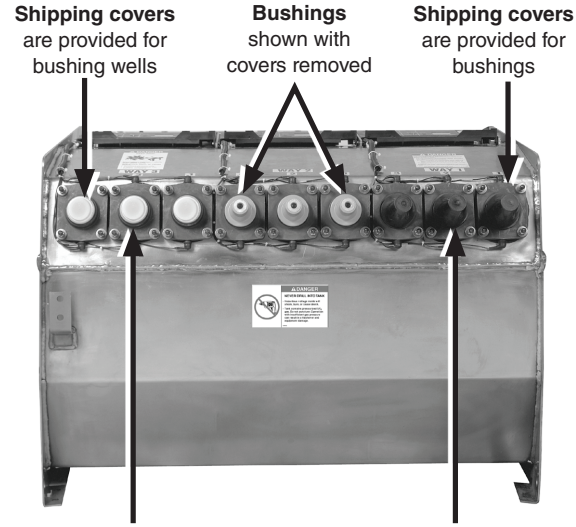


Figure 29. The switchgear tank, as shipped. (Illustration excludes typical cabling and motor operator provisions to emphasize the location of shipping covers and bolts.)

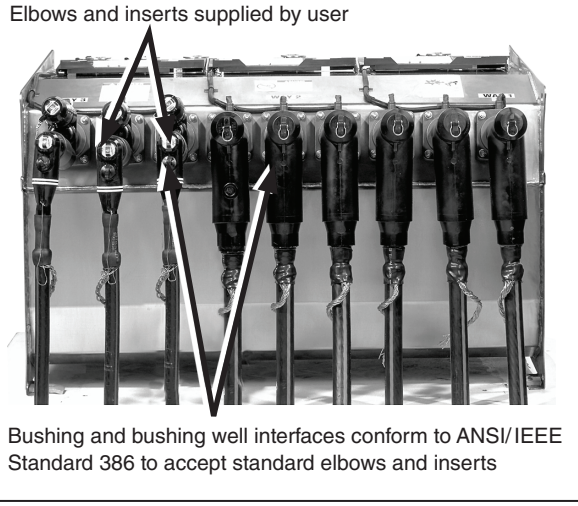


Figure 27. A Vista switchgear tank shown with user-supplied cables and elbows.

Optional Features

STEP 1. Switchgear may be equipped with S&C Closed-Gap Current Sensors, (see Figure 28 on page 35) which can be used with the optional **Overcurrent-Lockout** feature furnished with Micro-AT® Source-Transfer Control and with the optional Type ZSD Overcurrent Relay. These sensors are packed separately along with a supply of plastic tie wraps, connectors, and hardware. The control-wire leads to be connected to the current sensors are coiled and taped to the interior side wall of the appropriate enclosure.

Make the control wire-lead connections and install the current sensors following the procedures in the applicable instruction sheet and with reference to the applicable wiring diagram, all provided in the "Installation and Operation Information Kit" supplied with the switchgear.

STEP 2. Install and connect the surge arresters, if applicable.

STEP 3. Strip heaters are included as standard in all S&C System VI Switchgear metal-enclosed switchgear bays designed for outdoor installation. They are also optionally available in indoor switchgear to maintain the enclosed apparatus and interior areas free of condensation, which, if allowed to accumulate, can contaminate insulation and promote corrosion. Therefore, when strip heaters are included, make sure they are connected to an adequate power source and energized before placing the switchgear in service. See Figure 1 on page 7.

⚠ DANGER

If the space heaters are wired to be normally served through the secondary windings of voltage transformers located in the switchgear assembly, do not energize the space heaters from a temporary source until the following precautionary measures have been taken:

1. Disconnect the secondary leads or remove the secondary fuses, and remove the primary fuses from the voltage transformers.
2. If secondary connections are disconnected, tape the ends of the leads to prevent inadvertent short circuits or contact with the transformer secondary terminals.
3. Connect the temporary source to the space heaters.

These precautionary measures must be taken to avoid energizing (backfeeding) the switchgear conductors at high voltage through the voltage transformers, which will result in serious injury or death.

STEP 4. Fault indicators in Vista switchgear bays are to be furnished by the user and installed in accordance with the manufacturer's instructions. Optional mounting provisions for fault indicators are available. See Figure 30.

If mounting provisions are specified, mount the fault indicators on the mounting brackets and attach the associated sensors to the cables below the cable terminations. See Figure 31.

STEP 5. If any interphase insulating barriers were removed to facilitate accomplishment of the preceding steps, reinstall them at this time. Take care not to damage barriers on installation and make certain they are installed in the locations from which they were removed.

NOTICE

Make sure the clearances between barriers and energized parts conform to the minimum dimensions specified in Table 1 on page 32. **Failure to do so can result in damage to the equipment.**

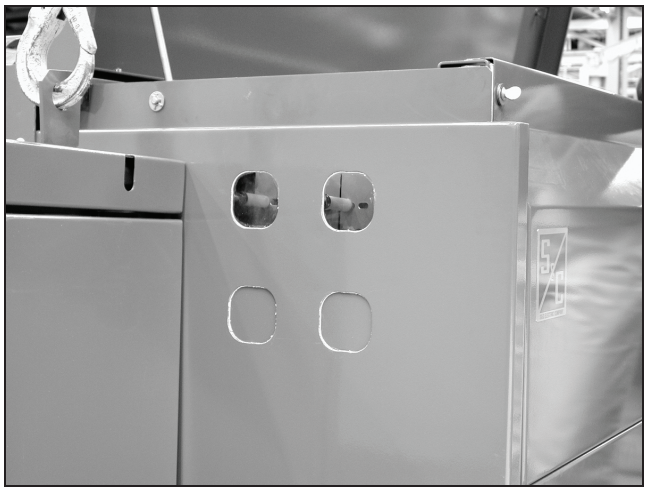


Figure 30. The mounting provisions for user-furnished fault indicators.



Figure 31. The mounting brackets for user-furnished fault indicators.

Before Walking Away

STEP 1. Sweep the enclosure floors free of debris. Wipe the barriers, insulators, bushings, terminators, switches, and fuses clean with a suitable mineral-spirits solution and dry with a clean dry cloth.

STEP 2. Check the functional operation of the key and mechanical interlocks, if furnished.

> **⚠ WARNING**
>
> To maintain the integrity of key interlock schemes, duplicate keys must be destroyed or made accessible only to authorized persons. If duplicated keys are made available after installation, it can increase the chances of using the key interlocks when they are not supposed to be used. **This can result in unwanted operation, which could result in serious injury or death.**

STEP 3. Remove all shipping tape, bay-number labels, and any polyethylene or tape from vents. Remove any remaining adhesive. Wipe down the exterior of the enclosures with a clean, damp cloth. Refinish any scratches or abrasions with S&C touch-up finish and red-oxide primer, which are available in aerosol spray cans. No other finish or primer is approved. See Figure 32.

The area to be touched up should be cleaned to remove all oil and grease. Sand the area to remove any traces of rust that may be present, and make sure all edges are feathered before applying primer.

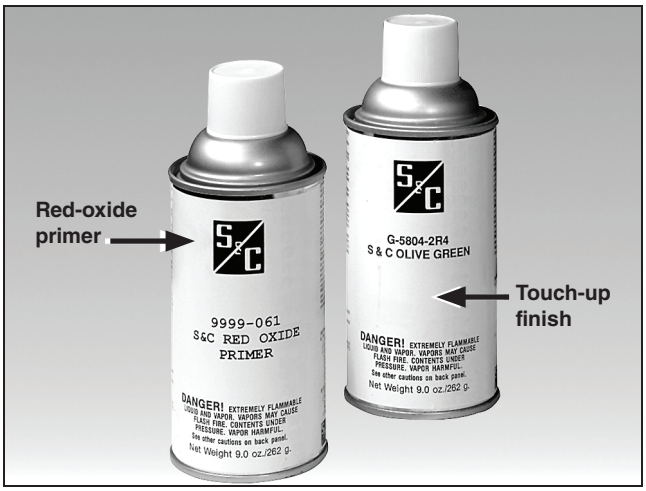


Figure 32. Red-oxide primer and touch up finish.

STEP 4. Perform the following important checks:

⚠ WARNING

To avoid equipment damage and possible serious personal injury, before walking away, perform the following checks:

1. Check the interior of each bay for foreign materials, tools, etc., that may have been mislaid on high-voltage bus and supporting members.
2. Make certain switch operators, if furnished, are coupled to interrupter switches.
3. Make certain all selector switches on source-transfer controls, if furnished, are in the desired positions.
4. Check all fuses to make certain they are fully closed and latched.
5. Close and securely latch all switchgear-bay doors.
6. Make certain all interrupter switches are in the correct positions, **Open** or **Closed**, as dictated by electrical system design.
7. Make certain all grounding means have been removed.
8. Padlock all door handles, switch-operating handles, and covers (if applicable).

Additional instructions on correct positioning of specific components for normal operation are contained in the S&C instruction sheet for the specific component. Refer to the “Installation and Operation Information Kit” provided with the switchgear.

Additions to existing switchgear assemblies may easily be made if the original switchgear includes "provisions for future extension." This is only available on metal-enclosed switchgear bays. To minimize the outage time, proceed as follows depending on whether an inner protective barrier was furnished with the "provisions for future extension:"

Inner Protective Barrier Furnished

STEP 1. Remove the end plate from the existing bay by removing the appropriate hardware on the outside of the bay. This may be done while the equipment is still energized; an inner protective barrier behind the end plate prevents exposure to live parts. See Figure 33, Figure 34, and Figure 35. On outdoor assemblies, apply a gasket between the existing unit and the new unit. See Step 4 on page 19 and Figure 12 on page 18.

STEP 2. Move the new unit into place immediately adjacent to the existing end unit. Make the new unit "service ready" by completing all the bus and cable connections and other operations described in Step 1 on page 18 through Step 3 on page 38.

STEP 3. De-energize and properly ground the existing switchgear.

STEP 4. Remove the inner protective barrier from the inside of the existing end bay, and also remove the knockouts for the bolt holes and ground bus. See Figure 34 and Figure 35.

STEP 5. Bolt the units together. See Step 5 on page 20.

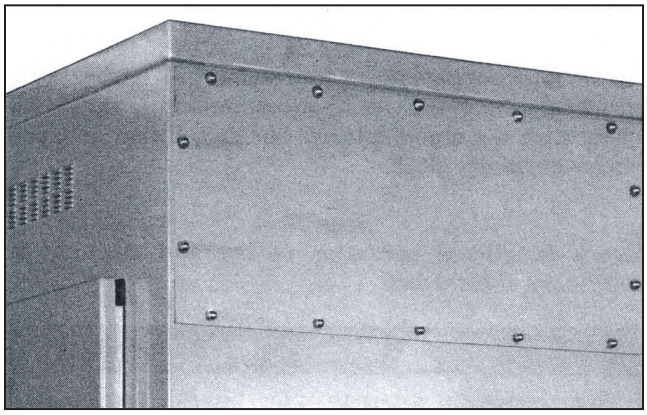


Figure 33. View of the end plate on an existing unit when an inner protective barrier is furnished.

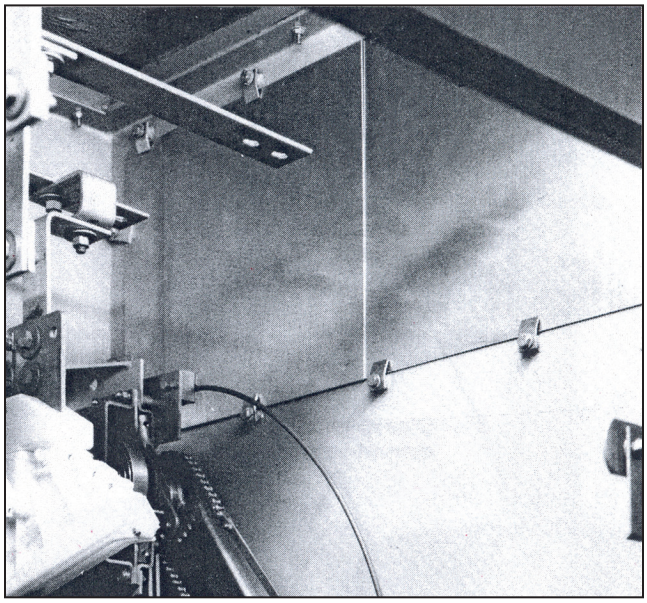


Figure 34. Interior view of the existing unit before removal of the inner protective barrier.

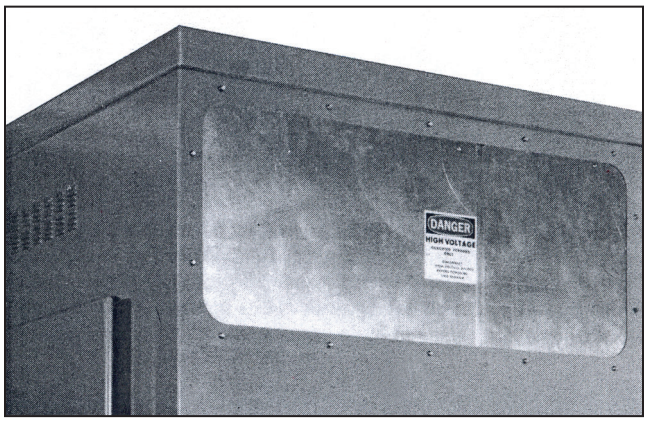


Figure 35. The end plate removed to accept a new unit leaving the inner protective barrier exposed.

STEP 6. On outdoor switchgear (as well as indoor switchgear equipped with optional dust-proof or drip-proof construction), apply the rubber channel gasket (provided) to the through-bus opening between the units as applicable. For higher voltage units, install the roof cap. See Step 6 on page 41.

STEP 7. Install the inter-unit bus splices. See Step 4 on page 24 and Figure 23 on page 26. Refer to Figure 39 on page 42.

STEP 8. Make certain all temporary grounds have been removed before re-energizing the switchgear.

Inner Protective Barrier Not Furnished

Follow these steps when the inner protective barrier is not furnished:

STEP 1. De-energize and properly ground the existing switchgear.

STEP 2. Remove the end plate from the existing bay by removing the appropriate hardware on the inside of the bay. Also, remove the knockouts for the ground bus and the bay-to-bay bolt holes. See Figure 36, Figure 37, and Figure 38. On outdoor assemblies, be sure to apply the gasket between the existing unit and the new unit. See Step 4 on page 19 and Figure 12 on page 18.

STEP 3. Move the new unit into place immediately adjacent to the existing end unit. Make the new unit "service ready" by completing all the bus and cable connections and other operations described in Step 1 on page 22 through Step 3 on page 38.

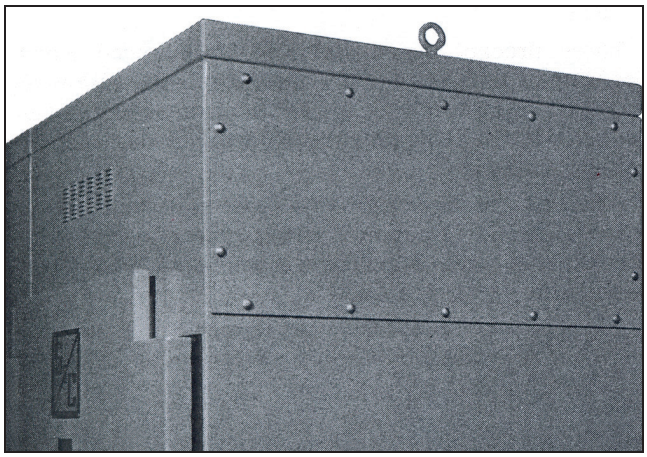


Figure 36. View of the end plate on an existing unit when the inner protective barrier is not furnished.

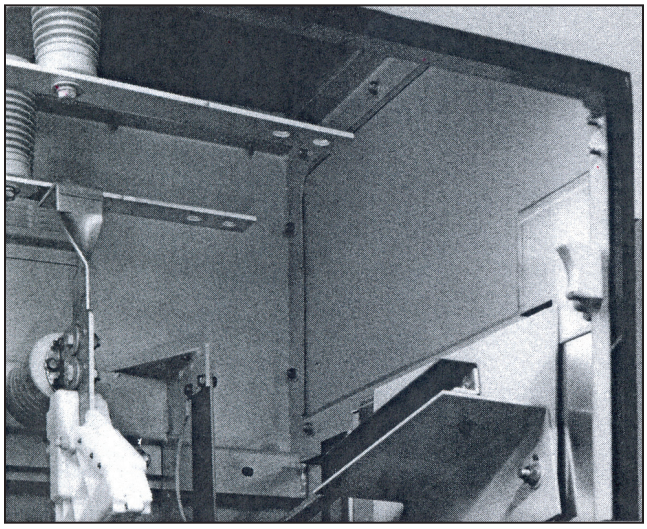


Figure 37. Interior view of the existing unit before removal of the end plate.

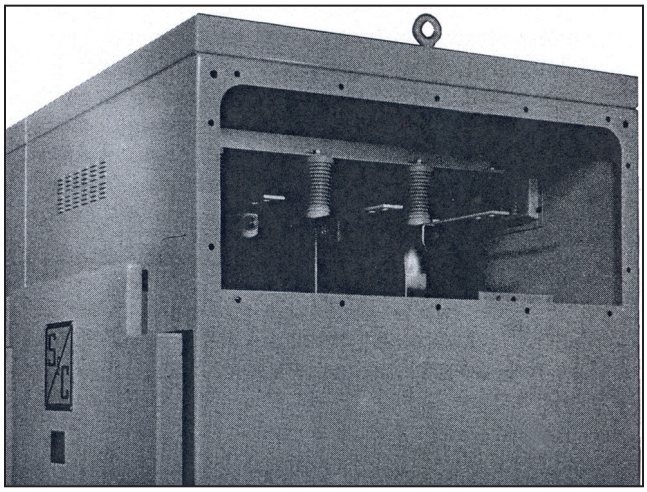


Figure 38. View of the end plate on an existing unit when the inner protective barrier is not furnished.

STEP 4. Bolt the units together. See Step 5 on page 20. See Figure 39.

⚠ WARNING

To avoid equipment damage and possible serious personal injury, before walking away, perform the following checks:

1. Check the interior of each bay for foreign materials, tools, etc., that may have been mislaid on high-voltage bus and supporting members.
2. Make certain switch operators, if furnished, are coupled to interrupter switches.
3. Make certain all selector switches on source-transfer controls, if furnished, are in the desired positions.
4. Check all fuses to make certain they are fully closed and latched.
5. Close and securely latch all switchgear-bay doors.
6. Make certain all interrupter switches are in the correct positions, **Open** or **Closed**, as dictated by electrical system design.
7. Make certain all grounding means have been removed.
8. Padlock all door handles, switch-operating handles, and covers (if applicable).

Additional instructions on correct positioning of specific components for normal operation are contained in the S&C instruction sheet for the specific component. Refer to the “Installation and Operation Information Kit” provided with the switchgear.

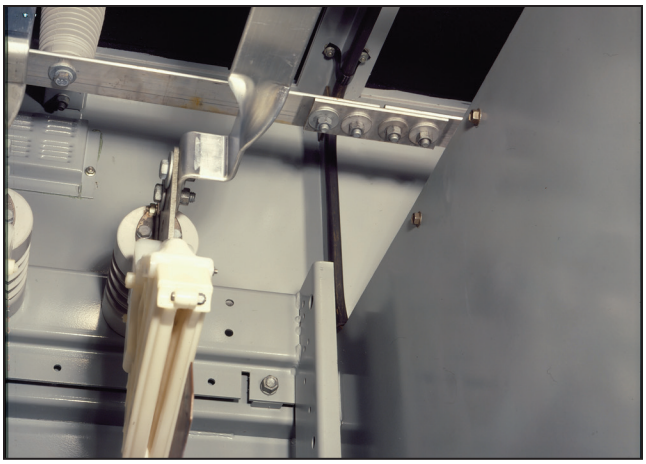


Figure 39. With end plate (and inner protective barrier, if furnished) removed, the gasket has been installed, bays bolted together, and the bus splices have been installed.

⚠ WARNING

The test procedures described in this document must be performed by qualified persons who are thoroughly experienced with this type of equipment and with the applicable codes and standards. See the "Qualified Persons" section on page 2 for more information. **Performing test procedures without adequate training and experience may lead to serious personal injury or death.**

Dielectric Testing on Metal-Enclosed Switchgear Bays

⚠ WARNING

Before performing dielectric tests, make sure the high-voltage conductors are not connected (i.e., are de-energized and properly isolated). Test for voltage, and isolate and tag all circuits in accordance with established system-operating safety procedures. In addition, remove the primary fuses and disconnect all secondary connections from all voltage transformers and disconnect all surge arresters. **Failure to do so can result in personal injury or death.**

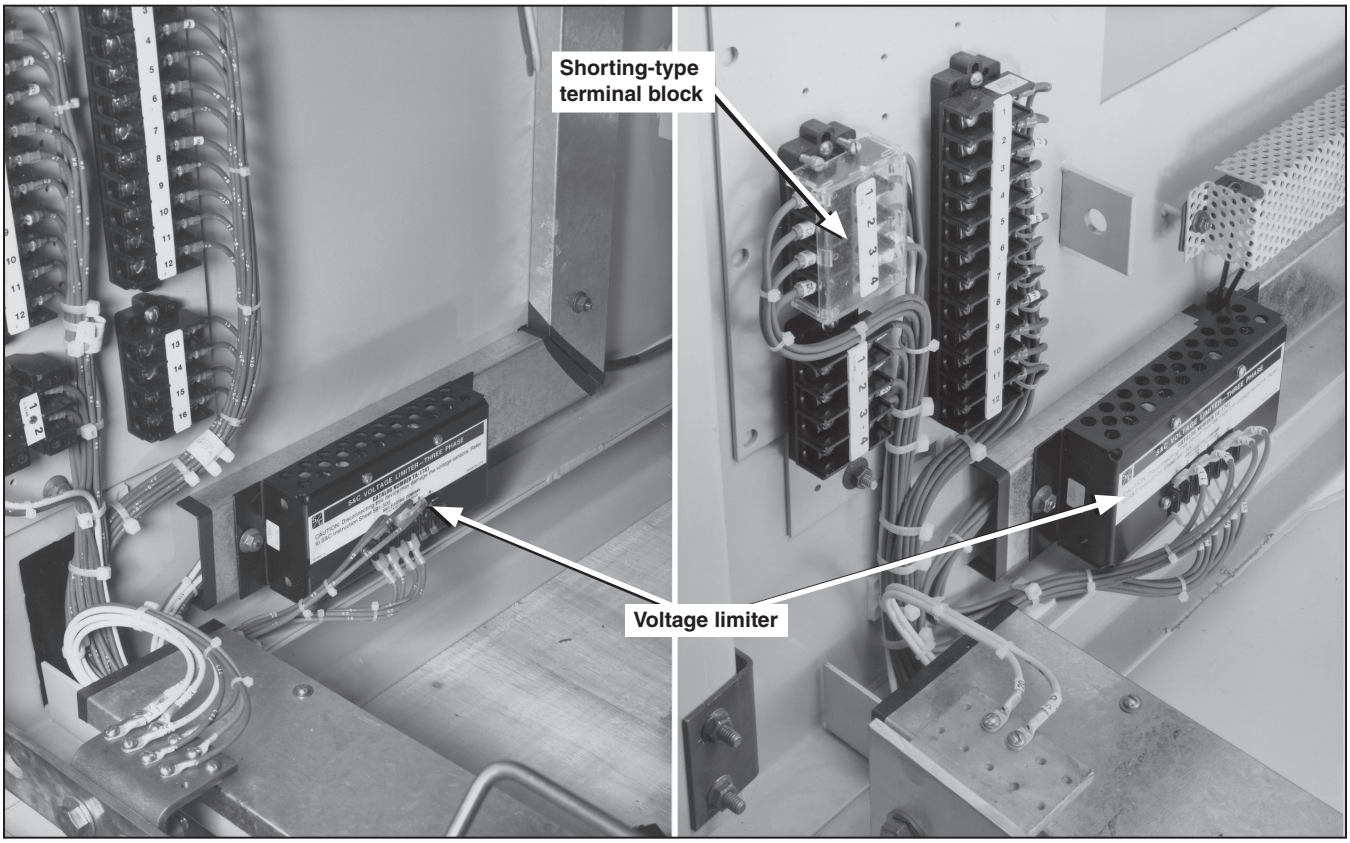


Figure 40. An S&C Voltage Limiter is mounted on the left wall of the high-voltage compartment in applications involving S&C Source-Transfer Controls in entrance bays (as illustrated in the photo at left) and in applications involving Type SPD Open-Phase Detectors in feeder bays. In the latter case, a shorting-type terminal block is furnished (as illustrated in the photo on the right).

When high-voltage AC dielectric tests are to be performed on switchgear incorporating S&C Voltage Sensors, special precautions must be taken to prevent damage to the voltage sensor and the S&C Voltage Limiter. These precautions include the following:

STEP 1. Insert shorting screws into the shorting-type terminal block. See Figure 40 on page 43.

STEP 2. In applications involving S&C Source-Transfer Controls, remove the plug from the input receptacle located at the rear of the source-transfer control and transfer the plug to the control's shorting receptacle; refer to the S&C instruction sheet on the source-transfer control furnished in the "Installation and Operation Information Kit."

These precautions should also be followed when performing high-voltage DC dielectric tests, although application of rated DC dielectric test voltages will not damage the voltage sensors.

After all the dielectric tests have been completed, remove the shorting screws and transfer the plug from the shorting receptacle on the source-transfer control back to the input receptacle.

S&C recommends voltage-transformer primary fuses not be reinstalled—or secondary connections of unfused voltage transformers reconnected—until just prior to final energization of the switchgear for service. Remove all grounds and reconnect all high-voltage conductors and surge arresters.

Preliminary Operational Testing Before Switchgear Is Energized

If the switchgear is equipped with Micro-AT Source-Transfer Controls, Type ZSD Overcurrent Relays, or Type SPD Open-Phase Detectors, instructions for preliminary operational testing are contained in the S&C instruction sheets applicable to these devices.

The following test procedures apply only to switchgear equipped with custom S&C Source-Transfer Controls with electromechanical components.

If it will be some time before high voltage is connected to the switchgear, the user may perform a preliminary checkout to expedite full service once high voltage is available.

Operation of electromechanical source-transfer controls and switch operators may be checked using an auxiliary control-voltage source of the required voltage

⚠ DANGER

The voltage transformers must be disconnected on the low-voltage side when external voltage is used to test ac-powered switch operators and source-transfer controls to avoid energizing the high-voltage conductors through the voltage transformers. **Failure to do so will result in serious injury or death.**

Follow these steps to perform the preliminary check:

STEP 1. Draw out the voltage transformers completely and disconnect all secondary connections if drawout-type transformers are provided. Otherwise, remove the primary fuses of the voltage transformers and disconnect the secondaries by removing the secondary fuses or by disconnecting the secondary connections to the transformers.

STEP 2. If secondary connections are disconnected, tape the ends of the leads to prevent inadvertent short circuits or contact with the transformer secondary terminals.

STEP 3. As a safety precaution, S&C recommends all voltage-transformer fuses be removed and kept out until just prior to final energization of the switchgear. With unfused voltage transformers, remove the secondary connections (as described in Step 1) until installation and any tests are completed.

STEP 4. If the switchgear assembly includes S&C Voltage Sensors used in conjunction with a custom source-transfer control, special precautionary measures must be taken. To avoid damage to the S&C Voltage Sensor's transformer because of inadvertent open-circuiting or removal of the burden, the voltage-sensor secondaries must be shorted at the shorting-type terminal blocks located in the switchgear bays.

When operational testing is completed:

(a) Disconnect the auxiliary control-voltage source.

(b) Remove the shorting screws from the voltage-sensor secondary circuit and store the shorting screws for future use in the holes provided in the terminal block.

(c) Re-install the voltage-transformer secondary fuses and reconnect the secondary leads, where applicable. Re-install the voltage-transformer primary fuses if they were removed.

Routine Vista Switchgear Bay Testing

For the convenience of users who normally perform electrical tests on system components such as switchgear, appropriate withstand test values for Vista Underground Distribution Switchgear are given in Table 2 on page 46 and in Table 3 on page 47. These test values are significantly greater than the normal operating voltage of the switchgear and are near the flashover voltage of the gear. They should be applied only when the switchgear is completely de-energized and disconnected from all power sources.

⚠ WARNING

When performing electrical withstand tests on Vista Underground Distribution Switchgear, always observe the following precautions. **Failure to observe these precautions can result in a flashover, injury, and equipment damage.**

1. Completely de-energize the switchgear and disconnect it from all power sources.
2. Terminate bushings with an insulated cap or other appropriate cable termination capable of withstanding the test voltage.
3. Verify the insulating-gas pressure gauge is in the Green zone.

DC Cable Testing and Fault Locating on Vista Switchgear Bays

Dc testing of installed cables is performed to determine the condition of the cables and to locate faults. Industry standards like IEEE 400, "IEEE Guide for Making High-Direct-Voltage Tests on Power Cable Systems in the Field," describe such testing and should be referenced for selection of the test procedures.

Dc testing also includes cable "thumping" (the sudden application of DC voltage from a large capacitor for the purpose of fault locating), which causes transients and voltage doubling at the end of the open cable. When the cables are attached to the switchgear, the gear will also be subjected to the DC test voltages.

⚠ WARNING

The dc-withstand capability of the switchgear may be reduced because of aging, damage, gas leakage, or electrical or mechanical wear. Therefore, the dc-test voltage must be selected so it does not exceed the withstand limits of the switchgear. **Application of dc-test voltage greater than the withstand capability of the switchgear can result in a flashover, injury, and equipment damage.**

Always verify the insulating-gas pressure gauge is in the Green zone before proceeding with any testing.

Table 2. Maximum Insulation Test Voltages of Vista Underground Distribution Switchgear

Vista Switchgear Rating, kV			Withstand Test Voltage, kV	
50 Hertz	60 Hertz	Impulse (BIL)	Power Frequency①	Dc②③
12	15.5	95	27	42
24	27	125	40	62
36	38	150	50	82

① The power-frequency withstand test voltages listed in the table are approximately 80% of the design values for new equipment.

② The DC withstand test voltages listed in the table are approximately 80% of the design values for new equipment.

③ Dc withstand test voltages are given for reference only for those users performing DC withstand tests. The presence of these values does not imply a DC withstand rating or performance requirements for the switchgear. A DC withstand design test is specified for new equipment because the switchgear may be subjected to DC test voltage when connected to the cable. The DC withstand test values listed in the table are approximately equal to the AC peak test voltage.

⚠ DANGER

Do not exceed the test voltages given in Step 3. Exceeding the test voltages can cause a flashover of the isolating gap or phase-to-phase insulation of the switchgear. **This can lead to a power-frequency fault in the gear or the DC test source, and result in severe personal injury or death.**

⚠ WARNING

Follow the recommendations provided by the manufacturer of the DC test equipment or fault-locating equipment. Follow the user's operating and safety procedures for grounding the cable, connecting the DC test source, isolating the DC test source (in case of flashover), ungrounding the cable, applying the DC test source, discharging the cable, and regrounding the cable. **Failure to follow these operating and safety procedures may result in injury or equipment damage.**

Vista Underground Distribution Switchgear has been designed to allow DC testing of the cables with the other ways of the gear energized. The integral grounding switch may be used to ground the cable.

After testing, the DC test equipment should be used to discharge any stored charge on the cable before grounding with the grounding switch. The DC test voltages and DC cable thumping voltages should not exceed the voltages given in Table 3.

Table 3. Maximum Cable Testing and Cable Thumping Dc Withstand Voltages of Vista Underground Distribution Switchgear

Vista Switchgear Rating, kV			Dc Cable Test Voltage, kV	Dc Cable Thumping Voltage, kV①
50 Hertz	60 Hertz	Impulse (BIL)		
12	15.5	95	30	15
24	27	125	40	20
36	38	150	40	20

① The DC cable thumping voltage is 50% of the DC cable test voltage because voltage doubling will occur at the open end of the cable, which is assumed to be a unit of Vista Underground Distribution Switchgear. If the open end of the cable is grounded, the DC cable thumping voltage applied to the cable and switchgear can be increased to the DC cable test voltage.

Very Low Frequency (VLF) Cable Testing on Vista Switchgear Cables

⚠ WARNING

The VLF AC withstand capability of the switchgear may be reduced because of aging, damage, gas leakage, or electrical or mechanical wear. Therefore, the AC test voltage must be selected so it does not exceed the withstand limits of the switchgear. **Application of AC test voltage greater than the withstand capability of the switchgear can result in a flashover, injury, and equipment damage.**

Always verify the insulating-gas pressure gauge is in the Green zone before proceeding with any testing.

⚠ DANGER

Do not exceed the test voltages given in Table 3 on page 47. Exceeding the test voltages can cause a flashover of the isolating gap or phase-to-phase insulation of the switchgear. **This can lead to a power-frequency fault in the gear or the VLF test source, and result in severe personal injury or death.**

⚠ WARNING

Follow the recommendations provided by the manufacturer of the VLF test equipment. Follow the user's operating and safety procedures for grounding the cable, connecting the VLF test source, isolating the VLF test source (in case of flashover), ungrounding the cable, applying the VLF test source, discharging the cable, and regrounding the cable.

Failure to follow these operating and safety procedures may result in injury or equipment damage.

⚠ WARNING

When VLF cable testing has been completed, or has been interrupted, you must discharge the cable system and the test equipment. Allow the time needed to fully discharge the cable system and test equipment.

Failure to fully discharge the cable system and test equipment can result in serious damage to the cable system and test equipment.

IEEE Standard 400.2, "IEEE Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF) (less than 1 Hz)," addresses the application of 0.01- to 1-Hz high-voltage AC excitation as one means for evaluating a shielded power cable system during an acceptance test or a maintenance test. The cable system must be taken out of service for this testing.

An acceptance test is a field test made after installation of the power cable system, including terminations and joints, but before the cable system is placed in normal service. A maintenance test is a field test made during the operating life of a power cable system to detect deterioration and to check serviceability of the system.

VLF cable testing may subject the Vista Underground Distribution Switchgear to the AC test voltage when the cables are attached to the switchgear. S&C recommends that the Vista switchgear be completely de-energized and disconnected from all power sources when performing VLF cable testing. Before proceeding with the VLF cable testing, verify the Vista switchgear insulating-gas pressure gauge is in the Green zone.

Upon completion of the VLF cable testing, or an interruption in the testing, the test set must be turned off to discharge the cable circuit and test set. Then, the cable system must be grounded.

The VLF sinusoidal waveform test voltages applied to the Vista switchgear must not exceed the voltages listed in Table 4.

Table 4. Low-Frequency Cable Testing

Vista Switchgear Very Low Frequency (.01- to 1-Hz) Sinusoidal Waveform Maximum Test Voltages①②				
Vista Switchgear System Class, kV	Acceptance Test (phase to ground)		Maintenance Test (phase to ground)	
	kV, RMS	kV, Peak	kV, RMS	kV, Peak
15.5	21	30	16	22
27	32	45	24	34
38	44	62	33	47

① Per IEEE Std. 400.2. The most commonly used, commercially available, VLF test set frequency is 0.1 Hz.

② Do not exceed the test voltage recommended by the cable manufacturer.

Fault-Interrupter Testing for Vista Switchgear Bays

When performing dielectrical tests on Vista Underground Distribution Switchgear, the vacuum fault interrupters will not be subject to voltage across the open gap because the disconnect switch isolates the vacuum interrupters from the test voltage. Because the vacuum interrupter will not be energized across the open gap, there is no exposure to the X-rays normally associated with high-voltage testing of vacuum devices.

Routine testing of the vacuum fault interrupters is not recommended. For those users who desire to test the vacuum interrupters, contact the nearest S&C Sales Office for specific instructions.

Resistance Measurement for Vista Switchgear Bays

⚠ DANGER

De-energize the Vista Underground Distribution Switchgear before performing the resistance measurements described in this procedure. Follow all applicable safety procedures. **Failure to de-energize the Vista Underground Distribution Switchgear before taking resistance measurements can result in serious injury or death.**

Resistance measurements are used to look for areas of the gear that may exhibit poor contact between current carrying parts.

Resistance measurements are taken using a four-terminal measuring device that provides at least 100 amperes of current to the main circuit. Resistance measurements should be taken from the bushing conductor across each way to the same phase on each way of the unit. For example, a measurement would be taken from Way 1 Phase A to Way 2 Phase A, from Way 2 Phase A to Way 3 Phase A, from Way 1 Phase A to Way 3 Phase A, from Way 1 Phase B to Way 2 Phase B; etc.

To measure resistance, perform the following procedure:

STEP 1. Clamp the two current-carrying probes of the resistance-measuring device to the bushing conductors of the current-carrying path to be measured. See Figure 41. In this example the resistance is being taken between Way 1 Phase A and Way 2 Phase A

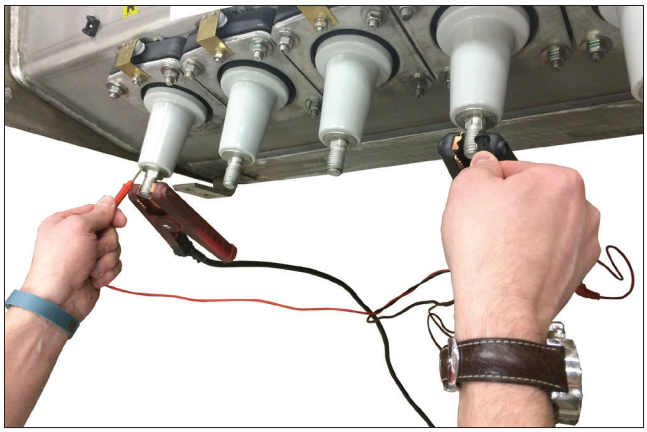


Figure 41. Connecting the resistance measuring device.●

● Resistance measurements shown without safety gloves. Please adhere to your company's standards in regards to using hand PPE when taking resistance measurements.

STEP 2. Clamp or touch the voltage-carrying probes of the resistance-measuring device to the flat conductive surface of the bushings that make up the current carrying path. Make sure the measurement probe is in contact with the current-carrying flat face of the bushing conductor rod.

NOTICE

DO NOT take resistance measurements from the threaded area of the bushing stud. Resistance measurements taken through the threads of the bushing stud will be inaccurate. See Figure 42.

If using clamp-style probes, slide the clamp all the way up against the current-carrying face to get a good connection. See Figure 42.

STEP 3. Record the resistance measurement. Acceptable resistance values are:

- Less than 500 micro-ohms
- Less than 600 micro-ohms for tie switches

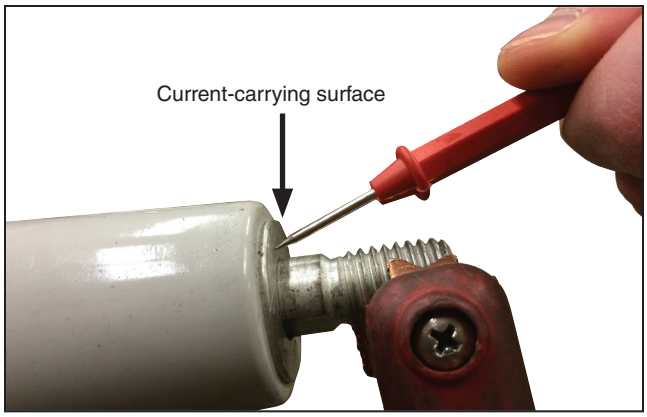


Figure 42. Take the measurement from the flat current-carrying surface of the bushing.●

⚠ WARNING

Check the functional operation and adjustment of mechanical cable interlocks on doors and switch operating mechanisms.

Failure to check and adjust these interlocks may result in personal injury or death.

The switchgear assembly may include interlocks (key or mechanical) on doors, switch operators, etc., of some bays. A few typical interlock schemes, including precautionary measures that must be taken to maintain interlock integrity, are discussed in this section. For the types and locations of interlocks included on the switchgear assembly, and for operating descriptions of special interlocking schemes specified, refer to the "CDA" and "RD" drawings.

Mechanical Cable Interlocks—Operation

Interrupter switches with switch operators may include a mechanical cable interlock that blocks switch operation when the enclosure door is open or unlatched.

Interrupter switches with fuses, whether manually operated or power operated, may include a mechanical cable interlock that prevents opening the enclosure door when the switch is in the **Closed** position (preventing access to fuses) and prevents closing the switch when the door is open or unlatched.

If mechanical cable interlocks are included, do not operate the switch unless the associated enclosure door is closed with the door latches securely engaged. Also, if the bay includes fuses, do not attempt to open the door unless the associated switch is open.

NOTICE

For MS-2 Switch Operators, if an attempt is made to operate the switch when the enclosure door is open, the switch operator will partially discharge and become jammed.

Follow these steps to recover from a jammed condition:

STEP 1. Turn the DECOUPLING INDICATOR lever on the switch operator to the right to the Drawout Stop Release position and at the same time pull on the hand grip to decouple the switch operator.

- It will take some force to pull the hand grip so the switch operator is decoupled.
- When decoupled, the switch operator will immediately fully discharge and then will automatically recharge.

STEP 2. Release the DECOUPLING INDICATOR lever and make sure it returns to the **Decoupled** position.

Follow these steps to couple the switch operator:

STEP 1. Press the OPEN or CLOSE pushbutton (as appropriate).

The switch operator will trip and automatically recharge. (This procedure returns the switch operator to the same position, i.e. switch operator **Open** or switch operator **Closed**, as the switch).

STEP 2. Turn the DECOUPLING INDICATOR lever to the **Drawout Stop Release** position and, at the same time, push on the hand grip to move the operator fully into the enclosure.

STEP 3. Release the DECOUPLING INDICATOR lever and make sure it returns to the **Coupled** position.

Mechanical Cable Interlocks—Inspection and Adjustment

Mechanical cable interlocks should be inspected periodically for proper functioning when, for example, the switch is being used. Inspection and adjustment procedures for these interlocks are described below.

⚠ WARNING

Inspection and adjustment should only be performed by qualified persons who are experienced in working with energized switchgear. See the "Qualified Persons" section on page 2 for more information. Inspection and adjustment of this type interlock may require access to the interior of the enclosure, resulting in exposure to high voltage. Furthermore, access to the interior may require opening the switch, which will interrupt power to the load.

Follow these steps to inspect the mechanical cable interlocks that prevent opening the door when the switch is closed and closing the switch when the door is open (typically applied on manual and power- operated modules containing fuses):

STEP 1. With the switch closed and (if furnished) the snaplock disengaged, attempt to open the high-voltage compartment door. If the door can be opened, the interlock requires adjustment.

STEP 2. Open the switch, which will interrupt power to the load. Then, open the high-voltage compartment door.

STEP 3. With the door open, attempt to close the switch. If the switch can be closed, the interlock requires adjustment. Make sure prior to closing the switch with an opened door, the upstream device by which this switch is connected should be opened and properly grounded in order to avoid accidents or injury.

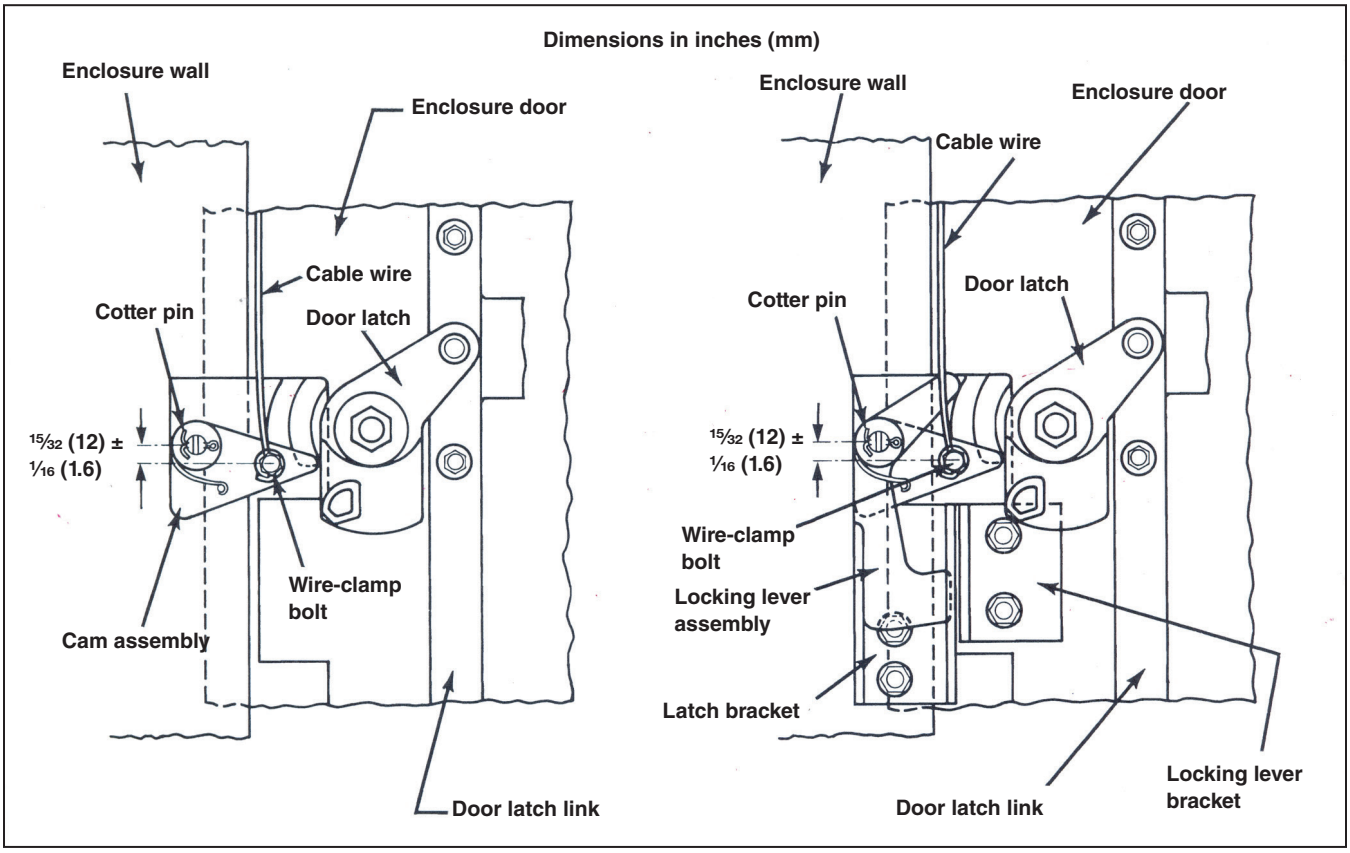


Figure 43. Dimensions to achieve alignment of mechanical cable interlocks which (a) prevent switch operation when the enclosure door is open or unlatched or (b) prevent opening the enclosure door when the switch is closed and closing the switch when the door is open.

Follow these steps to inspect the mechanical cable interlocks that prevent opening or closing the switch when the door is open (typically applied on power-operated modules containing a switch but no fuses):

STEP 1. Open the high-voltage compartment door.

STEP 2. With the door open, attempt to close the switch. If the switch can be closed, the interlock requires adjustment. Make sure prior to closing the switch with an opened door, the upstream device by which this switch is connected should be opened and properly grounded in order to avoid accidents or injury.

Follow these steps to adjust the mechanical cable interlocks:

STEP 1. To adjust the interlock, bring the door nearly closed to a point where both the locking lever pin (which is part of the locking-lever assembly on the enclosure stile) and the drive-plate tip (which is part of the interlock mechanism on the enclosure door) are visible and in close proximity. See Figure 43 on page 53.

STEP 2. Verify the distance from the surface of the locking lever pin to the tip of the drive plate is 5⁄16-inch (8 mm) ±1⁄16-inch (1.6 mm).

STEP 3. If adjustment is necessary to gain the correct dimension:

(a) Loosen the two nuts securing the locking lever assembly to the enclosure tile.

(b) Position the cable housing bracket relative to the locking lever plate so there is 15⁄32-inch (8 mm) ±1⁄16-inch (1.6 mm) between the tip of the locking lever and the surface of the locking lever plate.

(c) While maintaining the dimensional relationship established in (b) above, simultaneously slide both the cable housing bracket and the locking lever plate vertically to achieve the 15⁄32-inch (8 mm) dimension.

(d) Tighten the bolts.

Key Interlocks

⚠ WARNING

When optional key interlock schemes have been furnished, duplicate keys are provided for use during installation. If duplicated keys are made available after installation, it can increase the chances of using the key interlocks when they are not supposed to be used. **This can result in unwanted operation, which could result in serious injury or death.** To maintain the integrity of the key interlock scheme, the duplicate keys must be destroyed or made accessible only to authorized persons.

Note: Key interlocks are not security locks and are not a substitute for padlocks.

Entrance interrupter switches with fuses, whether manually operated or power operated by Type MS-2 or Type AS-30 Switch Operators may include key interlocks that guard against opening the enclosure door unless all associated entrance switches are open. If such key interlocks are included, do not attempt to open the enclosure door unless the associated switches are open. See view (a) in Figure 44 on page 55.

Entrance bays may include key interlocks that guard against opening the enclosure door unless an associated upstream or downstream device is open. If such key interlocks are included, do not attempt to open the enclosure door unless the associated device is open. See view (b) in Figure 44 on page 55.

Entrance interrupter switches, with or without fuses, whether manually operated or power operated by Type MS-2 or Type AS-30 Switch Operators may include key interlocks that guard against paralleling the power sources. If such key interlocks are included, do not attempt to close a source-interrupter switch unless the other source-interrupter switch, or bus-tie switch in split-bus configurations, is open. See views (b) and (c) in Figure 44 on page 55.

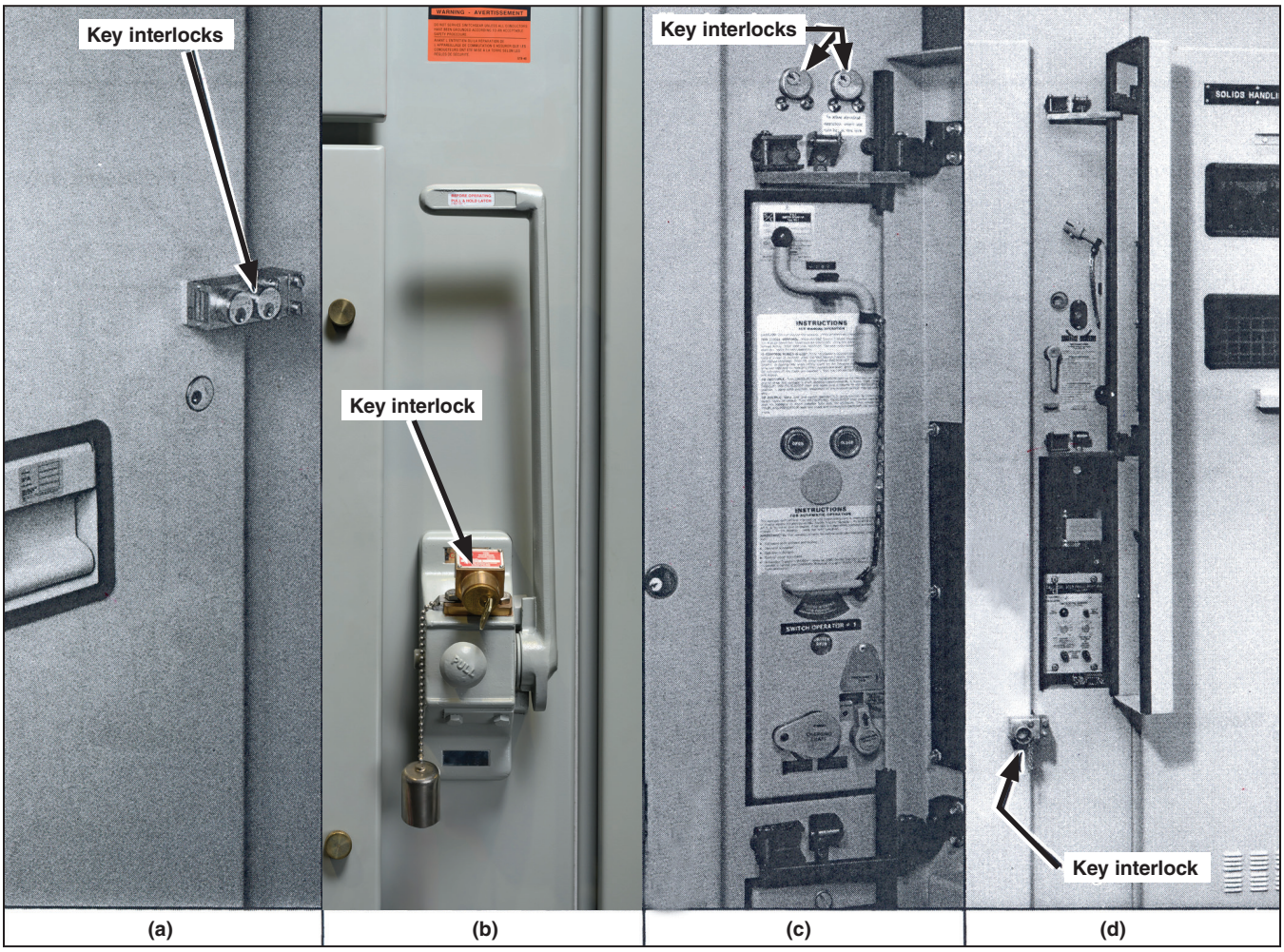


Figure 44. Key interlocks (a) on compartment door to guard against opening the compartment door unless the associated switch is open, (b) on manual switch-operating handle to guard against paralleling of the power sources and to guard against opening the door unless upstream and downstream devices are open, (c) on Type MS-2 Switch Operator to guard against paralleling of the power source, and (d) on compartment door (Type MS-10 Switch Operator shown) to guard against opening compartment door unless the associated upstream or downstream device is open.

Feeder interrupter switches with fuses and manually operated may include key interlocks that guard against opening the enclosure door unless the associated switches are open. If such key interlocks are included, do not attempt to open the enclosure door unless the associated switches are open.

Feeder interrupter switches, with or without fuses, whether manually operated or power operated by Type MS-10 Switch Operators may include key interlocks that guard against opening the enclosure door unless an associated upstream or downstream device is open. If such key interlocks are included, do not attempt to open the enclosure door unless the associated device is open. See (d) in Figure 44 on page 55.

NOTICE

Use of undue force in an attempt to operate switches contrary to the correct sequence dictated by the key interlock scheme may damage handles or latching mechanisms.

Vista switchgear bays can be equipped with key interlocks to lock load interrupter switches or three-pole fault interrupters into the **Open** position.

Note: The portable motor operator accessory cannot be used on Vista switchgear ways with key interlock mounting provisions or key interlocks. Permanent-style motor operators for remote supervisory Vista switchgear bays cannot be retrofitted onto ways with key interlocks or key interlock mounting provisions. Key interlock mounting provisions cannot be added after shipment. Only switchgear with ordered key interlock mounting provisions can be field equipped with key interlocks.

Maintenance recommended consists of periodic cleaning and inspection of the interrupter-switch, fuse, and bus-support insulators; barriers; cable-terminating devices; and louver filters (if furnished), which should be performed at intervals based on environmental conditions.

Note: Maintenance instructions for Vista switchgear bays can be found in the appropriate Vista Underground Distrubution System operation instructions. See "Retain This Instruction Sheet" section on page 2 for details.

The integrity of the enclosure finish should be checked, and any scratches or chips should be touched up with the appropriate touch-up finish.

Occasional exercising of interrupter switches, switch operators, and all automatic control equipment, as well as inspection of interlocks for correct functioning, is recommended. Specific recommendations on exercising are included in the S&C instruction sheet applicable to each component as well as in S&C inspection recommendations provided in the instruction manual furnished with the switchgear. To verify the correct functioning of interlock schemes; refer to the "Interlocks" section starting on page 52.

The frequency of inspection and maintenance necessary will vary and largely depend on the environmental conditions and location of the metal-enclosed switchgear. S&C recommends utilities perform all routine inspection by checking, cleaning, and maintaining the equipment in accordance with established utility standards and industry best practices. In the event the recommendations contained in this instruction sheet differ in any way from the user's operating and safety procedures, follow the user's operating and safety procedures.

Fuse replacement is infrequent because for cable systems there is no exposure to transient faults, only to rare permanent faults.

The inspection and maintenance recommendations and obligations stated above shall be the sole responsibility of the user. The warranty and/or obligations of S&C described in S&C Price Sheet 150, "Standard Conditions of Sale – Immediate Purchasers in the United States" (or Price Sheet 153, "Standard Conditions of Sale – Immediate Purchasers Outside the United States"), S&C Price Sheet 192T for Canada, or any special warranty provisions set forth in the applicable product line specification bulletin, shall only be applicable upon confirmation the product at issue has been stored, installed, operated, and maintained in accordance with these recommendations and standard industry practice. S&C shall not be liable for any damage or loss whatsoever arising out of or resulting from the user's failure to perform the necessary inspections and maintenance of the products covered in this publication.

★ These recommendations may differ from the user's operating and safety procedures. Where a discrepancy exists, follow the utility operating and safety procedures.

Performing Maintenance in High-Voltage Bays

⚠ WARNING

When access to high-voltage bays is required, it must be restricted to qualified persons. See the "Qualified Persons" section on page 2 for more information. Follow prescribed safety rules at all times. **Failure to do so can result in personal injury or death.**

Follow these steps for specific maintenance requirements:

STEP 1. Disconnect the fuses, interrupter switches, power switching equipment and their mechanisms, and any other devices from all power sources and all control sources before that device is inspected, serviced, or repaired.

STEP 2. Always assume both sets of power terminals on any interrupter switch, fuse, or terminal to be energized unless proved otherwise by test or by visual evidence of open-circuit conditions on both terminal ends.

STEP 3. Test for voltage. Know how to operate the correct test equipment for determining the voltage on both sets of power terminals for any fuse or interrupter-switch equipment.

STEP 4. After the switchgear has been completely disconnected from all sources of power, properly connect grounding leads to both sides of the equipment (to the incoming and the outgoing phases of the equipment to be maintained).

STEP 5. Make certain the switch-operating handles, operator housings, and metal enclosures are properly grounded.

STEP 6. Inspect and adjust all interlocks.

NOTICE

When control-source fuse replacement is required in Type MS Switch Operators or S&C Source-Transfer Controls, use only fuses as designated in the applicable switch operator instruction sheets. When bulb replacement is performed in source-transfer controls, use only designated S&C replacement bulbs. Costly damage to the switch operator or controls could result when the wrong fuse or bulb is used.

Maintaining Low-Voltage Components

Occasionally low-voltage components may require maintenance. When servicing or repairing space heaters, voltage-transformer secondary wiring, and any other components located in the high-voltage compartment, all of the preceding safety procedures apply.

Follow these steps when external voltage is used to test any secondary side wiring or devices:

⚠ WARNING

When access to high-voltage bays is required, it must be restricted to qualified persons. See the "Qualified Persons" section on page 2 for more information. Follow prescribed safety rules at all times. **Failure to do so can result in personal injury or death.**

STEP 1. Disconnect all voltage transformers and voltage sensors when external voltage is used to test any secondary side wiring or devices. This prevents energizing the high voltage conductors through voltage transformers or sensors.

STEP 2. Draw out the voltage transformers completely and disconnect the secondary connections if drawout-type transformers are provided.

STEP 3. Remove the primary fuses of the voltage transformers and disconnect the secondaries by removing the secondary fuses or by disconnecting the secondary leads.

STEP 4. Do not disconnect the burden or the voltage limiter from the voltage sensor until the switchgear is de-energized; otherwise the voltage sensor will be damaged.

STEP 5. For voltage sensors, the secondary leads must be shorted either by removing the plug from the input receptacle and transferring it to the shorting receptacle for applications involving the Micro-AT Source Transfer Control, Type SPD Open Phase Detector or by inserting screws into shorting-type terminal blocks. See Figure 40 on page 43.

Maintaining Other Low-Voltage Components (600 volts or less)

The maintenance of other low-voltage components (such as voltmeters, ammeters, relays, etc.), isolated from high-voltage bays, may be performed under the safety rules for equipment rated 600 Volts or less.

If maintenance is to be performed on ammeters, short-circuit the secondary connections of the associated current transformer at the shorting-type terminal block prior to removal of the ammeter. This may require access to the high-voltage compartment, in which case the foregoing procedures apply.

Follow these steps to return the equipment to service:

STEP 1. Reconnect any low-voltage terminals disconnected when servicing the gear. Re-install any primary or secondary fuses previously removed.

STEP 2. Close and securely latch each switchgear-bay door before energizing the circuit or operating any switching device.

STEP 3. Open any grounding switch, or remove other grounding means, before closing the associated interrupter switch(es).

STEP 4. Lock interrupter switches in the **Open** or **Closed** position, as dictated by the electric power system design.

STEP 5. Padlock all doors, switch-operating handles, and covers before leaving the installation site, even momentarily. Observe this procedure even when the gear is accessible only to qualified persons.