



General Instructions
SafeGear™ Metal-clad
Switchgear
Indoor Applications

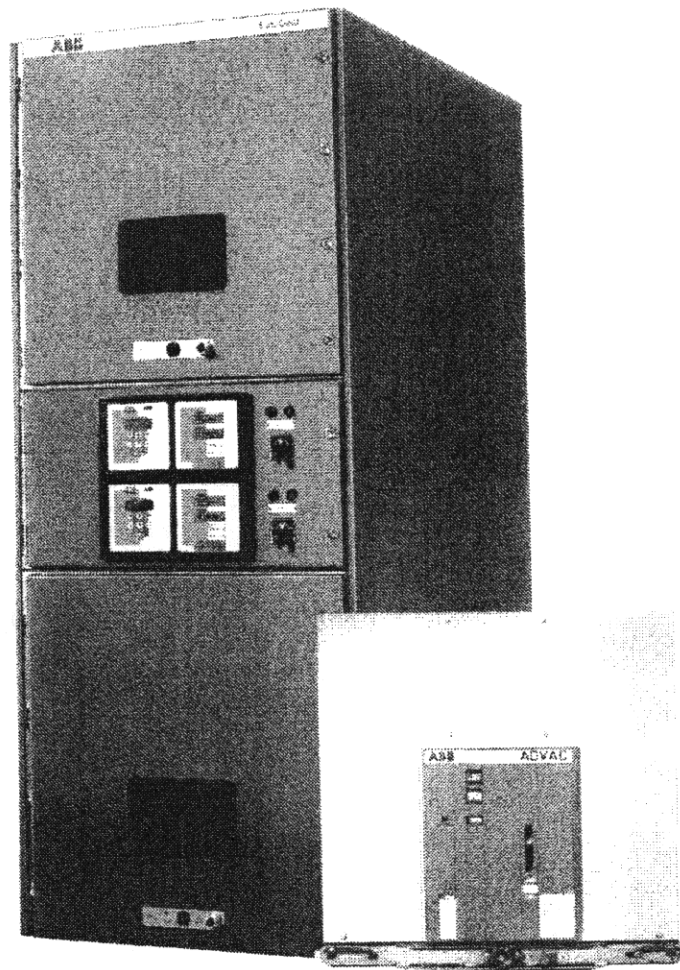


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Contents

1. INTRODUCTION.....	3
2. SAFETY	3
IMPORTANT NOTICE REGARDING CLOTHING	3
SAFETY NOTATIONS.....	4
BEFORE ENERGIZING THE SWITCHGEAR	5
3. RECEIVING AND HANDLING.....	6
UNLOADING AND HANDLING.....	6
TOWING	7
LIFTING.....	8
JACKING.....	9
ROLLING	10
REMOVAL OF SHIPPING BASES	12
4. STORAGE.....	13
5. INSTALLATION	14
GENERAL CONSTRUCTION.....	14
FOUNDATION.....	14
ASSEMBLING THE VERTICAL SECTIONS	15
SETTING THE VENTILATION FLAPS	19
INSTALLATION OF MOLDED BOOTS OVER BUS JOINTS.....	22
CONNECTION OF PRIMARY CABLES	22
GROUND BUS INSTALLATION.....	22
6. TESTING AND INSPECTION	23
7. STANDARD CONSTRUCTION FEATURES	25
GROUND BUS.....	25
SHUTTERS	25
POWER AND CONTROL CABLES.....	26
SECONDARY DISCONNECTING DEVICES	27
PRIMARY DISCONNECTS	28
CIRCUIT BREAKERS.....	28
AUXILIARY DRAWOUT MODULES.....	29
INSERTION	29
REMOVAL	32
8. ENCLOSURE SECURITY	33
9. INSPECTION AND MAINTENANCE.....	34
10. RENEWAL PARTS	35
DISCLAIMER OF WARRANTIES AND LIMITATION OF LIABILITY	35

1. INTRODUCTION

SafeGear™ metal-clad switchgear is designed to meet or exceed all the applicable ANSI, NEMA, IEEE and NEC standards. The scopes of these instructions are general in nature, and cover requirements for installation, setup, checkout and maintenance as applied to SafeGear™ metal-clad switchgear. Specific information on particular applications is furnished as general arrangement drawings.

The switchgear described herein is designed for the conditions normally encountered on electric utility power distribution systems. As such, it is suitable for use under the "Service Conditions" described in ANSI C37.20.2, section 3, unless stated otherwise by ABB for a particular application.

Additionally, SafeGear™ metal-clad switchgear is designed to meet the arc-resistant requirements of EEMAC G14-1, 1987, and the proposed ANSI C37.20.7-19xx guideline.

WARNING

To maintain the Arc-Resistant performance of this equipment, it is essential that it be maintained in a state of good repair, that all doors and access panels are properly installed, and all bolts used to secure the doors and access panels are securely tightened. Failure to do so can cause severe injury, death or substantial property damage.

2. SAFETY

WARNING

Read this instruction book carefully before attempting to install, maintain, operate or service this equipment. Failure to properly follow instructions can cause severe injury, death or property damage.

Keep this Instruction Book available to those responsible for the installation, maintenance, operation, and service of this equipment. Safety as defined in this Instruction Book involves two conditions.

1. Personal injury
2. Product or property damage

SEE IMPORTANT "DISCLAIMER OF WARRANTIES AND LIMITATION OF LIABILITY" ON PAGE 35.

WARNING

Failure to observe the requirements of OSHA standard 1910.269 can cause death or severe burns and disfigurement. That standard specifically prohibits the wearing of polyester, acetate, nylon, or rayon clothing by employees working with exposure to electric arcs or flames.

Safety notations, intended to alert personnel of possible personal injury, death or property damage, are inserted before the step in which the condition is cited. The four hazard intensity levels are defined as follows:

DANGER

"DANGER" is used to indicate a hazardous situation which has a high probability of death or severe injury and substantial property damage.

WARNING

"WARNING" is used to indicate a hazardous situation which has some probability of death or serious injury and property damage.

CAUTION

"CAUTION" is used to indicate a hazardous situation which may result in a minor or moderate injury and property damage.



"NOTICE" is used to indicate a statement of company policy as the message relates directly to the safety of personnel or protection of property

This switchgear should be installed, operated and serviced only by competent personnel, familiar with good safety practices. These instructions are written for such personnel and are not intended as a substitute for adequate training and experience in the use of this equipment. Should clarification or further information be required, or should problems arise which are not covered sufficiently for the user's purpose, refer the matter to the ABB Power T&D Company Inc. Sales office. When communicating with ABB regarding the product covered by this Instruction Book, always include the ABB assigned Shop Order (S.O.) number.

Additionally, all applicable safety procedures such as OSHA requirements, regional and local safety requirements, commonly accepted safe working practices, and good judgment must be used by personnel installing, operating or servicing the equipment covered by this Instruction Book.

WARNING

There is a hazard of electric shock and or burn whenever working in or around electrical equipment. Power must be off before working inside switchgear. Turn power off ahead of the switchgear before performing any maintenance operations. Check incoming line to ascertain positively that the equipment is totally de-energized. Always check outgoing circuits to ensure no back-feed condition exists. For maximum safety, utilize a ground and test device. Failure to do so can cause severe injury, death or substantial property damage.

CAUTION

Before energizing, the switchgear must be free and clean of all random foreign matter such as dirt and debris. There is a hazard of electrical shock and or burn whenever working in or around electrical equipment. Both primary and control voltages must be turned off before working inside the equipment. When a thorough inspection or work is required on a circuit breaker, it must be removed from the circuit breaker module. The bus should be de-energized and grounded when work is to be done on switchgear.

Before energizing the switchgear observe that:

1. The switchgear is assembled with all barriers in place, all medium voltage joints covered with boots or taped and all extraneous material and tools have been removed.
2. Potential tests have been made to determine that all insulation is in good condition.
3. All outgoing cables are either permanently connected or thoroughly insulated so as not to cause a fault, especially at circuits remote from switchgear.
4. The secondary circuits of energized current transformers should never be open circuited.
5. Current transformer secondaries are short-circuited when shipped from the factory. Before opening the short circuiting device, all current circuits must be complete beyond the current transformer short circuiting terminal blocks. Ensure that relays are set properly and are operable.
6. All circuits are properly phased.
7. There is an upstream (backup) circuit breaker that is in operating condition and set to clear any fault that inadvertently may occur.

3. RECEIVING AND HANDLING

Before shipment, the switchgear undergoes careful factory inspection. Each section is plainly marked at convenient places with its number and position. When size or other reasons make it necessary to divide the equipment for shipment, the unit number of the particular equipment is tagged on the vertical section. The circuit breakers are shipped in individual cartons or crates. Immediately upon receipt of the switchgear, examine the shipment for any evidence of damage or loss sustained during transportation. Check the contents against the packing list before discarding any packing material. If there is any discrepancy, notify ABB and the carrier at once. If damage to the equipment indicates rough handling, claim for damages should be filed at once with the carrier and ABB promptly notified.

Note: ABB standard shipping term is FOB factory, therefore ABB is not responsible for damage after delivery of shipment to the carrier.

Unloading and Handling

WARNING

Always be certain that all doors and access panels are in place and securely fastened before attempting to move the equipment. The doors and panels provide critical structural support to the enclosures. Failure to do so can damage the equipment, and can cause severe injury, death or substantial property damage.

WARNING

Avoid applying concentrated forces directly to the switchgear enclosures. Always apply forces to the shipping bases, or other load distribution devices. When absolutely necessary to apply forces directly to the enclosures, use extreme caution to avoid damage. Failure to do so can compromise the Arc-Resistant performance of the equipment, and can cause severe injury, death or substantial property damage.

SafeGear™ metal-clad switchgear vertical sections are shipped in splits of one to four units. Each shipping split is mounted on heavy steel shipping bases. The switchgear should be unloaded as near to the final installation site as possible.

The following are suggested methods for unloading and handling SafeGear™ metal-clad switchgear.

Towing

Use chains with a load rating which allows for safe handling of the switchgear (consult the chain manufacturer or local code requirements for the proper safety factors). Attach the chains to the cutout holes at the end of each shipping base (see Figure 1), and secure to the towing equipment. Make sure that truck bed height and dock height are even, or provide heavy duty steel sheets to bridge between the truck and the dock. Make sure that towing force is evenly applied to prevent any lurching or rocking motion being imparted to the switchgear. Slowly pull the equipment until the shipping bases are completely resting on the dock.

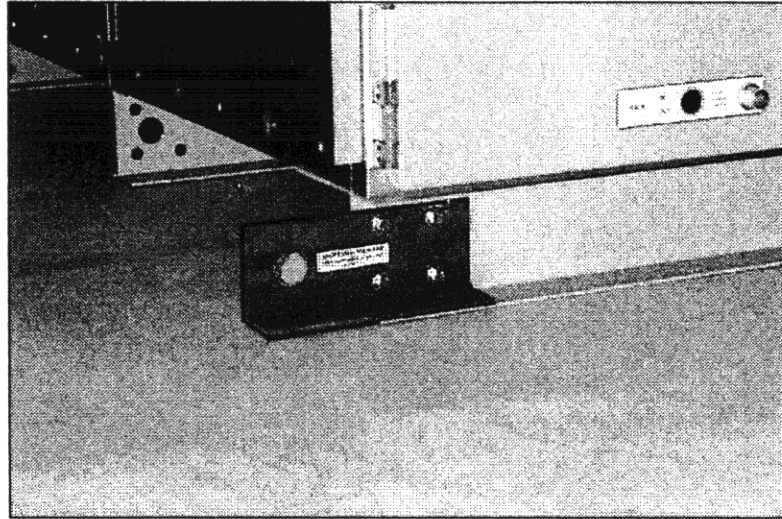


Figure 1. Photo showing optional towing/lifting eye extension.

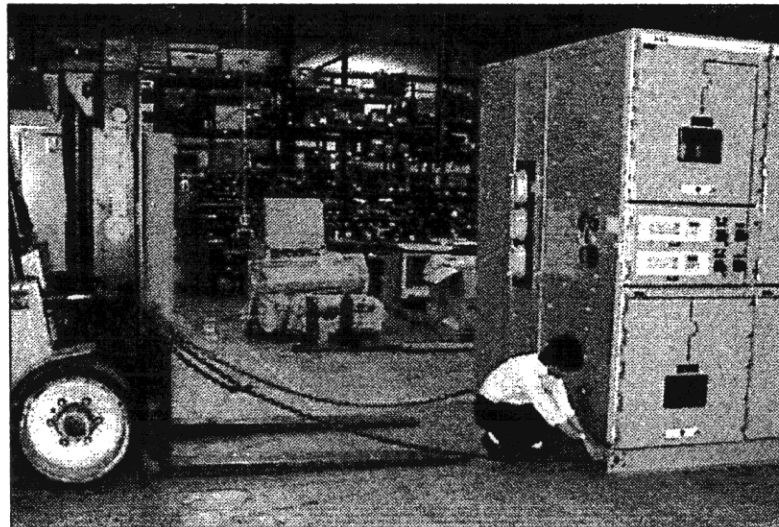


Figure 2. Attachment of Chains for Towing.

Lifting

Where the switchgear must be lifted by an overhead device, load rated nylon slings should be used. Figure 3 illustrates a method of attaching the nylon sling to the base by means of shackles. When using overhead lifting devices it is recommended that spreader bars be used.

When wire rope slings are used in place of nylon slings a 4"x4" timber should be placed between the sides of the switchgear and the sling.

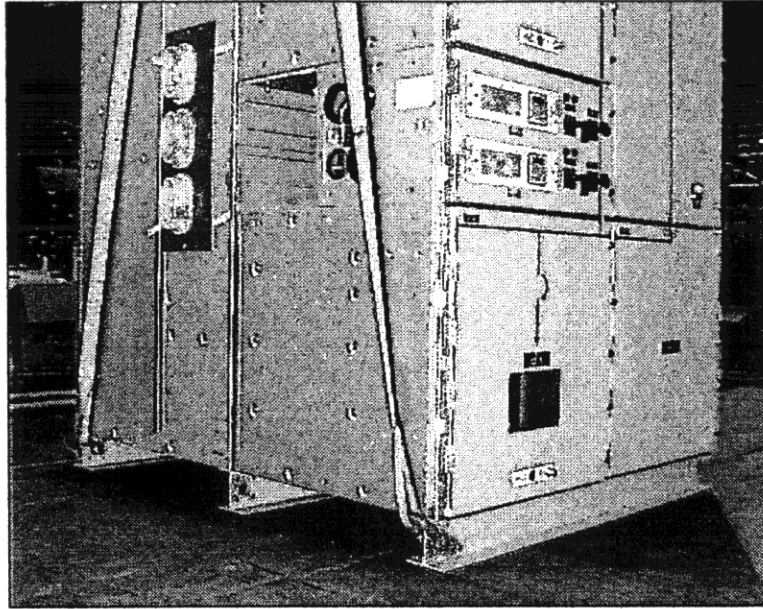


Figure 3. Nylon Sling on Equipment

Jacking**WARNING**

Do not apply towing, lifting, jacking or prying forces directly to the switchgear enclosures. Improper moving will cause damage that can compromise the Arc-Resistant performance of the equipment, resulting in severe injury, or death.

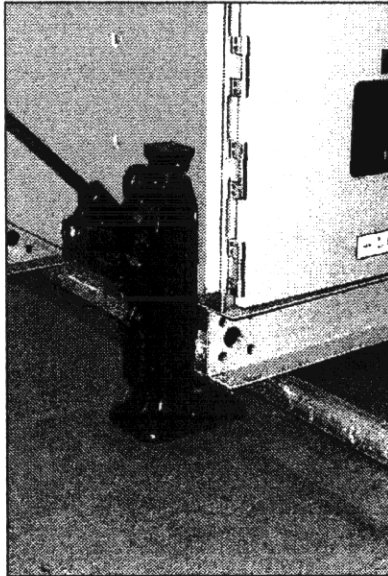


Figure 4. Use jacks to lift the ends of the switchgear.

When jacking or prying the equipment, never jack directly against the switchgear enclosure itself. Always jack against the shipping bases (see Figure 4), or against a load distribution plate (customer supplied).

To roll the equipment in the direction of the shipping bases

After jacking one end of the equipment evenly, place a roller on the floor, perpendicular to and across the shipping bases. Lower the jacks until the shipping bases are resting on the roller. Repeat this operation on the opposite end of the equipment. A third roller should be placed ahead of the equipment, along the route of travel, and positioned so that the shipping bases engage the third roller before disengaging the first. While the crew pushes the equipment toward its final position, one person should carefully take the freed roller from the rear end and place it ahead of the equipment in similar manner to that described above until the equipment is in the desired position (see Figure 5).

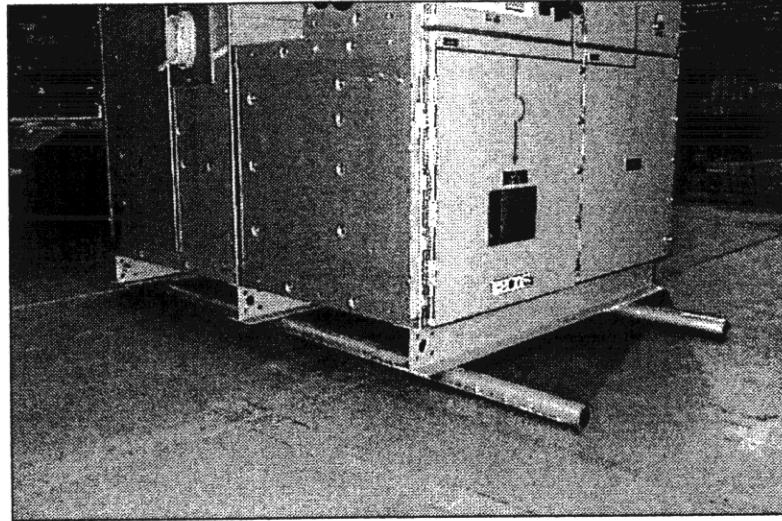


Figure 5. Placement of Rollers for moving SafeGear in the direction of the Shipping Bases.

To roll the equipment in the direction perpendicular to the shipping bases

After jacking one end of the equipment evenly, place rollers on the floor, parallel to and slightly inside the shipping bases. With the equipment still raised, place a rigid steel channel perpendicular to, and between the shipping bases and rollers. Lower the jacks until the shipping bases are resting on the channel. Repeat this operation on the opposite end of the equipment. A third roller should be placed ahead of the equipment, along the route of travel, and positioned so that the shipping bases engage the third roller before disengaging the first. While the crew pushes the equipment toward its final position, one person should carefully take the freed roller from the rear end and place it ahead of the equipment in similar manner to that described above until the equipment is in the desired).

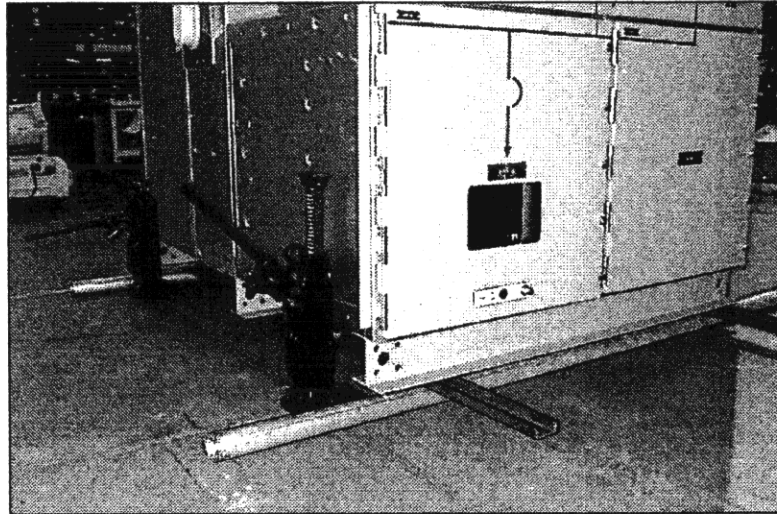


Figure 6. Placement of rollers and channels for moving SafeGear perpendicular to the shipping bases.

Removal of shipping bases

Open the switchgear doors and remove the bolts fastening the shipping bases to the metal-clad switchgear. Make sure that all doors and panels are closed and secure before continuing. Carefully jack up the switchgear uniformly on both sides to a height where the bases can be removed. Remember to use a load distribution plate to avoid damage to the equipment. It is necessary that four jacks be used for this operation, and that jacking be performed in a manner to keep the equipment uniformly level, avoiding any undue stress on the equipment. Remove the base. Select four pieces of timber of sufficient thickness to permit the toe of the jack to be removed after lowering. Place a piece of timber at each corner, and then slowly lower one side of the vertical section until it rests on the timber (see Figure 7). Repeat the step on the other side, so that the unit now rests completely on the four lumber pieces. Carefully, use a wide crowbar and timber fulcrum to raise the vertical section sufficiently to remove the timber corner piece and slowly lower the vertical section until it touches the floor. Repeat this step for all four corners.

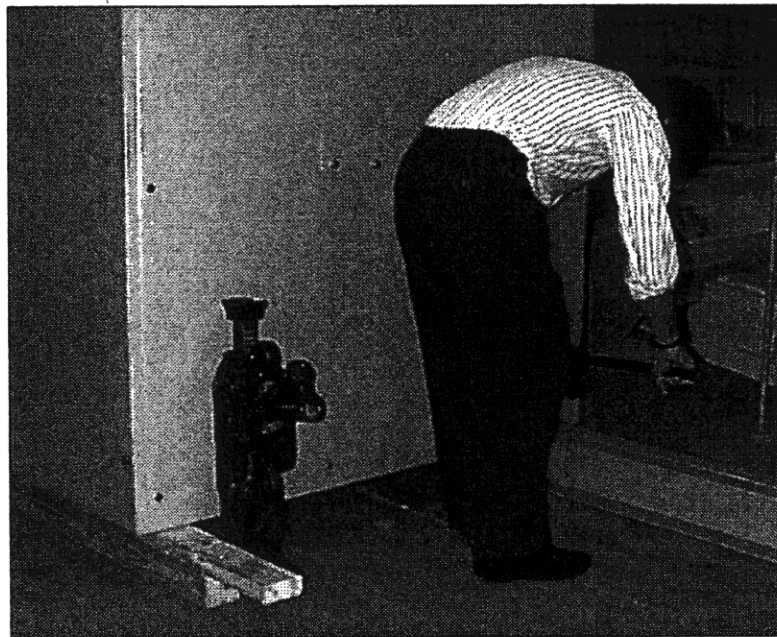


Figure 7. Removal of shipping bases.

If the switchgear consists of more than one section, it will be necessary to set each section next to the others. Place one section precisely in place, then move the next section as close as possible using the jack and roller technique. Greasing the floor before lowering the switchgear will facilitate close positioning of the sections.

4. STORAGE

CAUTION

The circuit breaker or cutout device to which a separate power source is connected must remain open. Failure to do so can cause personal injury or property damage.

Indoor switchgear sections are shipped covered with plastic wrap to protect the equipment from dust, dirt and weather during shipment only. This plastic wrap must be removed after the equipment is placed in storage at the job site.

Leave each switchgear vertical section on its shipping base until final installation. Remove circuit breakers and accessories from the shipping cartons or crates. Inspect for missing or damaged material.

Store in a clean, dry and well-ventilated area. Cover the switchgear with a heavy wrapping paper or other moisture barrier material to keep out dirt and moisture. Louvered or filtered openings should not be covered to permit free ventilation. Plastic film wrapping materials are not recommended as these materials tend to retain moisture due to condensation.

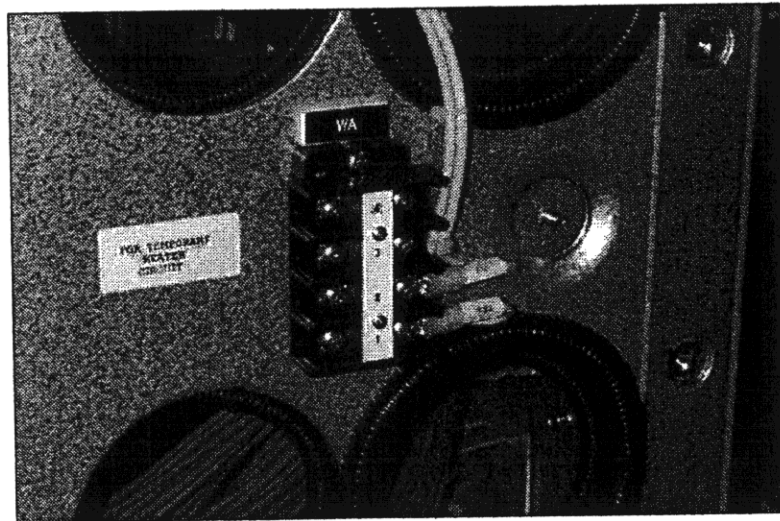


Figure 8. Heater load terminals.

If the switchgear is to be stored, or placed where dampness may be present, heaters should be used to keep the switchgear dry until it is placed in service. When metal-clad switchgear is equipped with heaters, the power source for the heaters should be brought to the load terminals (see Figure 8) of the thermal circuit breaker or cutout device that controls the heater circuits. The breaker or cutout device must remain open when a separate power source is used. In areas of high humidity, the heaters should remain energized at all times during storage and service when less than normal load is connected.

The storage building should be constructed such that it is not subject to flooding and that the floor is paved and well drained. The ambient storage temperature of the building should be warm (approximately 15°C) and dry (50% maximum humidity).

5. INSTALLATION

General construction

Indoor SafeGear™ switchgear consists of one or more vertical sections that are mounted side-by-side and connected both electrically and mechanically to form a modular construction. The modular construction is fabricated primarily from 14 gauge pre-coated Galvalume™ material (zinc-aluminum over cold-rolled carbon steel) which does not require painting due to the corrosion resistant properties of the material. Components that require welding (doors and end panels) or which require greater than 14 gauge (and not equaled by double 14 gauge galvalume material) are constructed of standard carbon steel and painted using a powder-coat epoxy. Hem bends (rigid overlap bending) are consistently used to enhance strength and to minimize potential exposure to sharp steel edges during installation and maintenance. Pressure relief flaps and exhaust chambers (Patents Pending) are located to channel hot gases and other by-products (that may result from an internal arc faults) away from personnel, and through the roof of the equipment. Pressure relief flaps located on the roof of the equipment should not be considered walkable.

WARNING

Do not step on the pressure relief flaps located on the roof of the equipment. Stepping on the flaps may cause minor personal injury or property damage.

WARNING

Keep all foreign objects clear of the roof mounted pressure relief flaps, and maintain a minimum clearance of four (4) feet from the top of the equipment to any obstruction. Failure to do so can compromise the Arc-Resistant performance of the equipment, and can cause severe injury, death or substantial property damage.

Foundation

Floor plan drawings are supplied for each installation. The design of the floor may include channel iron sills embedded in the concrete. It is important that these sills be straight and level their full length, and correctly spaced. To insure this condition, it is recommended that ties be bolted between the sills at various intervals after which the lower flange of the sill should be shimmed to proper height.

Power and secondary (control) conduits should be installed before the installation of the vertical sections, if the conduits bring the cabling from the floor. Available space is allocated for the conduits on the floor plan accompanying each order. These conduits should not extend more than one inch (1") above the station floor level. Make sure the conduits are plugged before pouring cement. The concrete floor in front of the vertical section should be smooth to facilitate the handling of the circuit breakers. The finished floor in front and underneath the switchgear must be level and flush with the top of the channel sills so that the circuit breaker will roll evenly on horizontal guide rails into the circuit breaker compartment.

Assembling the vertical sections

WARNING

Any distortion or damage to the equipment enclosures caused before, during or after installation must be properly repaired prior to energizing the equipment. Failure to do so may compromise the Arc-Resistant performance of the equipment, and can cause severe personal injury, death or substantial property damage.

WARNING

When installing equipment supplied in multiple splits, be certain to install all inter-frame connection hardware. Failure to do so may compromise the Arc-Resistant performance of the equipment, and can cause severe injury, death or substantial property damage.

SafeGear™ metal-clad switchgear equipment, consisting of four vertical sections or less, are shipped on a common shipping base(s). Switchgear consisting of more than four vertical sections are shipped in multiple shipping splits. If the switchgear consists of more than one split, the center section should be installed first, and the remaining sections added at each end. When the center section is in position, check for any distortion in shipping or handling. This may be done by using a leveling instrument at the center of the front and rear doors. If the vertical sections are not level, they must be straightened and aligned before proceeding any further. As each sectional is added, it must be checked in the same manner. Any distortion must be corrected before installation, otherwise considerable pressure may be required to bring the sections into alignment, causing stress in adjoining structures.

When equipment is supplied in multiple shipping splits, the main bus, control wiring, and inter-frame connections are dismantled at the point where the switchgear is separated. These should now be reassembled and all bolts and screws tightened to established torque values. A diagram of inter-frame connection points is shown in Figure 9. Bus support bolts should be reinserted through both side sheets. Incoming and outgoing connections should be made for both the main power circuit and all the control circuits.

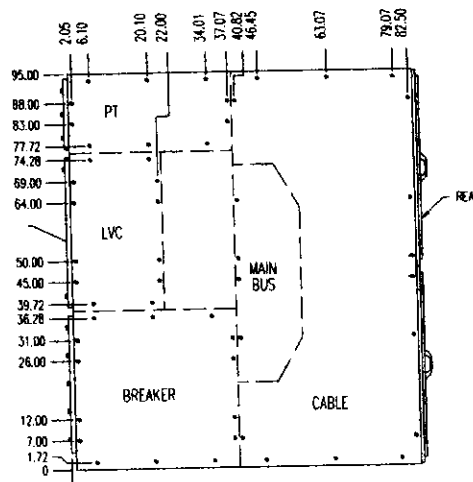
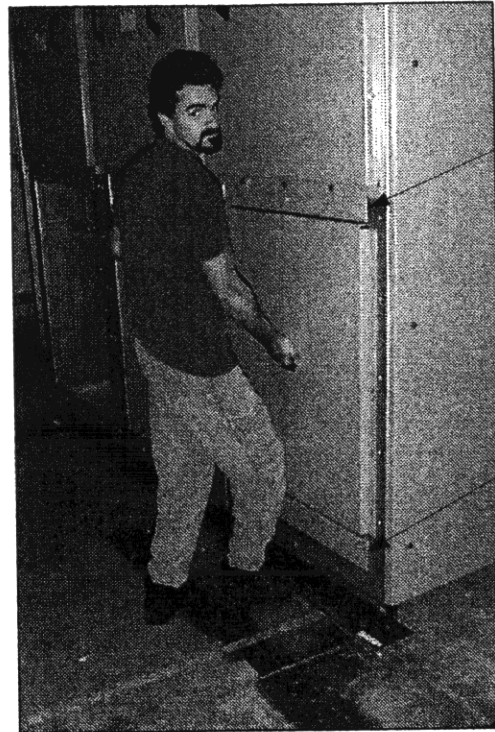


Figure 9. Interframe Bolt Locations.

Installing the rear inner and exterior panels.

The installation of the upper and lower rear panels are similar. The upper and lower internal rear panels must be properly installed before the external rear panels are bolted into place.

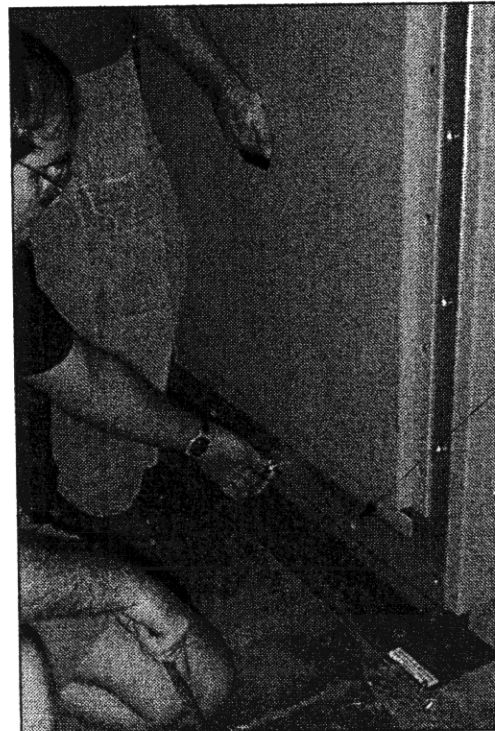
- | | | |
|---------------|----------------------|---|
| Step 1 | Upper Internal Panel | Position the panel so the 3 holes with weld nuts behind them are at the top. |
| | Lower Internal Panel | Position the panel so the 3 holes with weld nuts behind them are at the bottom. |
| Step 2 | Upper Internal Panel | Angle the lower end of the panel into the rear of the frame, sliding the lower flange behind the mid-frame channel support. Let the panel slide down until it rests on the mid-frame channel support. |
| | Lower Internal Panel | Angle the upper end of the panel into the rear of the frame, sliding the upper flange behind the mid-frame channel support. |
| Step 3 | Upper Internal Panel | Swing the top portion of the panel in toward the frame until the mounting flanges on both sides of the panel are against the rear of the frame. |
| | Lower Internal Panel | Slide the panel upward and swing the lower portion in toward the frame until the mounting flanges on both sides of the panel are against the rear of the frame. |
| Step 4 | Upper Internal Panel | Move the panel upward, sliding the top flange inside the frame, until the 3 holes along the top are aligned with the 3 mating holes in the frame. |
| | Lower Internal Panel | Move the panel down, sliding the bottom flange inside the frame, until the 3 holes along the bottom are aligned with the 3 mating holes in the frame. |
| Step 5 | Upper Internal Panel | Bolt the panel in place using 5 bolts on each side. Do not place bolts in the 3 top holes at this time. |
| | Lower Internal Panel | Bolt the panel in place using 5 bolts on each side. Do not place bolts in the 3 bottom holes at this time. |
| Step 6 | Exterior Panels | Bolt the exterior panels (upper and lower) in place using 18 bolts. See Figure 13. |



Position flange
of inner panel
behind frame.

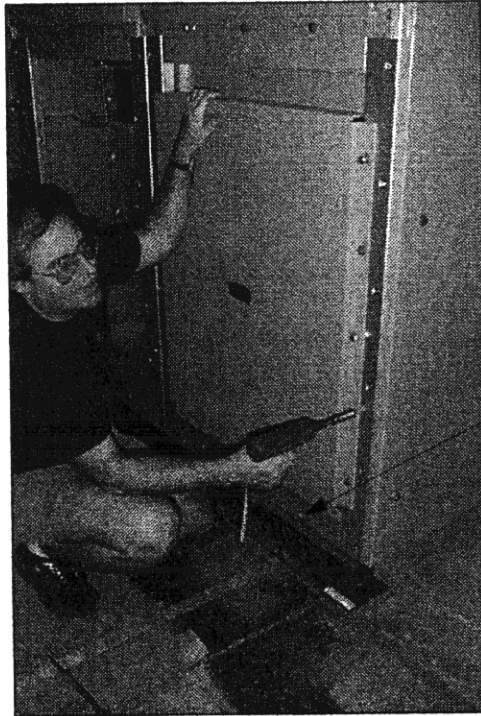
Position flange of inner
panel to allow it to
slide behind frame.

Figure 10. Position inner panel.



Align the three holes in
the flange with the three
holes in the frame.

Figure 11. Align inner panel with holes in frame.



Do not place bolts
in these three holes
at this time

Figure 12. Fasten inner panel in place.

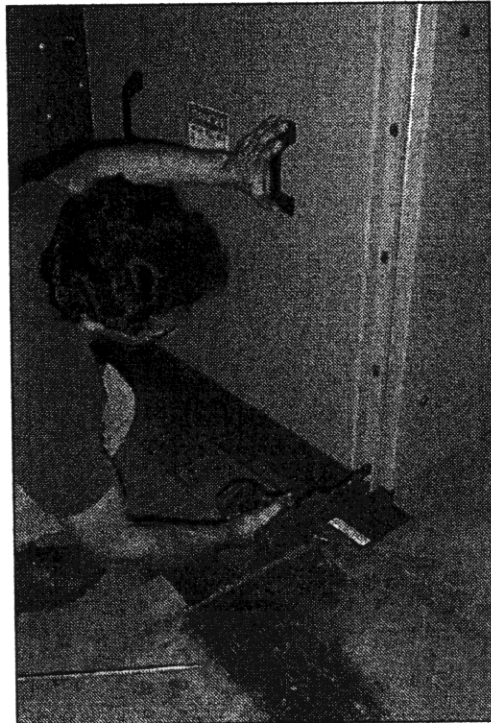


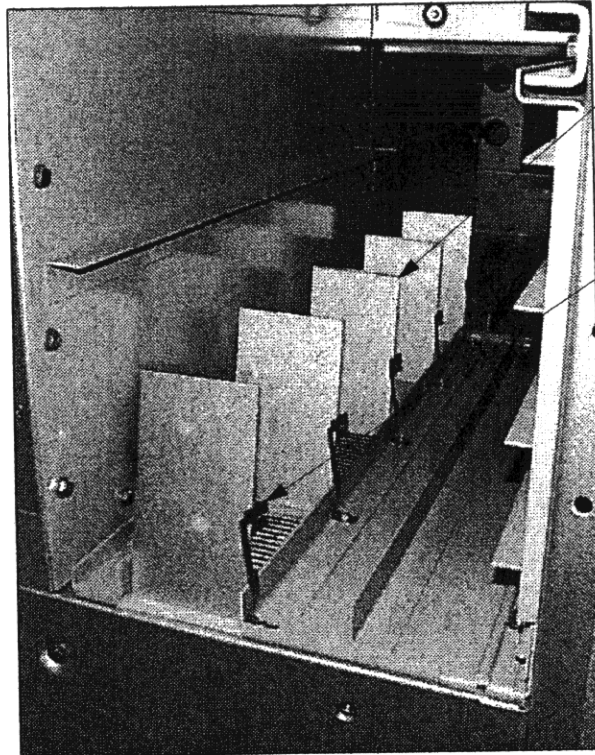
Figure 13. Fasten outer panel in place.

Setting the 2000A and 3000A Circuit Breaker Module Ventilation Vanes and Damper.

The Ventilation Vanes (see Figure 14) and Damper (see Figure 15) must be set into the open or operating position before final bolting together of the vertical sections.



Failure to set the Vanes and Damper into the open or operating position can cause the circuit breaker to overheat.



Ventilation Vanes must be set in the open (upright) position before putting the circuit breaker into service.

Adjust the springs as required to retain the vanes in upright position

Figure 14. Module ventilation flaps.

Damper must be
opened before
putting the circuit
breaker into service

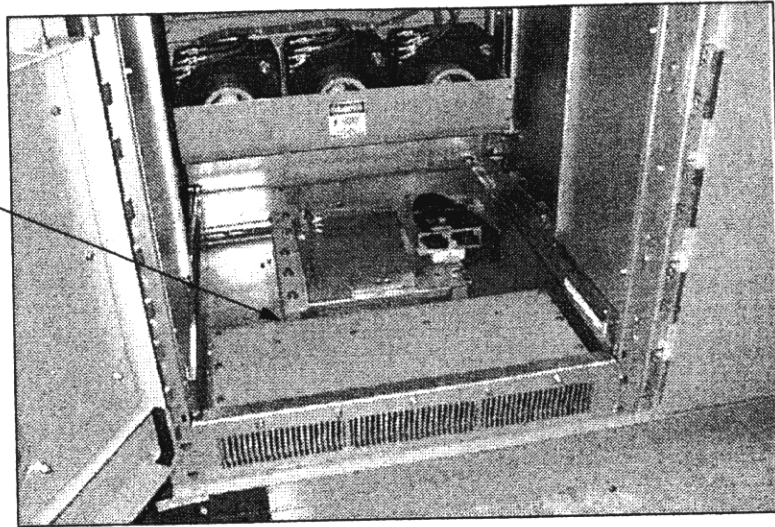


Figure 15. Location of 2000 and 3000 Amp Circuit Breaker Damper

Holes are provided in the floor for bolting the vertical sections to the channel sills. Welding of the switchgear to the channel sills is not recommended.

Installation of bus bar connection between shipping splits

The main bus in each vertical section is assembled in the factory complete, ending at the tap connections located at either end of the shipping split. Sections of main bus for connection between shipping splits are provided for installation in the field. All contact surfaces at bolted joints in the bus are plated. These contact surfaces should be cleaned before they are bolted together (see Figure 16). Conductivity of a bolted or clamped joint depends upon the torque applied. The contact surfaces may be cleaned by wiping with cloth saturated with an approved solvent. Take care not to remove the plating. Use of solvents should be limited to removal of grease and contamination from primary conductors and insulation.

CAUTION

Use only OSHA approved solvents. Avoid prolonged exposure to solvent vapors. Use solvents in a well ventilated area.

A non-flammable, non-chlorinated hydrocarbon solvent with a Threshold Limit Value of 300 PPM or higher is recommended. Proper hardware placement is required to assure good electrical contact. Tighten hardware to the following torque values:

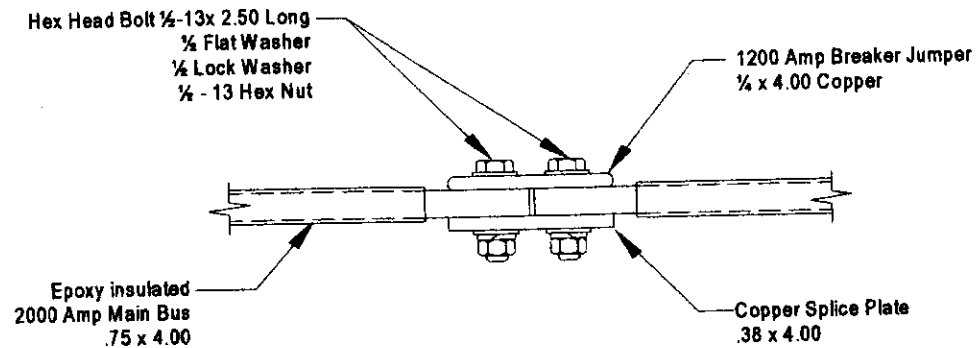


Figure 16. Typical Main Bus Connection

1/2" - torque to 30-45 ft. Lb. dry threads

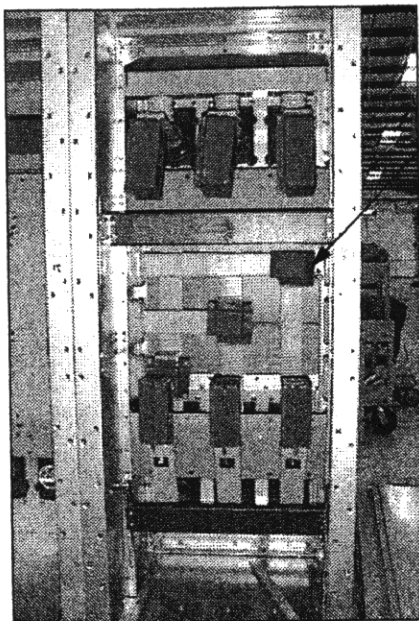
5/8" - torque to 50 - 75 ft LB dry threads

After bolting the sections of the main bus together at shipping joints, insulate the connection by taping or installation of a molded boot over the joint. If porcelain main bus supports are used, fill any gaps between bus and porcelain at the main bus supports using a dielectric sealant.

Installation of molded boots over bus joints

WARNING

All insulating boots covering joints or connections must be properly re-installed prior to energizing the equipment. Failure to do so can cause severe injury, death or substantial property damage.



Typical Installation
of molded boots.

Figure 17. Molded boot installation.

Bus bars are covered with a flame retardant insulation having a sufficient thickness to stand full line voltage for the rating of the switchgear. Straight joints as well as connections to usual switchgear components are covered by a molded boot (see Figure 17). After the bus has been reassembled at the junction point of shipment vertical sections, the flexible boot should be slipped over the joint and the flanges fastened together in the same manner as was installed by the factory. With this cover no wrapping or filling compound is required, since it fits tightly over the bus insulation.

Connection of primary cables

All primary connections must be insulated. Optional Molded boots for cable terminal connections may be supplied with the switchgear as specified on project data sheets. Other insulation materials may be used but must be furnished by others. Application of the insulating material is to be in accordance with the insulation supplier's instructions.

Ground bus installation

Ground bus bars are tin plated and bolted to the frames of the vertical sections at the factory before shipment. When vertical sections are shipped separately, it is necessary to reconnect the ground bus at the shipping split using the splice plate provided. Ground bus bars should be solidly and permanently connected to the station ground by means of a cable or bus of cross section not less than 0.50 sq.-inch. Bare copper should not come into direct contact with Galvalume sheet steel. Ground cable or bus should not be enclosed in conduit, and should take the most direct path available to ground.

6. TESTING AND INSPECTION

CAUTION

If phase to phase tests are made in addition to phase to ground tests, care must be taken that no shunt connected coils such as potential transformers are connected during the tests. Also, do not test solid state relays with high voltage. Instead, disconnect solid state relays prior to applying voltage tests.

With the vertical section erected, assembled, and connected, observe the following precautions:

- Remove all extraneous matter and see that all internal parts are free of dirt, grease, and moisture. If moisture has penetrated, dry out with air or heat.
- Remove all blocs in relays used for protection in shipment.
- Apply potential tests to check for any damaged insulation.

60 HERTZ, RMS, WITHSTAND VOLTAGES (1 minute)

Rated	Factory Test	Field Test	DC* Field Test
up to 250 volts	1500	1125	none
4160 volts	19,000 volts	14,250 volts	20,000
7200 volts	36,000 volts	27,000 volts	38,000
13,800 volts	36,000 volts	27,000 volts	38,000

1. Field tests are recommended when new switchgear vertical sections are added to an existing installation or after major field modifications. The equipment should be put in good condition before the field test. It is not expected that equipment shall be subjected to these tests after it has been stored for long periods of time or has accumulated a large amount of dust, dirt, moisture, or other contaminants without first being restored to good condition.
2. The table headed "Withstand Voltages" is given as a reference only for those using DC tests and represents values believed to be appropriate and approximately equivalent to the corresponding power frequency withstand test values specified for each voltage class of switchgear. The presence of this column in no way implies any requirements for a DC withstand test on AC equipment. When making DC tests, the voltage should be raised to the test value in discrete steps and held for one minute.
3. Check continuity of all circuits. A great deal of this work can be done after the circuit breakers are installed by energizing the control source and operating the equipment with the primary circuit de-energized. Indicating instruments check the continuity of current transformer and potential transformer circuits after the primary circuit is energized.

Set all relays, regulators, and other devices for proper operation of loads. No relays are set at the factory. Remove screws from shorting strips on terminal blocks in current transformer circuits. Screws should be stored in tapped holes in corners of the blocks. See Safety Precautions.

CAUTION

Verify proper phasing of all main circuits prior to energizing the equipment.

WARNING

Always de-energize the equipment (both primary and control voltages) prior to performing maintenance or testing inside the equipment. Failure to do so can cause severe injury, death or substantial property damage.

After the switchgear is assembled, and interconnection to the device it will control has been made, a final inspection and test of all mechanical and electrical connections should be performed. Extreme care must be exercised to prevent the equipment to be controlled from being connected to the system while the preliminary tests are being conducted. If disconnecting switches are not part of the apparatus or switchgear, the line leads should be disconnected to accomplish this. The testing equipment required will depend entirely on the type of installation. Portable voltmeters (both AC and DC) with a wide range of scales will usually be required. If the equipment to be put into service is extensive and complicated, both AC and DC ammeters should be available. Some simple portable device for ringing or lighting out circuits should be included in the testing equipment

7. STANDARD CONSTRUCTION FEATURES

Ground Bus

A ground bus extension is located in the front of the circuit breaker compartment, mounted on the ground bus mounting pan as shown in Figure 19. The ground bus contacts are located on the bottom of the rear structure of the circuit breaker. They engage the ground bus extension when the circuit breaker is in the disconnected, test and connected positions before primary or secondary connections are made. The ground connection is capable of carrying full rated short circuit current of the switchgear in accordance with the momentary and short circuit current rating requirements.

Shutters

WARNING

Do not manually actuate the shutter, or attempt to defeat the safety features of the automatic shutters until you are absolutely certain all equipment has been completely de-energized. Failure to do so can cause severe injury, death or substantial property damage.

The shutter arrangement is the means of blocking access to the primary terminals in the switchgear compartment when the circuit breaker is in the TEST or DISCONNECT positions. The shutter grounding is by dedicated ground wires, and is not dependent on grounding through hinges or moving contact surfaces. When the breaker is moved from "TEST" position toward "CONNECTED", the breaker actuates the shutter assembly from both sides simultaneously for smooth and balanced operation.

Manual operation of shutter lock mechanism. The shutters may be manually operated to provide access to the primary terminals (see Figure 18 and Figure 19). Do not attempt to manually operate the shutter release mechanism without first verifying that the equipment has been completely de-energized.

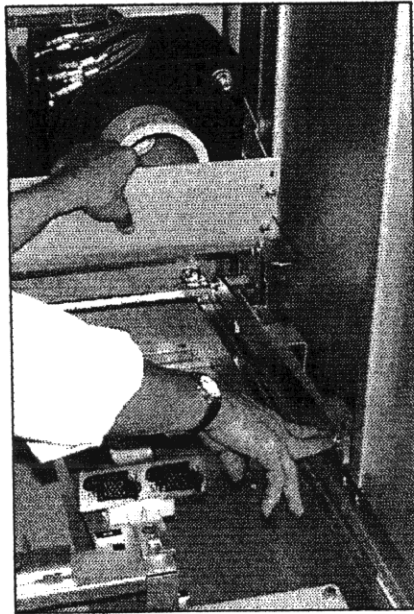


Figure 18. Manual operation of shutter release mechanism.

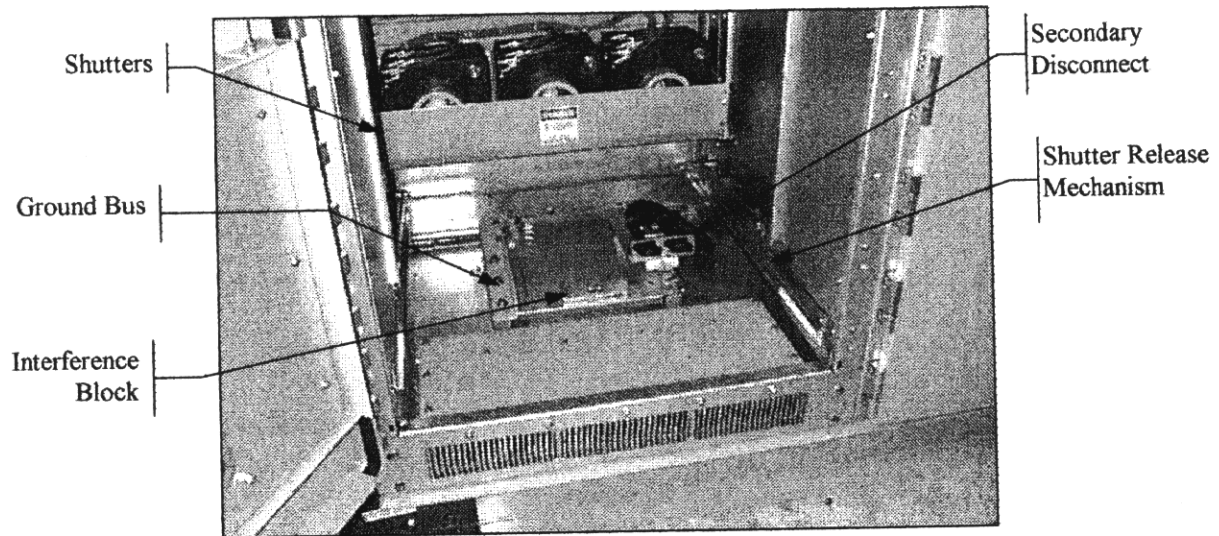


Figure 19. Shutters and Circuit Breaker Module

Power and control cables

The control source wiring to the switchgear should be of larger gauge than the balance of the control wiring. Heavy duty terminal blocks are provided for the connection of control source leads. The leads should first be checked for proper electrical sequence and polarity if applicable, before the connection is made. All secondary and control connections on metal-clad switchgear are factory wired according to connections diagrams applicable to the installation. The secondary and control connections for all outgoing connections are wired to terminal blocks accessible to the system wiring. Control connections between vertical sections are provided through openings in the side sheets of the low voltage compartments. When shipment is made in shipping splits of several vertical sections each, the cross connections between shipping splits are installed at the factory, and one end of each of the shipping split connectors is then disconnected and tagged. Care should be taken to ensure that all these connectors between shipping splits are secure and correctly remade when the shipping splits are placed together.

Secondary Disconnecting Devices

All secondary and control connections on the SafeGear™ switchgear are factory wired in accordance with connection diagrams applying to the installation. A single (25 pin) fully automatic self-aligning secondary disconnect is provided as standard. A double (50 pin) disconnect arrangement is available as an option (see Figure 20). The female portion of the disconnect system resides in the breaker compartment, so that energized contacts are recessed and remain "touch safe (Figure 15)." A total of up to 17 breaker auxiliary contacts are available on the circuit breaker and wired through the automatic secondary disconnect system. The standard switch configuration is (4) "a" contacts and (4) "b" contacts. Optional additional breaker mounted contacts include (5) "a" contacts and (4) "b" contacts, wired through an optional additional secondary disconnect. The secondary and control connections for all outgoing connections are wired to terminal blocks accessible to the system wiring.

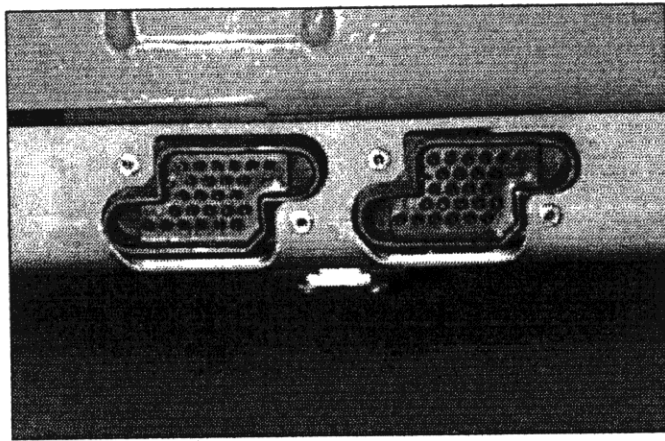


Figure 20. Circuit Breaker mounted portion of disconnect system.

Primary Disconnects

Each primary lead assembly on the circuit breaker consists of a vacuum interrupter housed in an insulating support, with copper upper and lower leads, and tulip type self-aligning, primary disconnects. Each primary disconnect of a drawout circuit breaker consists of silver plated copper fingers positioned in a circular configuration and compressed by a garter spring (see Figure 21). The springs are outside the current path. The mounting of these fingers on the circuit breaker permits inspection of the primary disconnects when the circuit breaker is withdrawn.

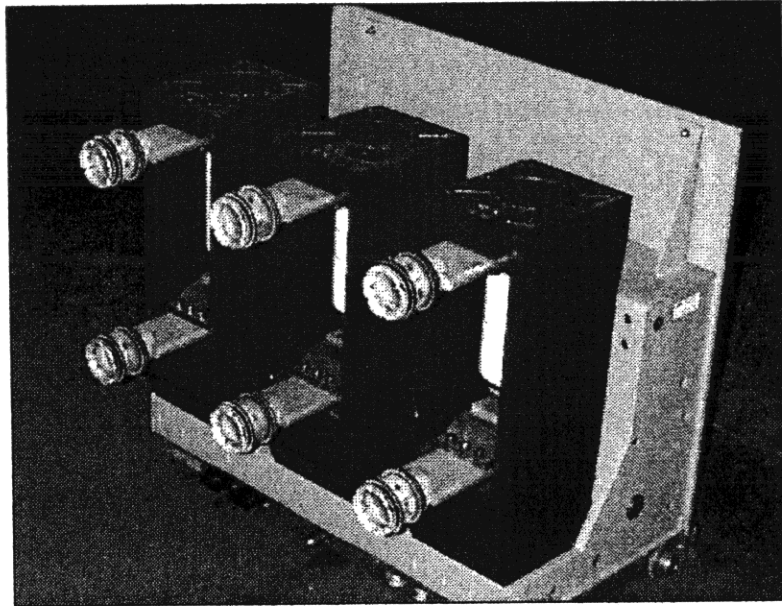


Figure 21. Primary Disconnects

Circuit Breakers.

Refer to ABB publication IB 6.2.12.7-1, "Installation/Maintenance Instructions for Medium Voltage Vacuum Power Circuit Breakers", for insertion and removal instructions.

AUXILIARY DRAWOUT MODULES

Auxiliary drawout modules are provided to mount the following drawout units.

Drawout Potential Transformers (PT)

Drawout Current Limiting Fuses for Control Power Transformers



Before attempting to insert a unit into a module, verify that all foreign objects, tools and debris have been removed and that there are no obstructions inside the module.

INSERTION

Insertion from the Withdrawn to the Disconnected position

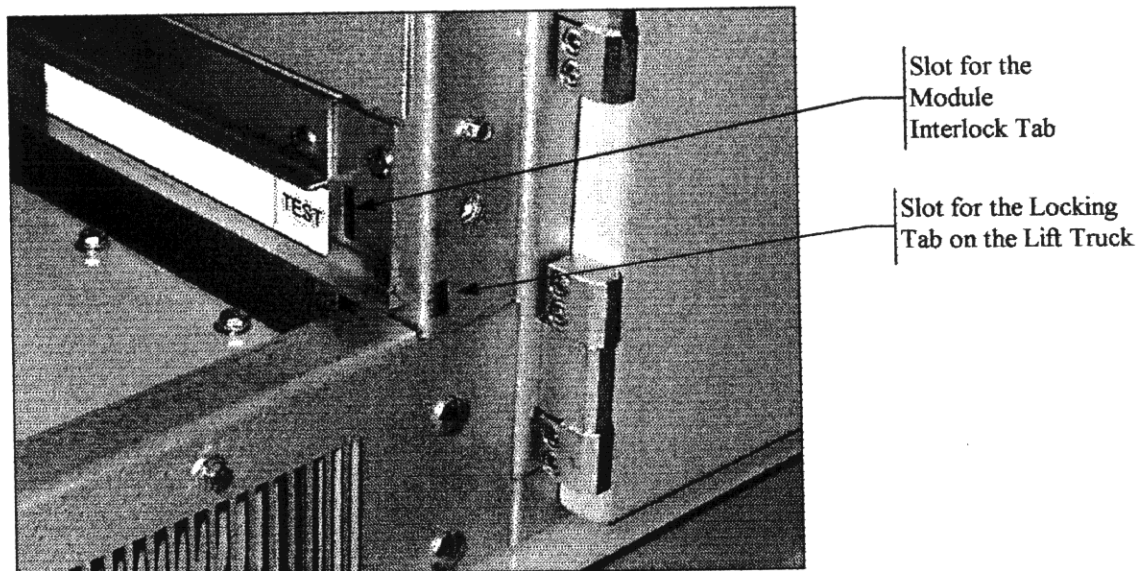


Figure 22. Interlock slots.

- Step 1.** Align the locking tabs of the lift truck with the slots in the front of the module (see Figure 22). Push the lift truck to the frame to engage the locking tabs with the module. Lower the truck slightly to lock in place. Set the lift truck brake. Try pulling the lift truck away from the frame to ensure that the locking tabs are firmly in place and that the brake is set.

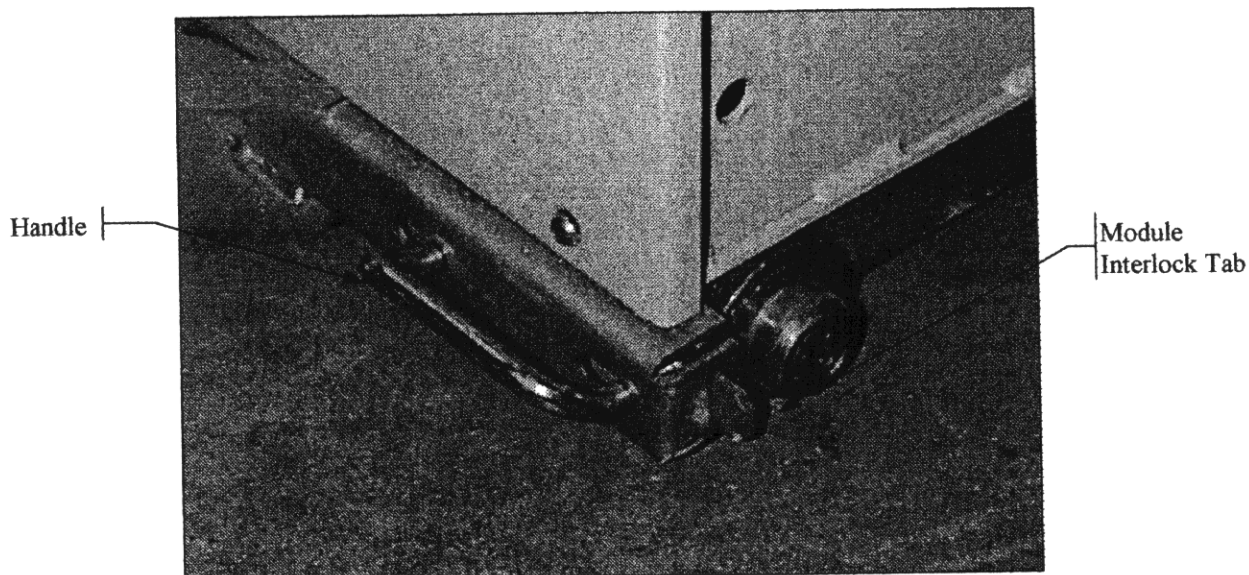


Figure 23. Module Interlock Tabs and Handles

- Step 2.** To release the unit from the lift truck, withdraw the Module Interlock Tabs by pulling the handles toward the center of the unit (see Figure 23).
- Step 3.** Push the drawout auxiliary unit into the module.
- Step 4.** Align the Module Interlock Tabs (Figure 23) with the auxiliary module slots (Figure 22).
- Step 5.** Engage the Module Interlock Tabs by returning the handles to their outward position.
- a. Verify that the Module Interlock Tabs are engaged in the auxiliary module slots.
- Note: The unit will not rack into the “connected” position if the Module interlock tabs are not properly engaged with the module.
- b. Push against both sides of the unit to verify that the tabs are locked into position.
 - c. The auxiliary unit is now in the Disconnected position.
- Step 6.** Disengage the lift truck and move away from frame.
- Step 7.** Close the door and secure all door bolts.

Insertion from the Disconnected to the Connected position (Racking)

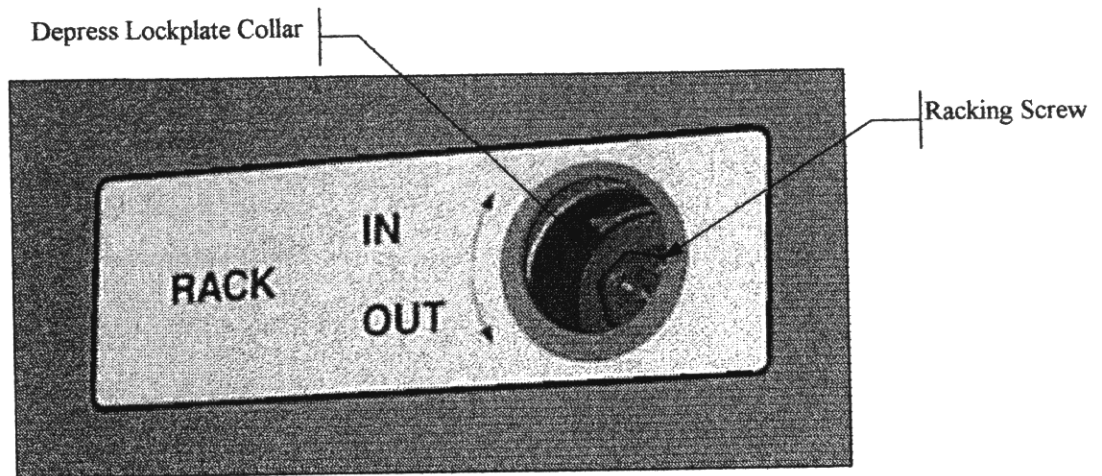


Figure 24. Auxiliary module racking screw and collar.

- Step 1.** Engage the Racking tool with the Racking Screw (Figure 24).
- Step 2.** Depress the Lock Plate Collar (Figure 24) with the racking tool.
- Step 3.** Rack the auxiliary unit into the Connected position by turning the Racking tool clockwise (CW) while maintaining pressure on the lockplate collar.

Note: As the unit approaches the Connected position, an increase in racking force is required to engage the primary contacts.



Once racking has begun, the movement should continue uninterrupted, to minimize arcing and wear of contacts.

Movement should be as smooth and continuous as possible to minimize contact wear. The arc-quenching design employed is capable of numerous load break operations, and is capable of functioning properly with reasonable pauses in the racking process. Consult the factory for additional information.

REMOVAL**Removal from the Connected to the Disconnected position (Racking).**

- Step 1.** Engage the Racking tool with the Racking Screw.
- Step 2.** Depress the Lock Plate Collar with the racking tool.
- Step 3.** Rack the auxiliary unit into the Disconnected position by turning the Racking tool counterclockwise (CCW).



Once racking has begun, the movement should continue uninterrupted, to minimize arcing and wear of contacts.

Movement should be as smooth and continuous as possible to minimize contact wear. The arc-quenching design employed is capable of numerous load break operations, and is capable of functioning properly with reasonable pauses in the racking process. Consult the factory for additional information.

Removal from the Disconnected to the Withdrawn position.

- Step 1.** Remove all door bolts and open the door.
- Step 2.** Align the locking tabs of the lift truck with the slots in the module. Push the lift truck to the frame to engage the locking tabs with the module. Lower the truck slightly to lock it in place. Set the lift truck brake. Try pulling the lift truck away from the frame to ensure the locking tabs are set firmly in place and that the brake is set.
- Step 3.** Withdraw the Module Interlock Tabs by pulling the handles to the center of the unit.
- Step 4.** Pull the unit out of the module using the handles that were pulled to the center in step 3.

8. ENCLOSURE SECURITY

WARNING

To maintain the Arc-Resistant performance of this equipment, it is essential that it be maintained in a state of good repair, that all doors and access panels are properly installed, and all bolts used to secure the doors and access panels are fully seated. Failure to do so can cause severe injury, death or substantial property damage.

Before energizing the equipment, verify the following:

1. The equipment is in a state of good repair, and there is no observable damage or distortion to the switchgear enclosures.
2. The doors and access panels close properly, and fit snugly against the enclosure frames.

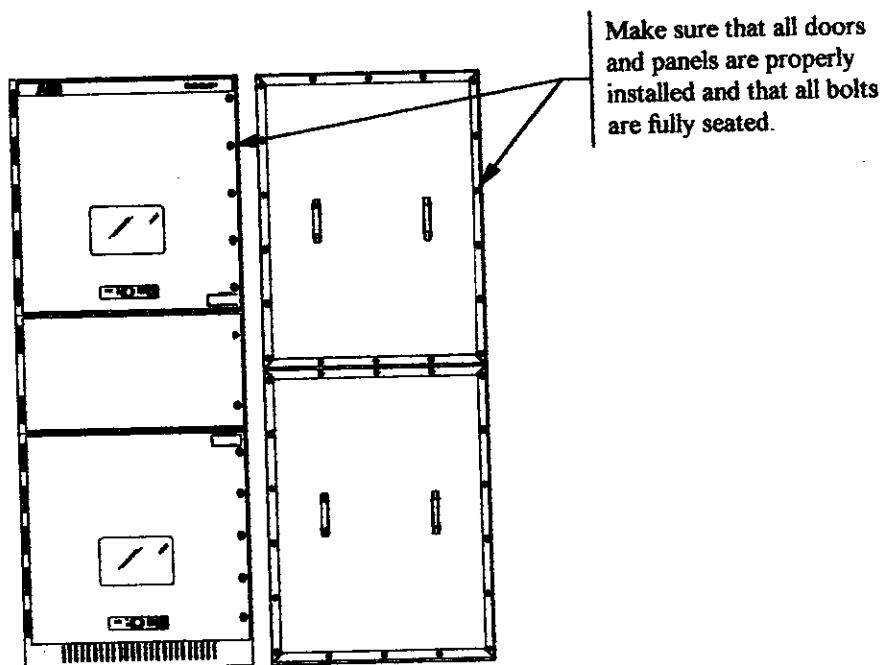


Figure 25. Typical front and rear view.

3. That all bolts used to secure the doors and access panels are tightened until they are fully seated.
4. That all inspection and test procedures have been successfully completed.

9. INSPECTION AND MAINTENANCE

WARNING

Before energizing, the equipment must be free and clean of all random foreign matter such as dirt and debris. There is a hazard of electrical shock and or burn whenever working in or around electrical equipment. All electrical power (both primary and control voltages) must be de-energized and grounded when work is to be done on switchgear. When an inspection or work is required on a circuit breaker, it must be removed from the switchgear. Failure to do so can cause severe injury, death or substantial property damage.

A regular general inspection at frequent intervals should be established to obtain the best service and reliability from the switchgear. Plant operations and local conditions will dictate the frequency of inspection required. Proactive steps should be taken to remedy any deficiencies identified during inspection. **PRIOR TO THIS INSPECTION DE-ENERGIZE ALL CIRCUITS.** The following checks in particular are emphasized.

1. Inspect all bolted connections, nut and screws for tightness.
2. Open all doors and remove all access panels.
3. Inspect all cables for tight connections and ample support.
4. Inspect control wiring for signs of wear and damage. Replace wires wherever doubtful.
5. Examine resistors and other devices prone to overheating.
6. Clean all insulation thoroughly.
7. Withdraw all drawout components and clean. (Refer to circuit breaker instruction bulletin for proper instructions)
8. Clean the stationary portion of the switchgear by wiping with a clean cloth. A compressed air hose will be useful in inaccessible areas.
9. Remove covers of all panel and surface mounted devices where practical. Check wiring for secure connections. Clean contacts on relays and switches wherever necessary. Replace covers.
10. Replace all panels and components. All door and access panel bolts must be in place and fully seated.

The finish used on SafeGear™ metal-clad switchgear enclosure parts is an aluminum-zinc alloy coating that is applied to cold rolled sheet steel. The finish used on the front door, bolted rear panels, barriers and end panels, etc. are phosphate treated and painted with an oven baked, corrosion resistant epoxy enamel. To touch up painted finish, after final erection, use touch up paint provided by ABB Distribution Systems Division, Switchgear Operations.

10. RENEWAL PARTS

WARNING

In the event of an internal electrical fault, which caused the Arc-Resistant features of the equipment to activate, the equipment should be thoroughly inspected (including the internal arc chamber) for damage and distortion. All parts found to have been damaged from the fault, should be replaced with factory original replacement parts. Do not attempt to repair damaged parts or substitute with used or unauthorized reproductions. Doing so can compromise the Arc-Resistant performance of the equipment, and can cause severe injury, death or substantial property damage.

Renewal parts should be ordered from ABB Distribution System Division, switchgear operation. The quantity of renewal parts to be stocked varies with the installation. Previous experience and the number of vertical sections in service are the best guides available. Specify the quantity, reference number, complete description of the parts and nameplate data of the device requiring these parts. Standard hardware, such as screws, bolts, nuts, washers, are items that should be bought locally.

For renewal parts, call: 1-800-929-SWGR

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