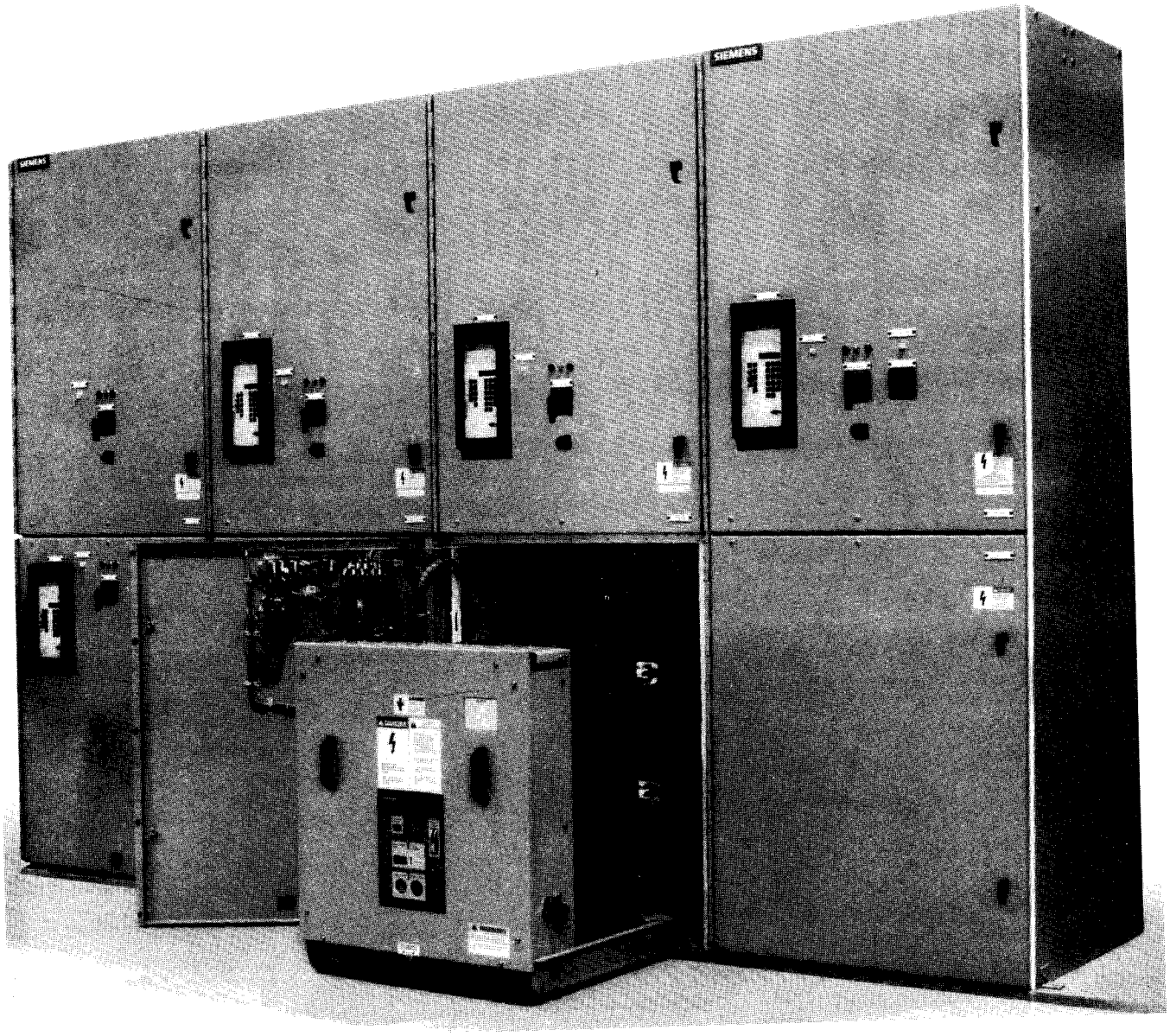
SIEMENS

5kV and 15kV Metal-Clad Switchgear

Type GM

Instructions
Installation
Operation
Maintenance
SGIM-3258B



⚠ DANGER

Hazardous voltages and high-speed moving parts.

Will cause death, serious personal injury or equipment damage.

Always de-energize and ground the equipment before maintenance. Read and understand this instruction manual before using equipment. Maintenance should be performed only by qualified personnel. The use of unauthorized parts in the repair of the equipment or tampering by unqualified personnel will result in dangerous conditions which will cause severe personal injury or equipment damage. Follow all safety instructions contained herein.

IMPORTANT

The information contained herein is general in nature and not intended for specific application purposes. It does not relieve the user of responsibility to use sound practices in application, installation, operation, and maintenance of the equipment purchased. Siemens reserves the right to make changes in the specifications shown herein or to make improvements at any time without notice or obligations. Should a conflict arise between the general information contained in this publication and the contents of drawings or supplementary material or both, the latter shall take precedence.

QUALIFIED PERSON

For the purpose of this manual a qualified person is one who is familiar with the installation, construction or operation of the equipment and the hazards involved. In addition, this person has the following qualifications:

(a) **is trained and authorized** to de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.

(b) **is trained** in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.

(c) **is trained** in rendering first aid.

NOTE

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

The contents of this instruction manual shall not become part of or modify any prior or existing agreement, commitment or relationship. The sales contract contains the entire obligation of Siemens Energy & Automation, Inc. The warranty contained in the contract between the parties is the sole warranty of Siemens Energy & Automation, Inc. Any statements contained herein do not create new warranties or modify the existing warranty.

5kV and 15kV Metal-Clad Switchgear

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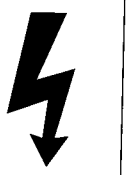
Introduction and Safety

Introduction

The GM family of 5-15kV Metal-Clad Switchgear is designed to meet all the applicable ANSI, NEMA and IEEE standards. Successful application and operation of this equipment depends as much upon proper installation and maintenance by the user as it does upon the careful design and fabrication by Siemens.

The purpose of this Instruction Manual is to assist the user in developing safe and efficient procedures for the installation, maintenance and use of the equipment.

Contact the nearest Siemens representative if any additional information is desired.



⚠DANGER

Hazardous voltages and high-speed moving parts.

Will cause death, personal injury or property damage.

To avoid electrical shock, burns and entanglement in moving parts this equipment must be installed, operated and maintained only by qualified persons thoroughly familiar with the equipment, instruction manuals and drawings. Read and understand this instruction manual before using equipment.

Qualified Person

For the purpose of this manual a **Qualified Person** is one who is familiar with the installation, construction or operation of the equipment and the hazards involved. In addition, this person has the following qualifications:

- Training and authorization to energize, de-energize, clear, ground and tag circuits and equipment in accordance with established safety practices.

- Training in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses, face shields, flash clothing, etc., in accordance with established safety procedures.

- Training in rendering first aid.

Signal Words

The signal words "**Danger**", "**Warning**" and "**Caution**" used in this manual indicate the degree of hazard that may be encountered by the user. These words are defined as:

Danger - Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

Warning - Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

Caution - indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

Dangerous Procedures

In addition to other procedures described in this manual as dangerous, user personnel must adhere to the following:

1. Always work on de-energized equipment. Always de-energize a breaker, and remove it from the switchgear before performing any tests, maintenance or repair.

2. Always perform maintenance on the breaker after the spring-charged mechanisms are discharged.

3. Always let an interlock device or safety mechanism perform its function without forcing or defeating the device.

Field Service Operation

Siemens can provide competent, well-trained Field Service Representatives to provide technical guidance and advisory assistance for the installation, overhaul, repair and maintenance of Siemens equipment, processes and systems. Contact regional service centers, sales offices or the factory for details, or telephone Siemens Field Service at 1-800-241-4453.

General Description

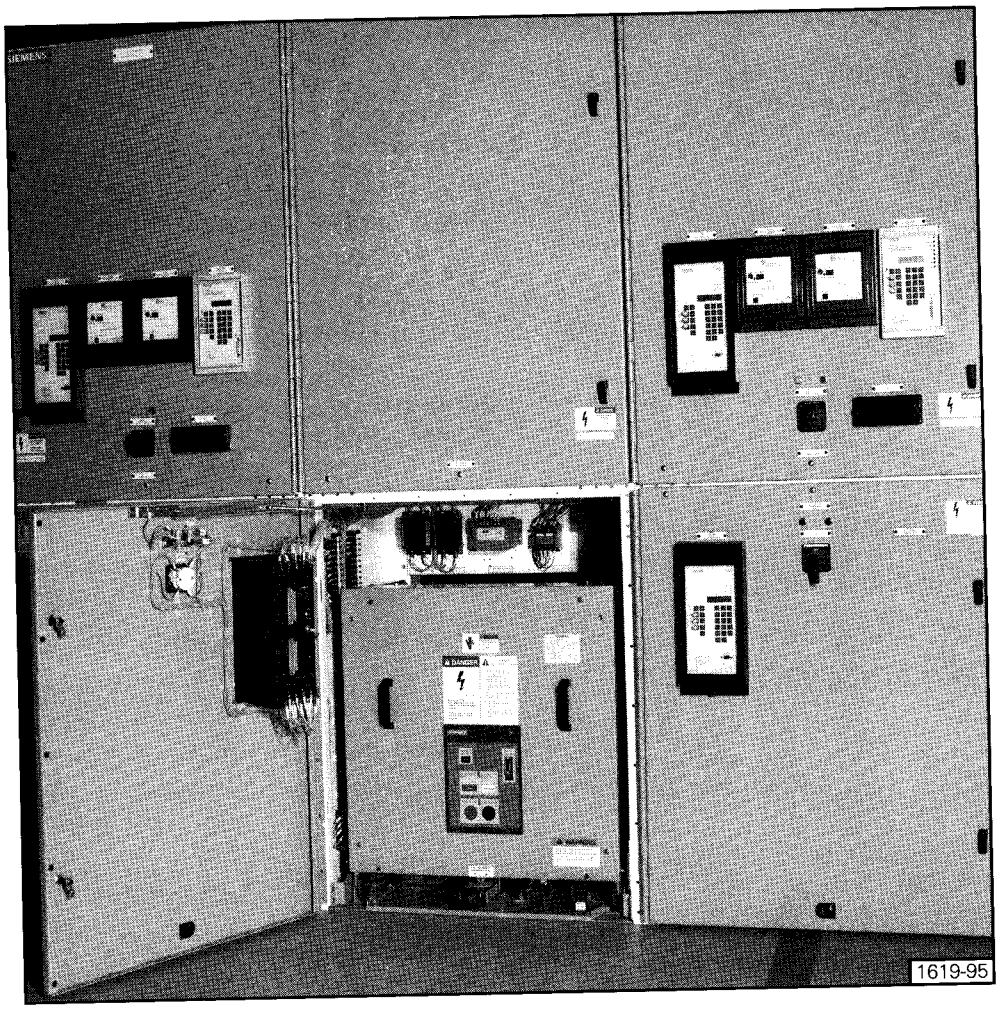


Figure 1. Typical Indoor Type GM Switchgear

Introduction

The successful performance and application of Metal-Clad Switchgear depends as much on proper installation and maintenance as it does on good design, careful manufacture and correct application.

Siemens Type GM Metal-Clad Switchgear is precision built equipment designed to function efficiently under normal operating conditions. It is designed and manufactured to operate within the ANSI C37 standards for Metal-Clad Switchgear. Performance requirements of these standards have been met or exceeded by these designs. The principal standard which applies to this class of switchgear is ANSI C37.20.2, Metal-Clad Switchgear.

The instructions included in this manual are provided to aid you in obtaining longer and more economical service from your Siemens switchgear. For proper installation and operation, this information should be distributed to your operators and engineers.

By carefully following these instructions, difficulties should be avoided. However, they are not intended to cover all details of variations that may be encountered in connection with the installation, operation and maintenance of this equipment.

Should additional information be desired, including replacement instruction books, contact your Siemens representative.

General Description

Scope
These instructions cover the installation, operation and maintenance of Siemens type GM metal-clad switchgear assemblies, using vacuum horizontal drawout circuit breakers. The equipment designs described in this manual include indoor, Shelter-Clad walk-in aisle outdoor, and non-walk-in outdoor configurations for application up to 15kV. A typical indoor switchgear assembly is shown in **Figure 1**. All diagrams, descriptions and instructions apply to all the above classes and designs unless noted otherwise.

Standard construction details of the switchgear, auxiliary equipment and necessary accessories are given in the appropriate sections. Special mechanical and electrical devices, furnished in accordance with purchase order requirements, are covered by supplementary instructions submitted with this instruction book.

The equipment furnished has been designed to operate in a system having the circuit capacity specified by the purchaser. If for any reason the equipment is later used in a different system, or if the short-circuit capacity of the system is increased, the momentary rating of the switchgear, the interrupting capacity of the circuit breakers and the bus capacity must be checked. Failure on the part of the user to receive approval of intended changes from Siemens may cause voiding the warranty.

General Description
The switchgear described in this manual is of the metal-clad type, as defined in ANSI C37.20.2. All parts are completely enclosed within grounded metal barriers. Secondary control devices and primary circuits are isolated from each other by shutters or barriers. Primary bus and joints are completely encased with insulation materials to suit the voltage class of the equipment.

Siemens switchgear carries a type designation, or class, as shown in **Table 1**. These designations may appear on drawings and familiarity with them will simplify communications with the factory.

Indoor equipment is arranged with upper and lower compartments in the front of the equipment. Generally, either or both compartments may contain a drawout circuit breaker, located behind a front panel which is used for relays, instruments, and similar devices. The front panel may be opened to provide access to the circuit breaker or interior auxiliary equipment, such as voltage transformers, or control power transformers. Typical indoor switchgear is shown in **Figure 1**.

Table 1. Switchgear Designation

DESIGN	TYPE
Indoor	GM
Shelter-Clad Single Aisle Outdoor	SGM
Shelter-Clad Common Aisle Outdoor	SGM
Non-Walk-In Outdoor	OGM

Shelter-Clad outdoor equipment consists of indoor equipment enclosed in a weather resistant housing complete with an illuminated, walk-in aisle. Circuit breakers can be moved inside the aisle and control devices checked without exposure to the elements.

Non-Walk-In outdoor switchgear consists of indoor equipment enclosed in a weather resistant housing complete with a gasketed outer door over the inner front panels. Circuit breakers can be moved outside of the cubicles with the use of a lift truck or similar handling device. Non-Walk-In outdoor equipment is used where it is felt that an enclosed service aisle is unnecessary, or space does not permit its use.

Receiving, Handling & Storage

Receiving
Each group of type GM metal-clad switchgear is securely blocked and braced for shipment. It is crated, boxed, or covered as required by shipping conditions. Whatever method of shipment, every precaution is taken to insure its safe arrival. If special handling is required, it is so indicated. Relatively delicate instruments are included and the switchgear assembly must be handled carefully when unloading.

Normally, the switchgear is shipped with the associated type GMI vacuum circuit breakers installed in their respective units, in the CONNECT position. Refer to instruction manual SG-3268 for information concerning the type GMI circuit breakers.

Identification
When the shipment includes more than one shipping group or equipment for more than one substation, marking tags are attached to each crate or package for identification. The drawing number on the tag is also on the shipping list. The shipping list identifies the contents with the unit numbers included in the shipping group. Refer to the general arrangement drawing for the location of each unit within the group lineup. Use this information to simplify the assembly operation and save unnecessary handling.

Inspection and Unpacking
Inspect the equipment as soon as possible after receiving for any damage that may have occurred in transit. Before unpacking, examine the package itself, as a damaged package may indicate an area of damage within. Be careful when unpacking equipment. The use of sledge hammers and crowbars may damage the finish, if not the equipment itself. Use nail pullers. After unpacking, examine equipment for any possible damage. Check the shipping manifest to be certain that all items have been received. If there is a shortage, make certain it is noted on the freight bill and contact the carrier immediately. Notify the Siemens sales office of any shortage or damage.

Shipping Damage Claims

Important: The way visible shipping damage is treated by consignee prior to signing the delivery receipt can determine the outcome of the damage claim to be filed.

Notification to carrier within the 15 day limit on concealed damage is essential if loss resulting from unsettled claims is to be eliminated or minimized.

1. When shipment arrives, note whether equipment is properly protected from the elements. Note trailer number on which the equipment arrived. Note blocking of equipment. During unloading, make sure count agrees with delivery receipt.

2. Make immediate inspection for visible damage upon arrival, and prior to disturbing or removing packaging or protective wrapping. This should be done prior to unloading when possible. When total inspection cannot be made on vehicles prior to unloading, close inspection during unloading must be performed and visible damage noted on the delivery receipt. Take pictures if possible.

3. Any visible damage must be noted on the delivery receipt and acknowledged with the driver's signature. The damage should be detailed as much as possible. It is essential that a notation "Possible internal damage, subject to inspection" be included on delivery receipt. If the driver will not sign the delivery receipt with damage noted, the shipment should not be signed for by the consignee or his agent.

4. Notify the Siemens sales office immediately of any damage.

5. Arrange for a carrier inspection of damage immediately.

   Important: Do not move equipment from the place it was set when unloading. Also, do not remove or disturb packaging or protective wrapping prior to carrier damage inspection. Equipment must be inspected by carrier prior to handling after receipt. This eliminates loss due to claims by carrier that equipment was damaged or further damaged on site after unloading.

6. Be sure equipment is properly protected from any further damage by covering it properly after unloading.

7. If practical, make further inspection for possible concealed damage while the carrier's inspector is on site. If inspection for concealed damage is not practical at the time the carrier's inspector is present, it must be done within 15 days of receipt of equipment. If concealed damage is found, the carrier must again be notified and inspection made prior to taking any corrective action to repair. Also notify Siemens sales office immediately.

8. Obtain the original of the carrier inspection report and forward it along with a copy of the noted delivery receipt to the Siemens sales office. Approval must be obtained by Siemens from the carrier before any repair work can be performed. Before approval can be obtained, Siemens must have the documents. The carrier inspection report and/or driver's signature on the delivery receipt does not constitute approval to repair.

Note: Any adverse judgment as to whether the equipment was properly loaded or properly prepared by shipper for over-the-road travel cannot be made at the destination. Shipments are not released from the factory without a clear bill of lading. Approved methods are employed for preparation, loading, blocking and tarping of the equipment before it leaves the Siemens factory. Therefore, if the equipment is received in a damaged condition, this damage to the equipment had to occur while enroute due to conditions beyond Siemens control. If the procedure outlined above is not followed by the consignee, purchaser, or his agent, Siemens cannot be held liable for repairs. Siemens will not be held liable for repairs in any case where the work was performed prior to authorization from Siemens.

Lifting and Moving

There are a number of methods that can be used in handling the switchgear which when properly employed will not damage the switchgear sections. The handling method used will be determined by conditions and available equipment at the installation site. Lifting with a crane is the preferred method of handling, however, overhead obstructions or low ceilings often dictate the method to be used. Rollers, jacks or fork lift trucks may be used prior to removal of wooden skids.

⚠WARNING

Heavy Weight.

Can cause death, personal injury, or property damage.

Observe all handling instructions in this instruction manual to prevent tipping or dropping of equipment.

Each group of switchgear has provisions for attaching lifting equipment. Though the lift points vary in location on indoor, Shelter-Clad outdoor, and non-walk-in outdoor designs, all are designed for use with a crane of adequate height and capacity. To estimate the maximum required crane capacity, multiply the number of sections to be lifted by 5,000 pounds.

A drawing pocket (or holder) is provided on each lineup of switchgear. This drawing pocket includes a general arrangement drawing of the switchgear lineup, plus a drawing with installation and handling instructions for the equipment. The drawing pocket is normally located at the left end of the lineup. Review this information carefully before moving the equipment.

Indoor Switchgear

Before removing the protective packing materials, indoor equipment may be moved by crane with lift cables attached through the packaging to the lifting bars on the top of the switchgear. If crane facilities are unavailable, or if tight spaces prevent use of a crane, rollers under the skids may be used.

Lifting Indoor Switchgear with Crane

Recommended lifting of indoor switchgear is by means of cables connected to an overhead crane. The cables are connected to the eyes in the top lifting bars. One set of lifting bars is located near the front of the switchgear, while another set of lift bars is located closer to the middle of the switchgear, as illustrated in **Figure 2**. A crane with sufficient height should be used so the load angle (from horizontal) on the lifting cables will be at least 45 degrees, when viewed from the front or the rear. A lesser angle could cause the equipment to be damaged. The lifting cables must have spreaders from front to rear to prevent twisting the lift bars.

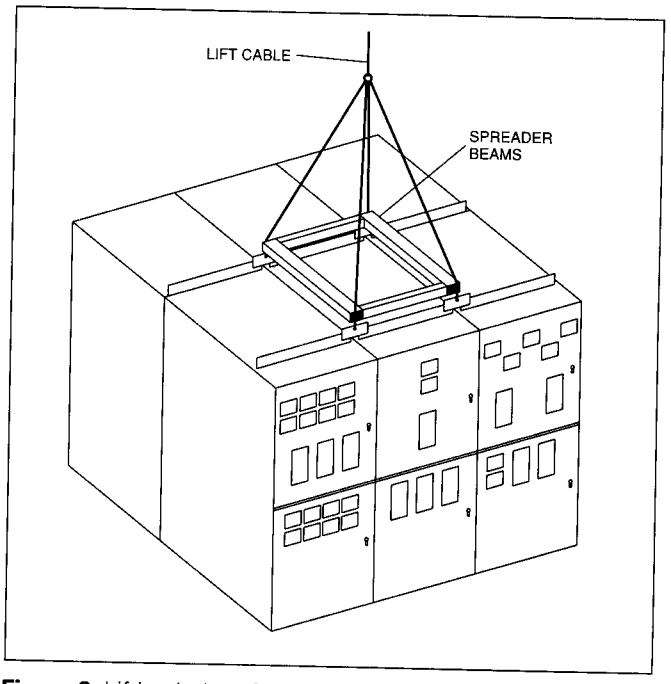


Figure 2. Lifting Indoor Switchgear - with Crane

Moving Switchgear in Obstructed Areas without a Crane

Within buildings and obstructed areas, where a crane cannot be used, move switchgear with rollers, cribbing, jacks and other such equipment as may be required to meet the situation. Forklift trucks should be used with discretion as improper lift points could cause extreme damage to equipment. For this reason, **use of a forklift truck to handle or move switchgear is not recommended.**

Jacks may be used to lift switchgear which is properly supported by sturdy timbers.

To prevent distortion of the cubicles, rollers and cribbing of equal height must be used in sufficient number to evenly distribute the load.

Figure 3 shows a method of using jacks on indoor switchgear to facilitate the use of rollers under the shipping skid. Care must be used to prevent damage to instruments and to maintain the stability of the timbers.

Remove rollers and lower switchgear carefully. Leave wooden skids (when provided) in place during moving operation until final location is reached.

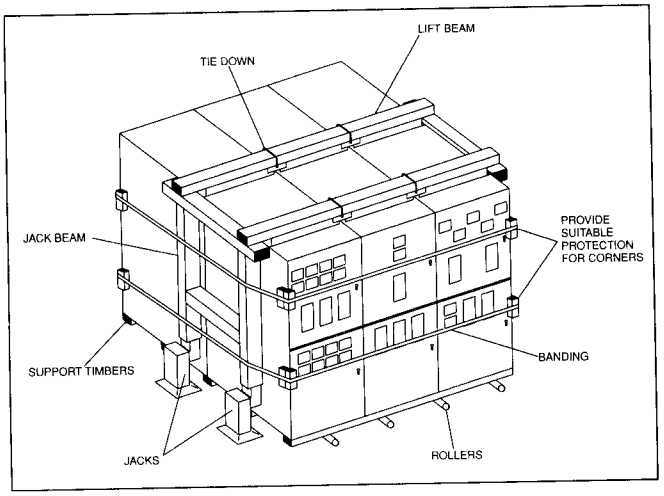


Figure 3. Moving Switchgear with Jacks and Rollers

Figure 4 shows a method of moving the switchgear into the final position, after it has been moved near to the final position using another method.

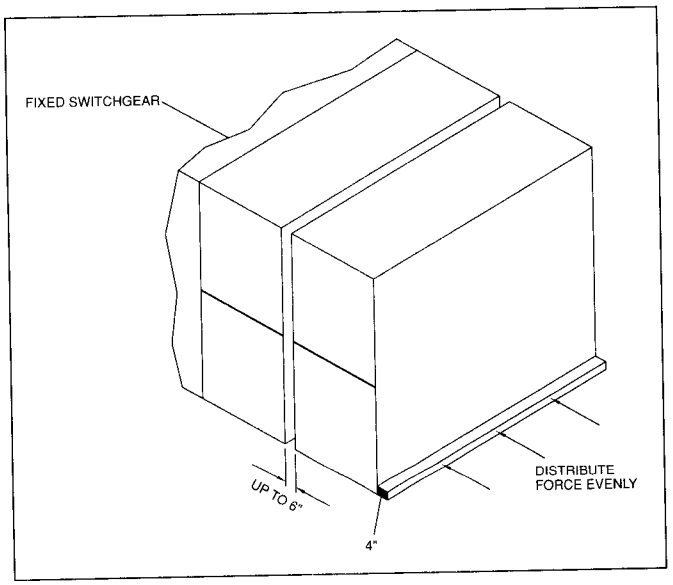


Figure 4. Moving Switchgear in Obstructed Areas without a Crane—Final Positioning

Outdoor Switchgear

The method of lifting non-walk-in or Shelter-Clad outdoor equipment is shown in **Figure 5**. The load angles (from horizontal) on the lifting cables, as viewed from the front or rear, must be at least 45 degrees. A lesser angle could damage the equipment. The lifting cables must have spreaders front to back and side to side to protect the equipment.

The recommended lifting pipe size (Ref. ASTM A-53) is type XXS 2-1/2" nominal (2.875" (73mm) OD, 1.771" (45mm) ID). The lifting pipe should be at least 18" (457mm) longer than the depth of the switchgear, and should include adequate means to prevent the lifting cables from slipping off of the lifting pipe during use.

Figure 6 shows a method of using jacks on outdoor switchgear to facilitate the use of rollers under the shipping skid. Care must be used with this method to prevent damage to the doors and to maintain stability of the timbers. Refer to previous section for additional information.

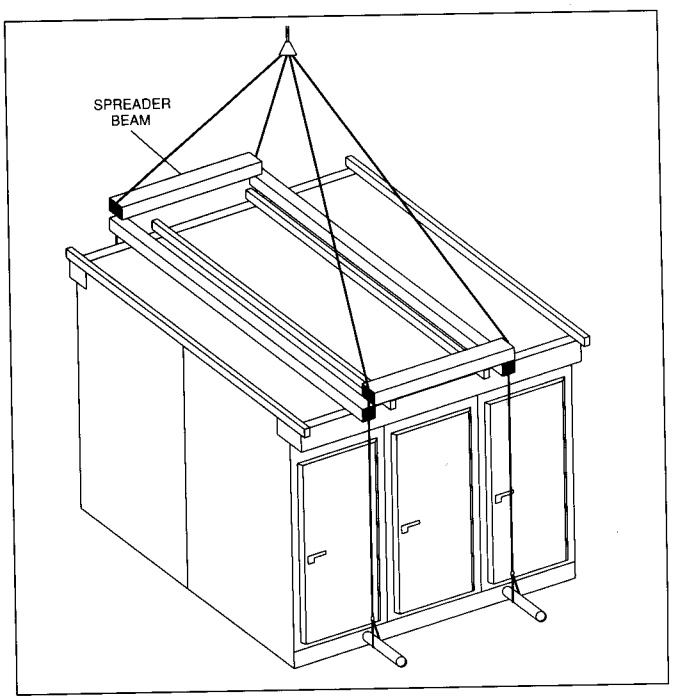


Figure 5. Lifting Outdoor Switchgear with Crane

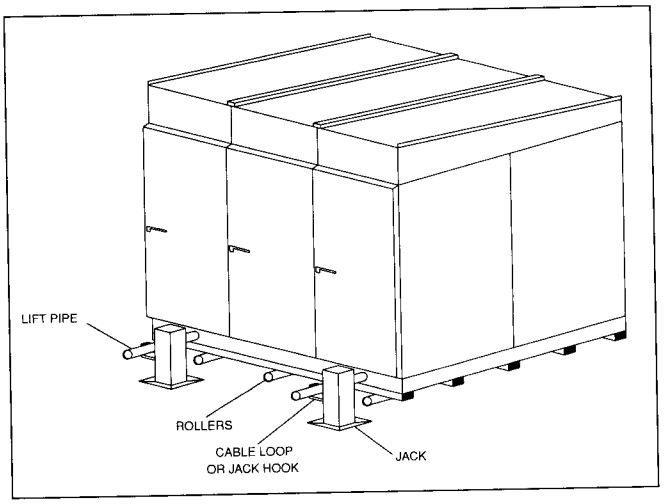


Figure 6. Moving Outdoor Switchgear with Jacks and Rollers

Final Movement of Assembly
Proper final movement and connection of the assembly requires that several items be completed:

1. Preplan sequence of installation movements and connections.
2. Where equipment must be slid into final location, start with the left end shipping group and continue in sequence. Secondary conduits which stub-up above floor level may block sliding.
3. Protect equipment and external items from damage during movement. Be sure to have smooth, unobstructed surfaces where the equipment is to be slid. Keep access openings clear.
4. Prepare for the connections across shipping splits before the equipment is moved into final position. Interunit bus supports and bus joint boots should be removed using side, rear and front access options as required. Note the mounting position and orientation and save hardware for use in reinstallation.
5. Thread coiled wires across shipping splits into interunit wire trough prior to moving equipment into its final position.
6. Where top lift capability is available, shipping pallets and other packaging materials may be removed before the last move into the final position.
7. Where top lift capability is not available, protect the switchgear bottom with support timbers and move with jacks and rollers just to the side of its final position. Remove rollers, shipping pallets and other packaging materials and remove jacking facilities. Clear any obstructions. The equipment may be slid sideways up to 6 inches (152mm) to join the shipping split. Any sliding force must be carefully applied across the bottom 4 inches (100mm) of the switchgear side with proper cribbing to fully distribute the force across the full depth of side. See **Figure 4**.
8. See "Installation" section for additional important information.

Storage: Indoor Switchgear
When switchgear is not to be installed immediately, it should be unpacked, inspected within 15 days of receipt and stored in a clean dry location. Indoor switchgear is neither weather resistant nor drip resistant. Therefore, it should be stored indoors. If it is to be kept in a humid or unheated area, provide an adequate covering and place a heat source of approximately 500 watts output within each vertical section to prevent condensation. Space heaters are not standard equipment on indoor switchgear. Lubricate any moving parts such as hinges, shutters, etc., if storage is for an extensive period of time. When batteries are supplied, connect them to a charger.

Storage: Shelter-Clad Outdoor Switchgear
When it is necessary to store Shelter-Clad outdoor equipment in a location exposing it to the weather, or in a humid location, energize the space heaters provided within the sections and make certain that louvers and vents are uncovered to allow air to circulate. If at all possible, erect the aisle section and install the switchgear at the permanent location even though it may be some time before the equipment is used. If the equipment cannot be erected at the permanent location immediately, cover shipping splits to protect from the elements.

Regardless of what method of storage is used, remove the aisle wall from in front of instrument panels to gain access to the space heater circuit so that heaters can be energized. Refer to wiring diagram drawing for space heater circuit connections. Replace the aisle wall and seal from the elements, or cover for protection from the weather. Connect batteries (if provided) to a charger. Lubricate hinges, shutters, and other moving parts.

Storage: Non-Walk-In Outdoor Switchgear
When it is necessary to store non-walk-in outdoor switchgear in an area exposed to the weather or under humid conditions, energize the space heaters provided and make certain that louvers and vents are uncovered to allow air to circulate. If at all possible, erect the switchgear at the permanent location even though it may be some time before the equipment is used. If the equipment cannot be erected at the permanent location immediately, cover shipping splits to protect from the elements.

Access to the heater circuit is gained by opening the door to the instrument panel compartment. Refer to wiring diagram drawing for space heater circuit connections. Connect batteries (if provided) to a charger. Lubricate hinges, shutters, and other moving parts.

Storage: Type GMI Vacuum Circuit Breakers and Lift Truck
Vacuum circuit breakers, if not installed in their respective switchgear compartments, must be stored indoors. Outdoor storage of circuit breakers (other than inside their respective switchgear compartments) is NOT RECOMMENDED.

If furnished, the lift truck for handling circuit breakers should be stored indoors. The lifting mechanism can be damaged by extended outdoor storage. For short term (30 days or less) storage, the lift truck may be stored outdoors, provided that it is adequately covered to protect it from the weather.

Installation

Preparation for Installation
Prior to installation of switchgear, study this instruction book and the switchgear drawings, such as general arrangement, three line diagram, schematic diagrams, wiring diagrams, installation instruction drawing, panel arrangement and panel arrangement bill of material, nameplate engraving list, and accessories drawing. Special attention should be given to the foundation information contained in this manual as well as the information provided on the equipment drawings. Be sure that the foundation conforms to the requirements described in this manual and the general arrangement drawing.

Foundation-General Requirements
Prior to installation of the switchgear, careful design, planning and construction of the foundation or base on which the switchgear will rest must be made. A thorough analysis and careful construction may alleviate many problems at the time of installation, and during operation. It is important that a true and level surface be provided, capable of supporting the weight of the switchgear and other related equipment.

If the switchgear cannot be lowered over conduits because of headroom or other restrictions, conduit couplings may be grouted in flush with foundation, and conduit nipples added after the switchgear is in place.

Conduits should be capped during construction to prevent entry of dirt, moisture and vermin.

All sill channels, bed plates, shims and anchoring hardware are furnished by purchaser unless covered by contract.

Indoor Foundations
As it is difficult to obtain a true and level floor on a concrete slab, it is highly recommended that 4" (minimum) sill channels be grouted into the floor as shown in **Figure 7**. The surface of the sills should be slightly above floor level. The surfaces of the sills must be level and in the same horizontal plane within 1/16" (1.6mm). There should be no projection above this plane within the area covered by the switchgear. If the floor or sills do not meet this requirement, it will be necessary to use shims when installing the switchgear on the mounting surface.

Figure 7 illustrates the location for sill channels for anchoring indoor switchgear. Cubicles may be anchored to sills by use of 1/2" (or 12mm) diameter anchor bolts, or welded in position.

Outdoor Foundations
Whichever type of foundation is used (e.g., concrete slab, sill channels, piers or pilings), it must have smooth and level surfaces. Surfaces supporting the switchgear must be in the same horizontal plane within 1/16" (1.6mm). If these conditions are not met, it will be necessary to use shims when installing the switchgear.

For outdoor switchgear, support shall be provided at each end and at the side of every second cubicle, so that the span between supports does not exceed 36" (914mm). Refer to **Figures 8** and **10**, and the switchgear general arrangement drawing for locations of support and anchoring points. If pilings are used, the diameter is to be determined by purchaser, however, they should not be less than 12" (305mm) diameter for sufficient contact, room for anchor bolts, and grouting in of bed plates (if used). All shipping splits must be properly supported.

Any conduits which are installed in concrete must be perpendicular to switchgear mounting surface. Conduits should extend a minimum of 6-3/4" (171mm) to a maximum of 7-1/2" (190mm) above mounting surface. This will allow the conduit to enter the cubicle and exclude entry of water and rodents.

Figures 8-9 show the method of anchoring outdoor Shelter-Clad (walk-in) switchgear, and **Figure 10** shows the method of anchoring outdoor non-walk-in switchgear.

Important: In the switchgear primary entrance area, steel reinforcing rods or mesh in concrete must not pass through the space shown on the general arrangement drawing, even though cored or bored holes in concrete may miss rods or mesh. A single phase of a system should not be encircled by ferrous metals.

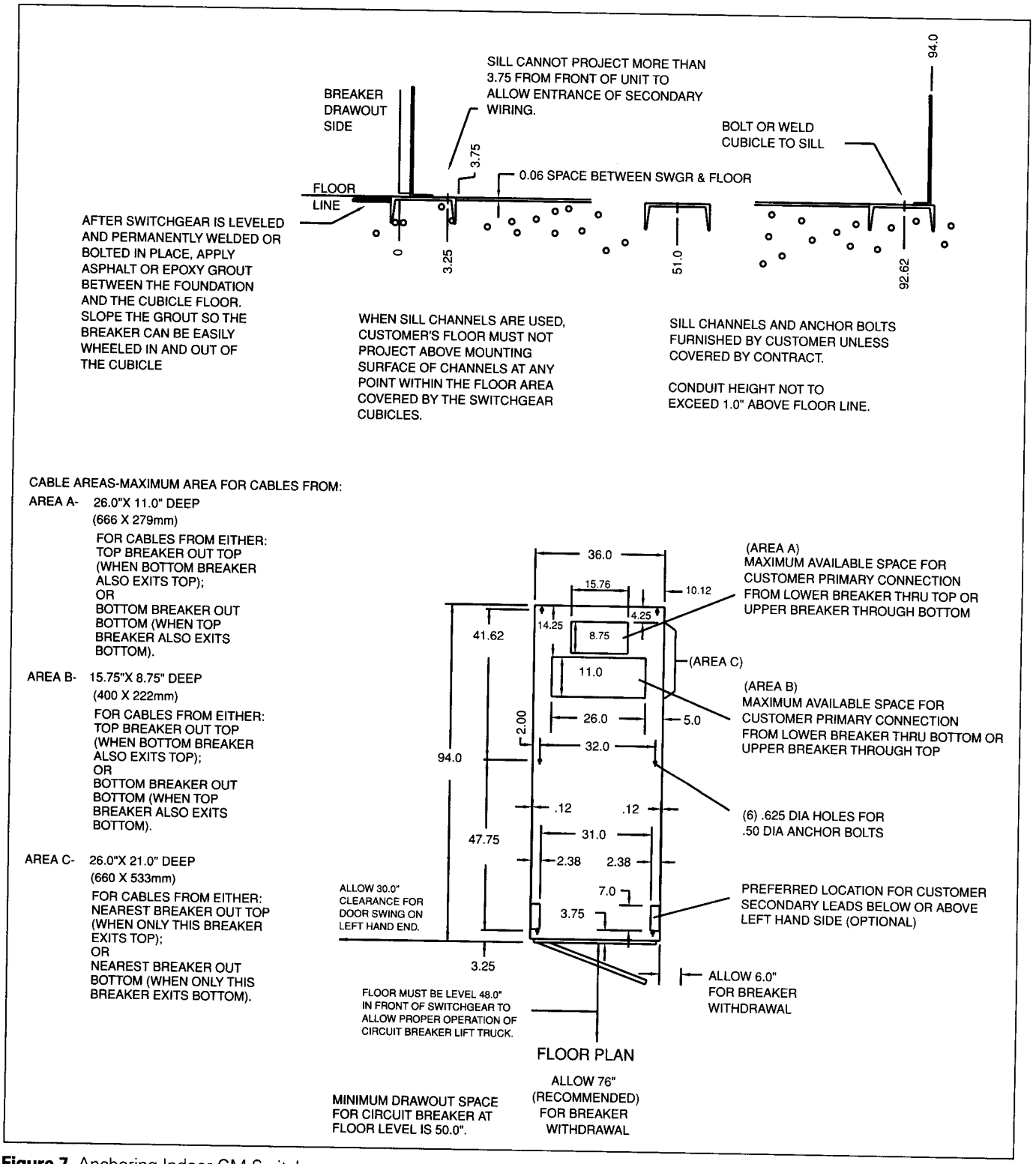


Figure 7. Anchoring Indoor GM Switchgear

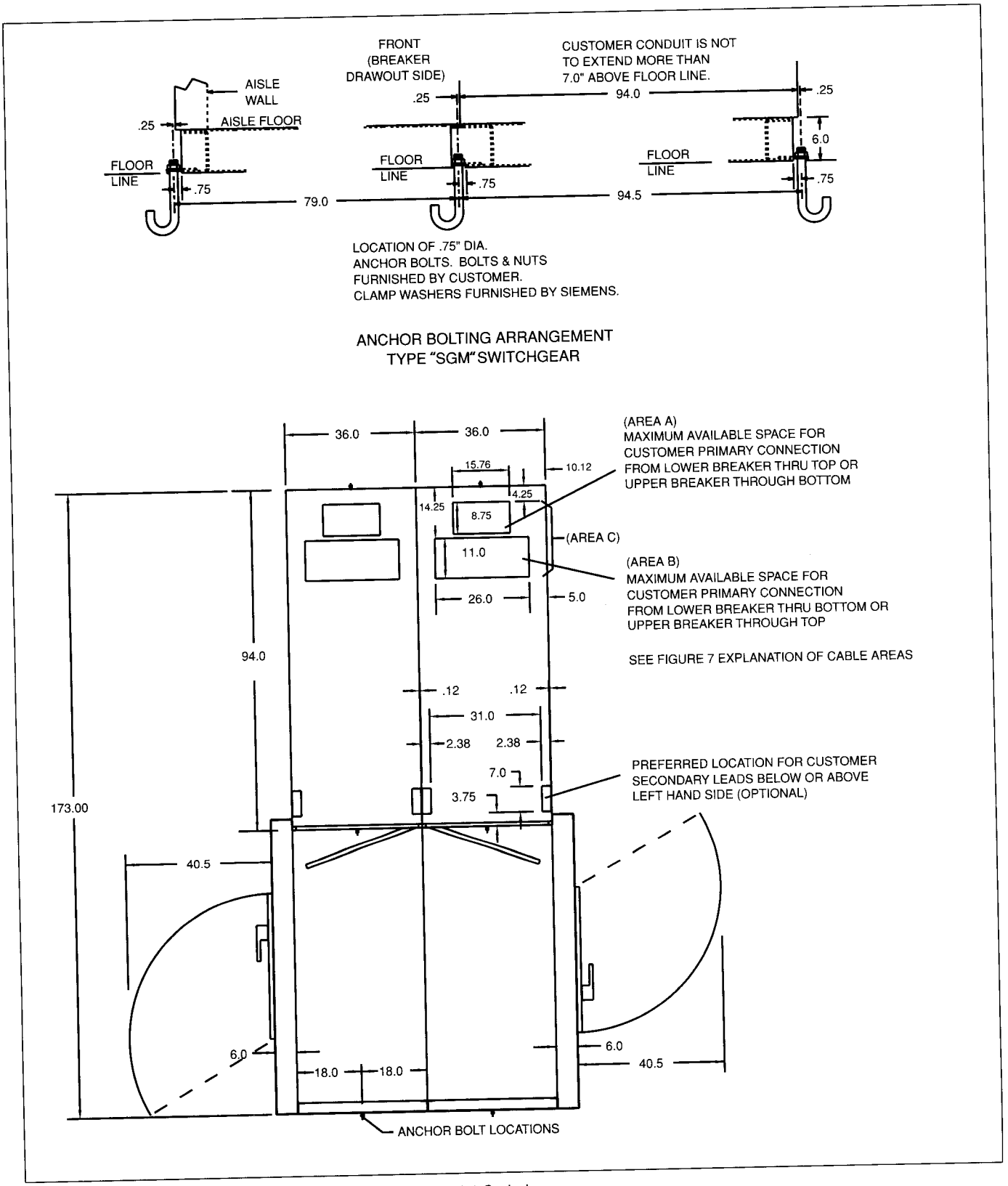


Figure 8. Anchoring Outdoor SGM Shelter-Clad (single aisle) Switchgear

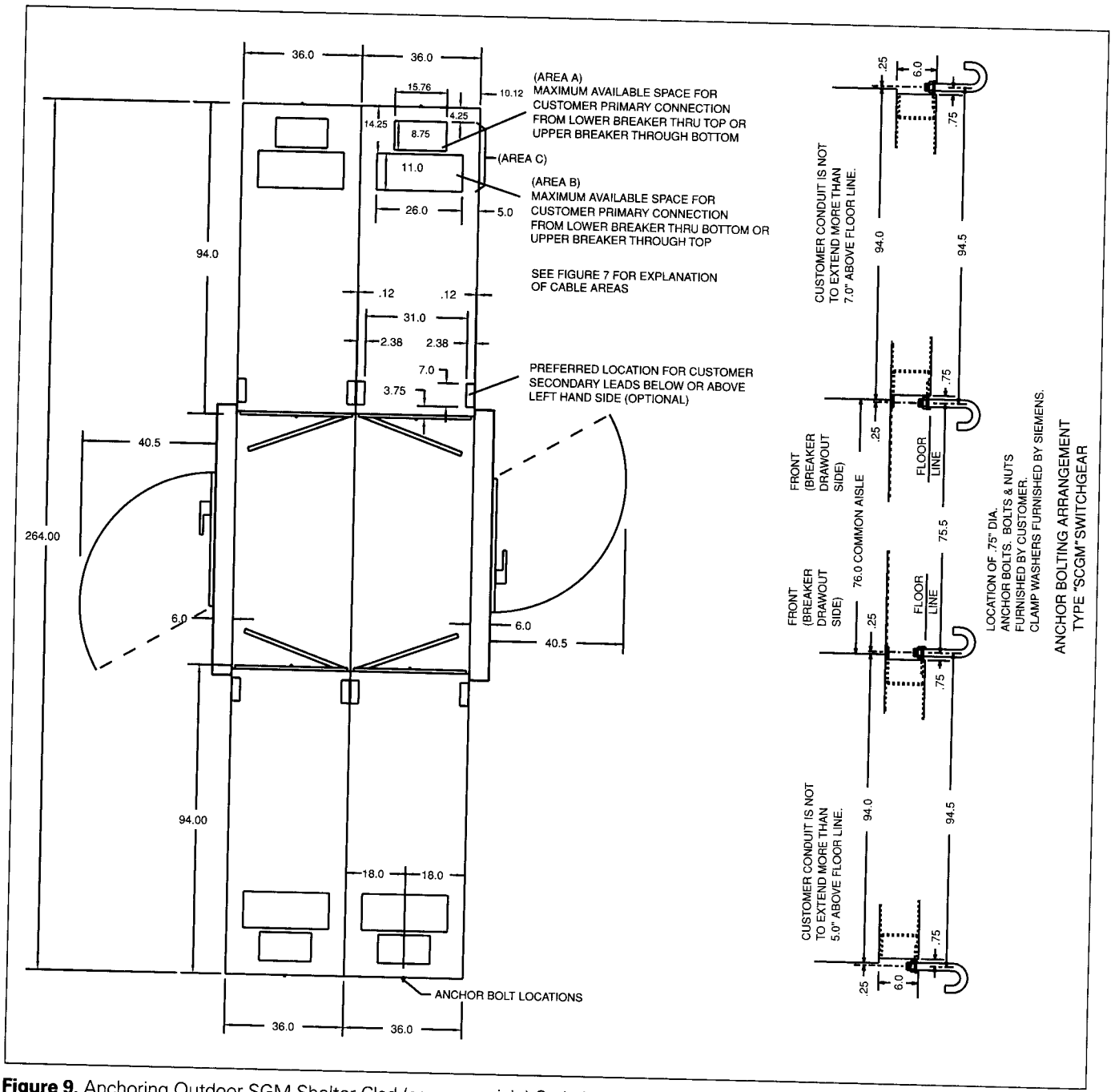


Figure 9. Anchoring Outdoor SGM Shelter-Clad (common aisle) Switchgear

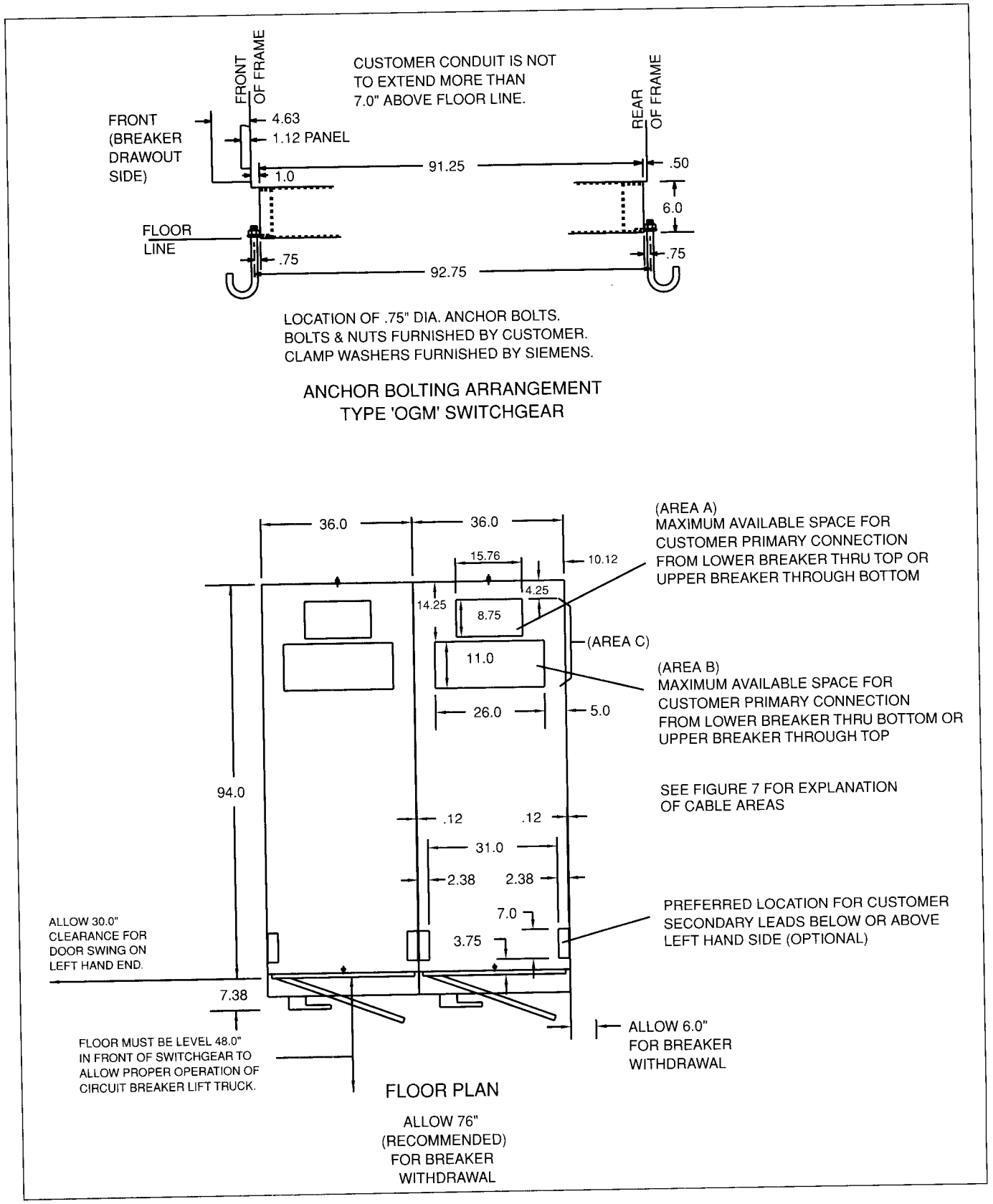


Figure 10. Anchoring Outdoor OGM Non-Walk-In Switchgear

Installing Shipping Sections

The proper method of installation depends on whether the switchgear has been shipped as one complete group, or in two or more shipping sections. The general arrangement drawings will indicate the shipping sections, cubicle numbers and their location within the switchgear lineup. Sections are assembled and wired in accordance with the arrangement as in the final installation.

Before setting and erecting the cubicles, determine the correct location of each shipping group on the general arrangement drawing. Sweep the mounting surface to remove all dirt and debris.

Installing Switchgear with Throat Connection to Power Transformer

When a transformer is connected to switchgear using a throat connection, the switchgear should be positioned next to the transformer as shown in **Figure 11**. It is very desirable that the switchgear be placed in position first, and then position the transformer.

If the transformer must be positioned first, conduit couplings should be provided in the switchgear foundation, so that the conduits do not extend more than approximately 2" (51mm) above the switchgear mounting surface. The switchgear should be positioned near the transformer, and just high enough to clear the secondary conduits, but low enough that the throat on the switchgear will clear the opening in the transformer terminal chamber (throat). When the switchgear is properly positioned so that the switchgear throat will fit into the transformer throat, move the switchgear toward the transformer until the switchgear throat extends approximately 2" (51mm) into the transformer throat, and the switchgear anchor bolts and conduits are correctly aligned. With all points now in alignment, conduit caps and floor plate conduit covers removed, carefully lower the switchgear into its permanent position. After all leveling and anchoring operations for the switchgear are complete, draw the sliding throat collar of the switchgear throat into place against the transformer throat. Tighten the throat hardware only enough to compress the gasket.

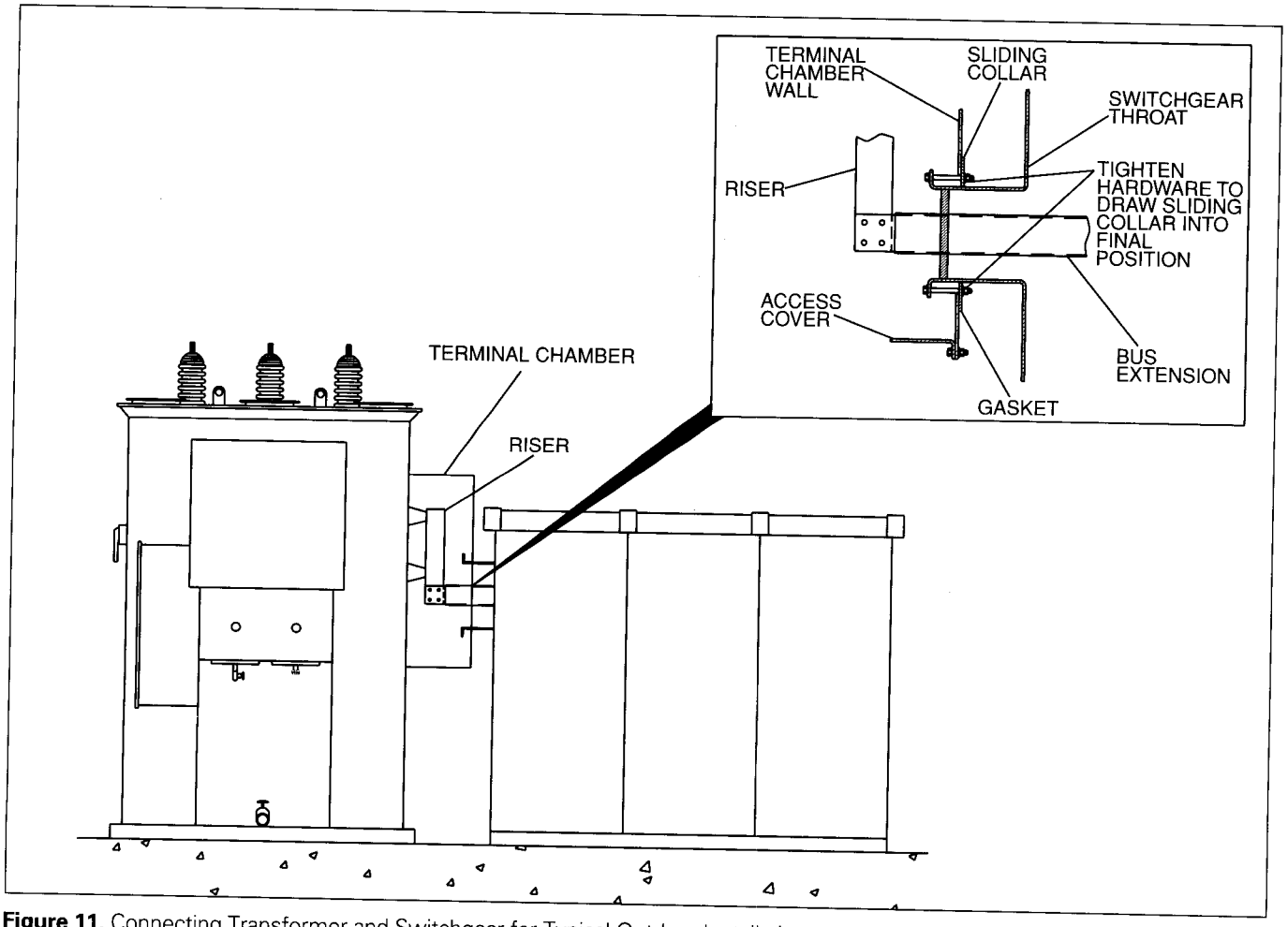


Figure 11. Connecting Transformer and Switchgear for Typical Outdoor Installation

Anchoring, Leveling, and Assembling Indoor Switchgear
Indoor switchgear shipping groups are held in true alignment by bolts holding the vertical sections to each other.

The entire shipping group is to be anchored and leveled as a single element without loosening any hardware until entire shipping group is leveled and anchored.

1. The switchgear equipment was accurately aligned at the factory. This care insures proper operation and fit of mating parts. Supporting surfaces for the switchgear at each anchoring bolt locations must be level and in the same plane within 0.06" (1.6mm). There must not be any projection above this plane within the area covered by the switchgear cubicles.

   If purchaser's floor or grouted sill channels do not meet this requirement, it will be necessary to shim in the following manner. The six (6) anchor bolt locations in each cubicle must freely rest in firm contact with the mounting support surfaces. There must not be any projection or obstruction in other areas which may distort the cubicle.

   Do not force cubicle in firm contact by drawing down anchoring bolts as such drastic means will distort cubicles. Add 4" (100mm) square shims adjacent to anchor bolts until firm contact is achieved. Check each anchor bolt location, 6 per cubicle. (See **Figure 7**)

2. Tighten anchor bolts or weld to sills.

3. If the lineup consists of multiple groups, move the next group into position, with the front of units in line and tight against the adjacent group. Do not bolt groups together at this time. Check that the cubicles are in firm contact with the foundation at each corner and anchor point, and that bolt holes are in alignment. Add 4" (100mm) square shims as necessary. Tighten the anchor bolts. Now bolt groups together.

4. After installation is complete, the lifting bar between units may be removed and the unit lift bars pushed down inside the units. Note that bolts inside the units which clamp the lift bars in place must be loose to allow movement of the lift bar.

Anchoring and Leveling Outdoor Shelter-Clad Switchgear
In Shelter-Clad arrangements, the switchgear (as shipped) is true and in correct position relative to its support base. The formed floor sections are a permanent part of the switchgear, and are not to be loosened or moved from position.

Verify the anchor bolt locations in the concrete and all points shown in the general arrangement plan view. Sweep the foundation to make certain it is free of pebbles and other debris. Check the general arrangement drawing for positioning of the switchgear and sequence of installation if arrangement consists of more than one shipping group.

Single aisle Shelter-Clad cubicles are shipped with the aisle wall covering the breaker drawout compartment. This wall may be removed before moving the switchgear into position on its foundation, if conduit clearances are in doubt, of if the aisle is to be assembled immediately after leveling.

1. Remove seal material at top of aisle wall.

2. Unbolt, remove, and scrap the 1-1/4" plate and 1-1/4" angle.

3. Support wall with crane or other means. (Allow approximately 125 lb. (57kg) per unit) and remove the two angles at each end of the group which hold the aisle wall in place. These angles can now be scrapped. Carefully lay aside aisle wall until needed for aisle assembly.

4. Remove nuts from all anchor bolts, remove caps from all secondary conduit stubs, and remove covers from secondary openings in cubicle floor plates.

   The arrangement may consist of a single complete shipping group, or may be split into a number of shipping sections for a long lineup. Refer to the general arrangement drawing for instructions as to which shipping group should be installed first, and in what sequence the remaining groups are to be installed. Move the first group into position as shown on the general arrangement drawing.

5. The switchgear equipment was accurately aligned at the factory. This care insures proper operation and fit of mating parts. Supporting surfaces for the switchgear's 6" (152mm) base must be level and in the same plane within 0.06" (1.6mm). If concrete, grouted channels, pier supports, etc., do not meet this requirement, or if there is any projection higher than the support points in line with the base, shims must be installed in the following manner to provide an equivalent true surface for switchgear support.

   Outdoor switchgear groups which have been assembled on a 6" (162mm) base must be supported along this base with a span between support points not exceeding 36" (914mm). If shims are required, use 4" (100mm) square strips placed between the bottom of the base and the foundation, in the anchor bolt area where they will be clamped firmly in place. Do not force cubicle in firm contact by drawing down anchoring bolts as such drastic means will distort cubicles.

6. Add clamp washers and nuts to anchor bolts and tighten securely.

7. Check all breaker compartments for free movement of the shutters.

8. Move the next group into position. The front edge of the cubicle base should be in line with those of the previously installed group. This will insure a good fit with the aisle floor plates. Make certain that the end of the group being installed is tightly against the previously installed group. Repeat steps 5, 6, and 7 and install all shipping split hardware.

Assembly of Single Aisle Shelter-Clad Switchgear
Figure 12 illustrates the assembly of single aisle Shelter-Clad switchgear, and **Table 2** lists the standard components supplied. The item numbers in the table are used in all instructions pertaining to this procedure.

Assemble as follows:

1. Temporarily support the aisle wall assembly in its permanent position as shown in the general arrangement drawing.
2. Put roof covers in place to hold top of aisle wall in place. Do not tighten hardware.
3. Align the ends of the aisle wall, aisle channel and switchgear. Place floor plate in position between the switchgear and wall. Install each set next to the end position between the switchgear and the wall. With floor plate set tightly against the switchgear floor plates, bolt floor plates in position. Tighten anchor bolts to secure channel locations.
4. With roof cover hardware loose, plumb front wall and tighten attaching hardware.
5. Install all floor plates.
6. Caulk aisle walls.

   Set door assemblies in place. Bolt the door to the aisle wall and to the side plate of the cubicle.

Note: Place lift truck (if supplied) for upper cell breakers inside the aisle enclosure before installation of the last door assembly to the enclosure. The lift truck is wider and higher than the hinged aisle door opening, which prevents convenient entrance of the lift truck if the door assemblies are in place.

7. Put all roof covers in place and bolt to the adjoining roof cover with 3/8" hardware.
8. Set roof channels over roof cover joints. Bolt to clips welded to roof with retainer nuts.
9. Drill cable cover to suit conduit installation. Bolt the cover in place.
10. Mount aisle conduit, switches, receptacle and wire to the junction boxes. See conduit arrangement.
11. If equipment consists of more than one shipping group, caulk each vertical shipping split at the back of the switchgear with metal filler provided.

Assembly of Common Aisle Shelter-Clad Switchgear
Figure 13 illustrates the assembly of single aisle Shelter-Clad switchgear, and **Table 3** lists the standard components supplied. The item numbers in the table are used in all instructions pertaining to this procedure.

Assemble as follows:

1. Install all floor plates.
2. Caulk at joints.
3. Raise door assemblies into place. Bolt doors to side plates of cubicles.

Note: Place lift truck (if supplied) for upper cell breakers inside the aisle enclosure before installation of the last door assembly to the enclosure. The lift truck is wider and higher than the hinged aisle door opening, which prevents convenient entrance of the lift truck if the door assemblies are in place.

4. Mount aisle conduit, switches, receptacle and wire to the junction boxes. See conduit arrangement.
5. Place roof decks in position and fasten with bolts provided.
6. Fasten the roof decks together with 3/8" hardware.
7. Set channel-shaped covers over the joints of roof decks and bolt to clips welded to roof with retainer nuts.
8. Tighten all bolts to complete assembly.
9. Drill cable cover to suit conduit. Bolt the cover in place.
10. If equipment consists of more than one shipping group, caulk each vertical shipping split at the back of the switchgear with metal filler provided.

Assembly of Single Aisle Shelter-Clad Switchgear with Work Space
Figure 14 illustrates the assembly of single aisle Shelter-Clad switchgear with an attached Work Space area, and **Table 4** lists the standard components supplied. The item numbers in the table are used in all instructions pertaining to this procedure.

Assemble as follows:

1. Mount aisle end plate at the end opposite the work space.
2. Move aisle wall to its permanent location as indicated on the general arrangement drawing.
3. Mount the end plate and proceed.
4. Put the work space floor plate base in position as indicated.
5. Assemble aisle walls. See general arrangement drawing for location of special panels for fans, etc. Apply caulking at the joints of the wall sections.
6. Bolt work space rear plates (item 56) together, in a manner similar to the aisle wall sections, and then bolt to the switchgear unit.
7. Caulk at joints.
8. Install end plate and attach to switchgear.

Note: Place lift truck (if supplied) for upper cell breakers inside the aisle enclosure before installation of the last door assembly to the enclosure. The lift truck is wider and higher than the hinged aisle door opening, which prevents convenient entrance of the lift truck if the door assemblies are in place.

9. Install aisle floor plates in the same manner as for single aisle layouts.

10. Install roof support (item 78) from cubicles to end of work space area.

11. Put all roof decks in place and bolt to the top of the end plate and to the roof support. Leave hardware finger tight until step 13 is complete.

12. Fasten roof decks together with 3/8" hardware.

13. Mount trim angle. Tighten all hardware.

14. Set roof channels over roof deck joints, bolt to clips welded to roof with retainer nuts.

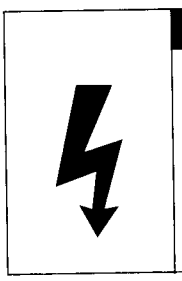
15. Mount aisle conduit, switches, receptacle and wire to the junction boxes. See conduit arrangement.

16. If equipment consists of more than one shipping group, caulk each vertical shipping split at the back of the switchgear with metal filler provided.

Expanding Length of Existing Shelter-Clad Switchgear by Addition of Units

The new extended foundation, be it slab, pier or pilings, must be constructed in the same careful manner as described under "Outdoor Foundations". The new foundation must be level and in the same plane within 0.06" (1.6mm) as the existing foundation.

Certain items will be removed from the existing installation as described in the following instructions. Remove these items carefully and store them for re-mounting in the expanded setup.



⚠DANGER

Hazardous voltages and high-speed moving parts.

Will cause death, severe personal injury or property damage.

Do not work on energized equipment. Always de-energize and ground the equipment before working on the equipment.

1. Remove the channel-shaped covers over roof joints from both aisle and switchgear unit.

2. Remove the trim angle from the outer edge of the roof deck.

3. Remove the back plates to provide access to the hardware securing the end cover. Remove the end cover with associated parts and save for later re-installation.

4. Disconnect aisle conduit.

5. Remove all hardware securing the side plate to the switchgear frame and hardware securing aisle end plate to the aisle wall. It may be necessary to tap a knife blade down the vertical seam between the aisle wall and the end plate to cut the caulking. Remove the side plates from both switchgear and aisle.

6. The lineup is now ready for installation of the new unit or units. If the foundation was carefully constructed there should be no problems with lineup of the base or matching the level of existing equipment.

7. With new units in true alignment with existing and properly leveled, bolt units together with 1/2" hardware provided.

8. Run aisle wiring from the terminal block in existing end units, through the barrier and header to the junction box area.

9. Mount other parts removed from existing equipment and caulk all external seams with metal filler.

10. Make all electrical connections as instructed in installation manual or shown on drawings.

11. Caulk each vertical split at back of switchgear between the existing equipment and the new addition with metal filler. Replace bus compartment barriers and install back plates.

Anchoring, Leveling, and Assembling Conventional Outdoor (Non-Walk-In) Switchgear

In conventional outdoor (non-walk-in) arrangements the switchgear (as shipped) is true and in correct position relative to its support base. The formed floor base sections are a permanent part of the switchgear, and are not to be loosened or moved from position.

Verify the anchor bolt locations in the concrete and all points shown in the general arrangement plan view. Sweep the foundation to make certain it is free of pebbles and other debris. Check the general arrangement drawing for positioning of the switchgear and sequence of installation if arrangement consists of more than one shipping group.

1. Remove nuts from all anchor bolts, remove caps from all secondary conduit stubs, and remove covers from secondary openings in cubicle floor plates.

   The arrangement may consist of a single complete shipping group, or may be split into a number of shipping sections for a long lineup. Refer to the general arrangement drawing for instructions as to which shipping group should be installed first, and in what sequence the remaining groups are to be installed. Move the first group into position as shown on the general arrangement drawing.

2. The switchgear equipment was accurately aligned at the factory. This care insures proper operation and fit of mating parts. Supporting surfaces for the switchgear's 6" (152mm) base must be level and in the same plane within 0.06" (1.6mm). If concrete, grouted channels, pier supports, etc. do not meet this requirement, or if there is any projection higher than the support points in line with the base, shims must be installed in the following manner to provide an equivalent true surface for switchgear support.

   Outdoor switchgear groups which have been assembled on a 6" (162mm) base must be supported along this base with a span between support points not exceeding 36" (914mm). If shims are required, use 4" (100mm) square strips placed between the bottom of the base and the foundation, in the anchor bolt area where they will be clamped firmly in place. Do not force cubicle in firm contact by drawing down anchoring bolts as such drastic means will distort cubicles.

3. Add clamp washers and nuts to anchor bolts and tighten securely.

4. Check all breaker compartments for free movement of the shutters.

5. Move the next group into position. The front edge of the cubicle base should be in line with those of the previously installed group. This will insure a good fit with the aisle floor plates. Make certain that the end of the group being installed is tightly against the previously installed group. Repeat steps 3, 4, and 5 and install all shipping split hardware.

Expanding Length of Existing Conventional Outdoor (Non-Walk-In) Switchgear by Addition of Units

Expanding the length of existing conventional outdoor switchgear by field addition of units should be handled in the same manner as Shelter-Clad switchgear with the exception that there is no aisle with which to be concerned. Follow the instructions given under "Expanding Length of Existing Shelter-Clad Switchgear by Addition of Units". However, note that only roof channels, bus compartment barriers, and end plates need to be removed on conventional switchgear.

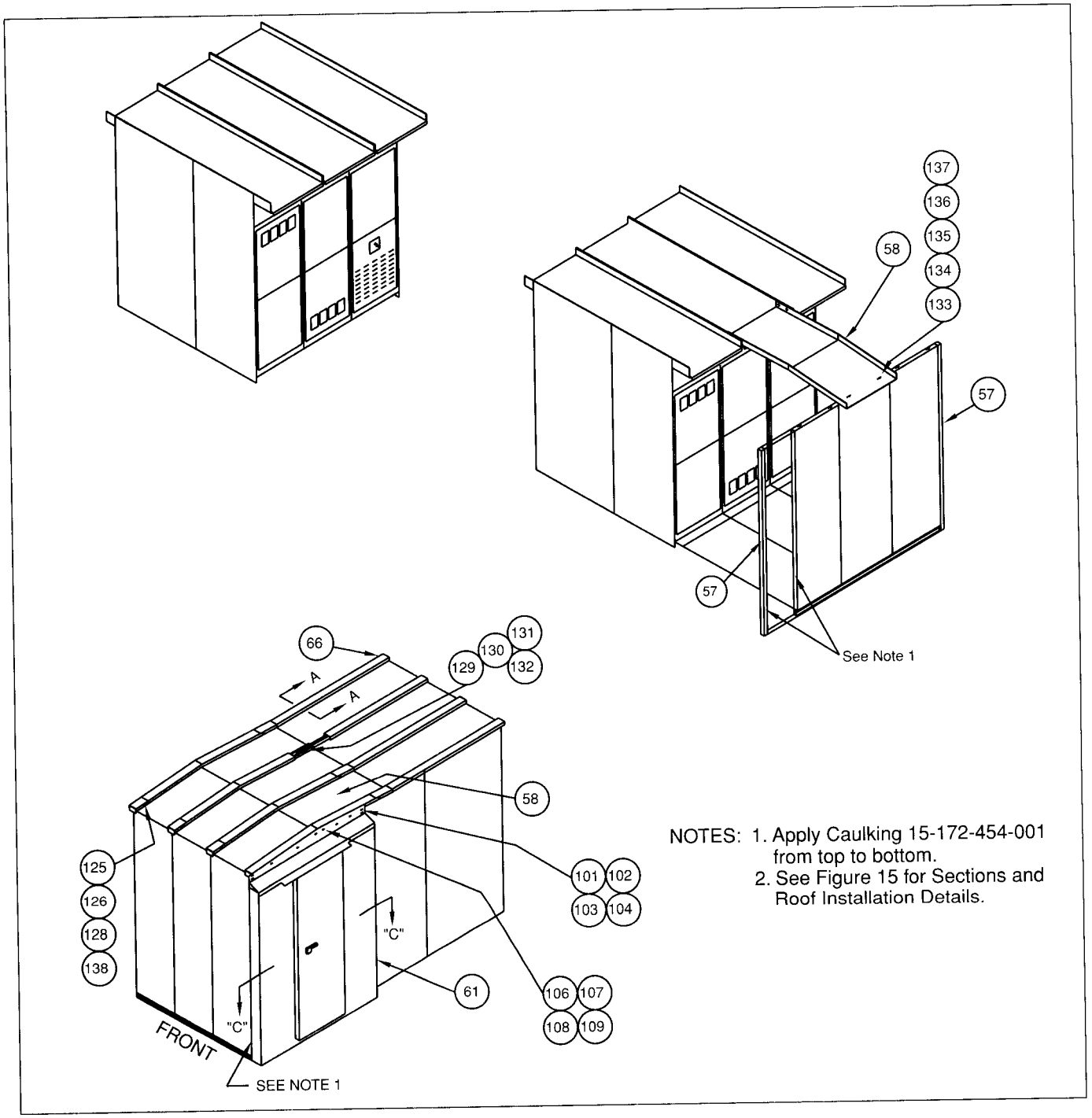


Figure 12. Single Aisle (SGM) Field Assembly

Table 2. Single Aisle (SGM) Field Assembly Components

Item No	Part Name	Part Number
54	Aisle floor assembly	18-748-411-501
57	Aisle wall spacer	18-658-130-048
58	Aisle roof	18-808-034-501
60	Aisle roof spacer	18-658-106-037
61	Housing assembly 6"	18-483-740-501
63	Aisle roof trim angle	18-740-698-124

Item No	Part Name	Part Number
64	Aisle roof cap	18-740-698-119
65	Aisle roof end cap	18-740-698-118
66	Equipment roof cap	18-741-143-501
101-113	Aisle end hardware	18-658-583-823
125-138	Aisle roof & floor hardware	18-658-583-824

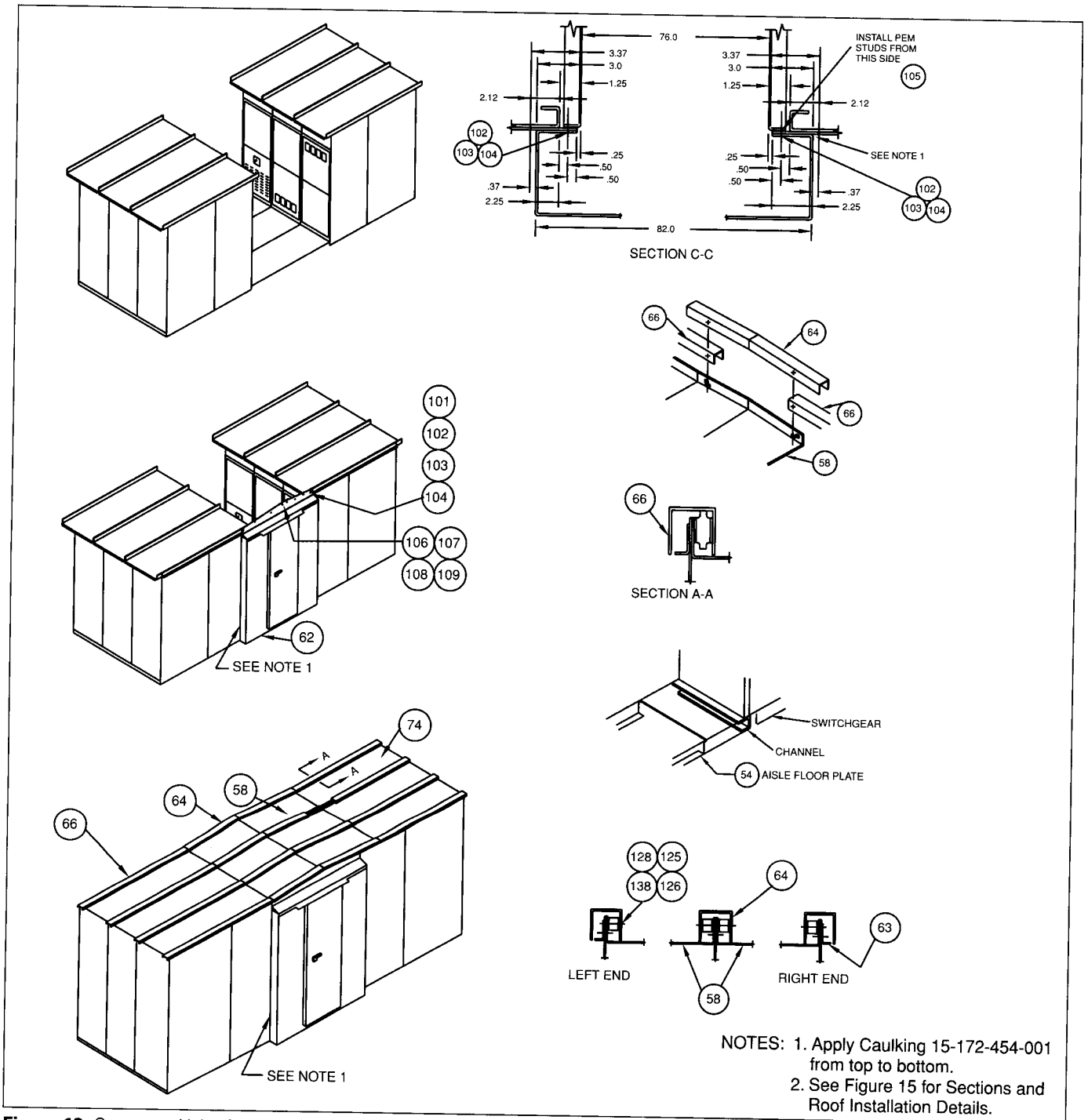


Figure 13. Common Aisle (SGM) Field Assembly

Table 3. Common Aisle (SGM) Field Assembly Components

Item No	Part Name	Part Number
54	Aisle floor assembly	18-748-412-501
58	Aisle roof	18-808-034-501
61	Housing assembly 6"	18-483-740-501
63	Aisle roof trim angle	18-740-698-124

Item No	Part Name	Part Number
64	Aisle roof cap	18-740-698-119
66	Equipment roof cap	18-741-143-501
101-113	Aisle end hardware	18-658-583-823
125-138	Aisle roof & floor hardware	18-658-583-824

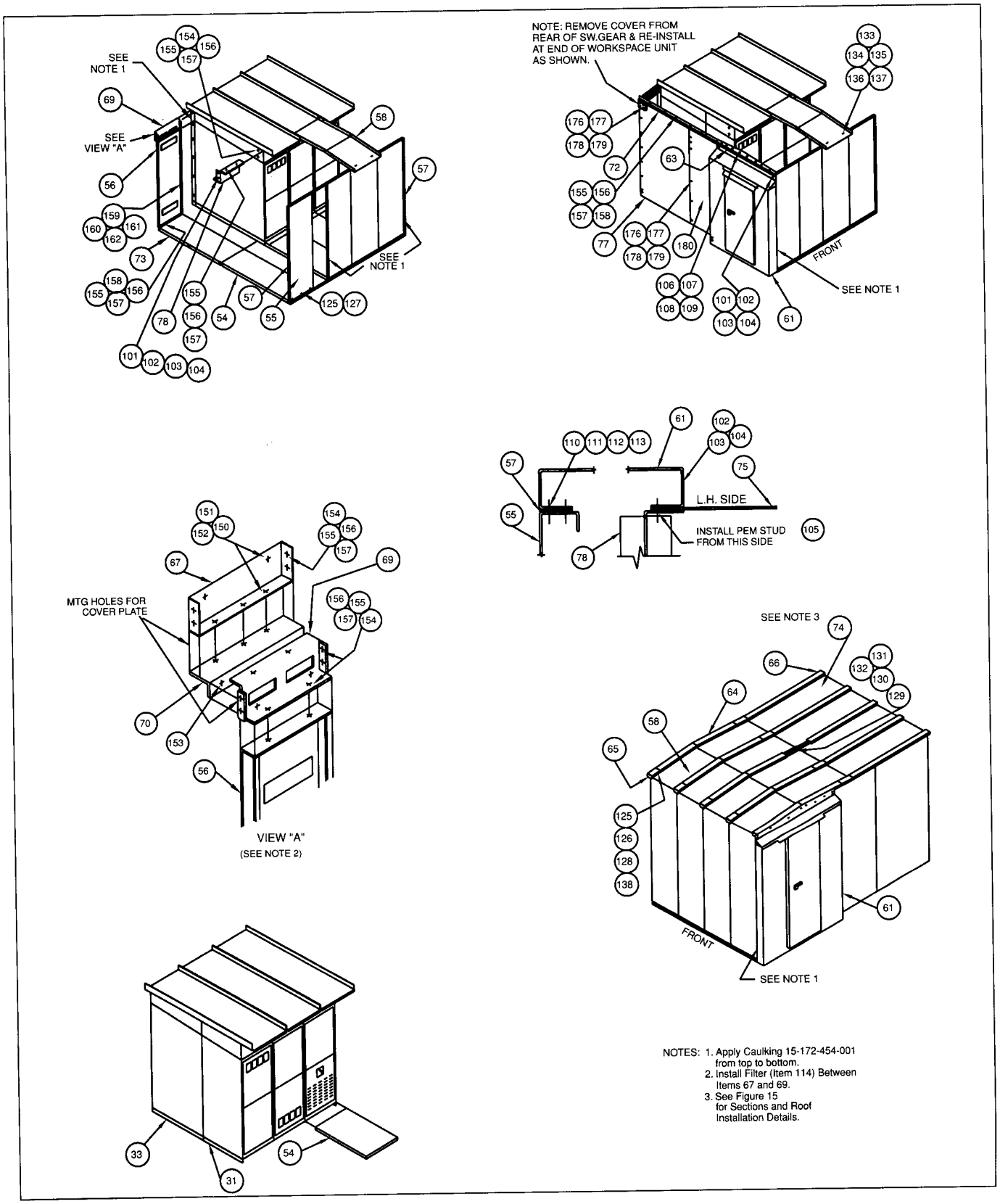


Figure 14. Single Aisle (SGM) with Work Space Field Assembly

Table 4. Single Aisle (SGM) With Work Space Field Assembly Components

Item No	Part Name	Part Number
54	Aisle floor assembly	18-748-412-501
55	Wall panel assembly (aisle)	18-748-405-801
56	Wall panel assembly (workspace)	18-748-488-801
57	Aisle wall spacer (at end only)	18-658-130-048
58	Aisle roof	18-808-034-501
61	Housing assembly 6"	18-483-740-501
63	Aisle roof trim angle	18-740-698-124
64	Aisle roof cap	18-740-698-119
65	Aisle roof end cap	18-740-698-118
66	Equipment roof cap	18-741-143-501
67	Header assembly (rear)	18-741-143-539
69	Roof support (rear)	18-814-127-001

Item No	Part Name	Part Number
70	Vent panel (rear)	18-740-698-215
71	Roof trim angle (left end)	18-747-094-001
72	Roof trim angle (right end)	18-747-093-001
73	Workspace floor assembly	18-748-418-501
74	Roof panel	18-814-101-501
75	End trim front (left end)	18-815-700-002
76	End trim front (right end)	18-815-700-001
77	End trim rear (left & right)	18-815-701-001
78	Roof support (front)	18-814-126-001
101-113	Aisle end hardware	18-658-583-823
125-138	Aisle roof & floor hardware	18-658-583-824

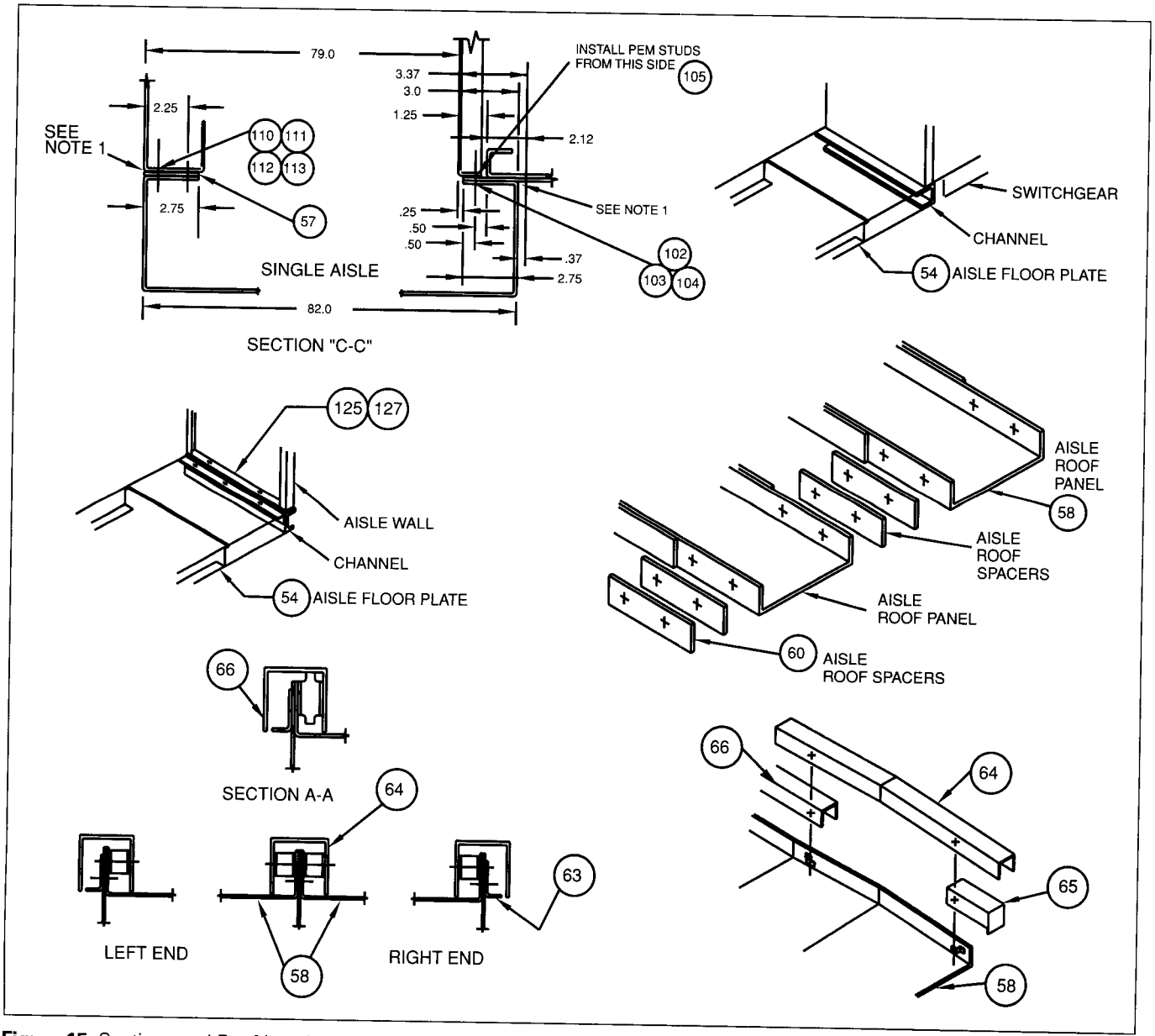
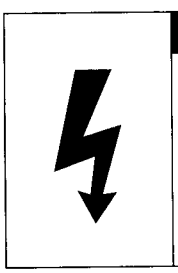


Figure 15. Sections and Roof Installation Details

Bus Bar
Bus bar is furnished for connection between many of the high voltage items within the switchgear enclosure, such as main bus, circuit breakers, and pads for cable terminations. Cables are provided for connection to primary disconnect assemblies for voltage and control power transformers, and for connection to surge arrestors or surge limiters.

Standard bus bar material is copper with silver-plated joints for electrical connections. Aluminum bus, with tin plated joint surfaces, is also available. Bus bars are insulated with an epoxy insulation applied by the fluidized bed method. Bus bar joints are insulated with molded insulation boots (where a boot is available) or are taped.

Additional insulation is provided by clearance thru air and bus supports. In some locations, standoff insulators are used. Glass polyester molded interunit bus supports are provided as standard. Porcelain or epoxy insulator rings (inserts) mounted in glass polyester supports, porcelain or epoxy standoff insulators and/or porcelain primary disconnect bushings may be furnished as options.



⚠DANGER

Hazardous voltages.

Will cause death, severe personal injury, and property damage.

Do not contact energized conductors.

De-energize and properly ground high voltage conductors before working on or near them.

Bus Joints
When a switchgear lineup is split for shipping purposes, the primary bus and ground bus connections must be made when installing the switchgear. These bolted connections are relatively simple to make. Refer to **Figures 16** and **17** and these instructions.

The bus bars and connection hardware for joining the groups together are normally shipped mounted on a bracket in one of the units involved in the connection. When this is not possible, the connection bars and hardware will be shipped in a separate package, and will be listed on the "Accessories" drawing. (This drawing is listed on the "Reference Drawing List").

Access to the main bus from the cable termination area is achieved by removing the main bus compartment barrier (R in **Figure 25**) which separates the main bus from the cable area. If access to the main bus is impeded by installed equipment, access to the main bus can usually be achieved by removal of barrier F, shown in **Figure 25**. Barrier F is accessible from the lower circuit breaker compartment.

For some arrangements it may be necessary to remove items between the main bus barriers and the rear of the unit in order to gain full access. After completion of the bus assembly and insulation, these items should be reassembled in reverse sequence.

1. Molded plastic insulation boots for bus bar joints are normally shipped factory installed at shipping splits. Note their location and orientation, so they may be properly reinstalled after the joint is bolted together. Carefully remove and save the nylon hardware and the boot. In some cases a snap closure is molded into the boot and replaces some of the plastic hardware.

2. All surfaces must be free of dust, dirt or other foreign material.

   Do not use any abrasive cleaner on plated contact surfaces. Cleaning is normally not necessary and should not be done unless parts are badly tarnished. If cleaning is necessary, use a mild cleaner and thoroughly rinse the parts to remove all residue. Keep cleaning agent off insulation.

3. Before assembling any bus bar joint, check that the bar is inserted through bus supports (when required) and interunit bus supports, including neoprene grommets and insulator rings (inserts) where that option is furnished. Grommets (as shown in **Figure 16**) are used to support the bus bars in the insulator rings (inserts). Observe the factory positioning of these grommets when connecting at shipping splits to insure that bus bars will line up properly. Normally, the bus bar is oriented in the insert toward the front. Neoprene grommets are to be installed centered in the insert.

4. Also observe the relationship of the bus bar to the breaker riser (i.e., whether bus bar is in front of, or behind, the riser). Maintain this relationship when connecting bus bars. Spacers are required in some bus joint connections.

5. Assemble all joints with the parts dry. Do not use any grease or "no-oxide" product, even when aluminum bus is used. Aluminum bus is tin plated, and can be applied directly to other tin plated aluminum bar or to silver plated copper without the use of a "no-oxide" product.

Note: All main bus hardware furnished is plated high strength steel. Cap screws are 1/2-13 SAE Grade 5. Do not substitute with smaller or lower grade hardware than supplied.

6. Use proper hardware. For joints involving only copper bus, heavy flat washers are used on both sides of the bus bar joint—under the cap screw head as well as under the nut and lockwasher. These washers insure an evenly distributed force around each bolt, producing a low resistance joint. Proper torque value produces a joint of adequate pressure without cold flow. Refer to **Figure 19**.

   For joints involving aluminum bus, the flat washer and lockwasher under the nut are replaced with a "Belleville" spring washer.

7. Assemble all joints as shown in **Figures 16** thru **19**. Install all hardware the same way that factory bus connections were installed. Hardware must be aligned properly or molded insulation may not fit over the joints.

7.A. Place a flat washer on the cap screws (bolt) and insert the cap screw through the bus joint towards rear of unit.

7.B.1. On copper-copper bus joints, place a flat washer against the bar with a lockwasher between the flat washer and the nut.

7.B.2. On copper-aluminum or aluminum-aluminum bus joints, a "Belleville" spring washer is placed under the nut, with the concave side of the spring washer against the bus bar.

7.C. Spacers are required at certain bus joints to insure the cross sectional area of the joint. The conditions where these spacers are required vary with the type of bus joint. Refer to **Figure 18**.

8. Torque the .50" SAE Grade No. 5 cap screws to 50-75 lb-ft. (68-102 Nm) torque. (If special hardware is required by an order, other torque values will be supplied with field assembly drawings.)

9. Install insulation boots or tape joints where required per instructions in following sections.

10. Connect ground bus. See **Figure 28**. Insert bar in side wall opening to overlap the ground bus in adjacent cubicles.

11. Torque the 0.38" SAE Grade 5 cap screw used in the ground bus to 25-40 lb-ft. (34 to 54 Nm).

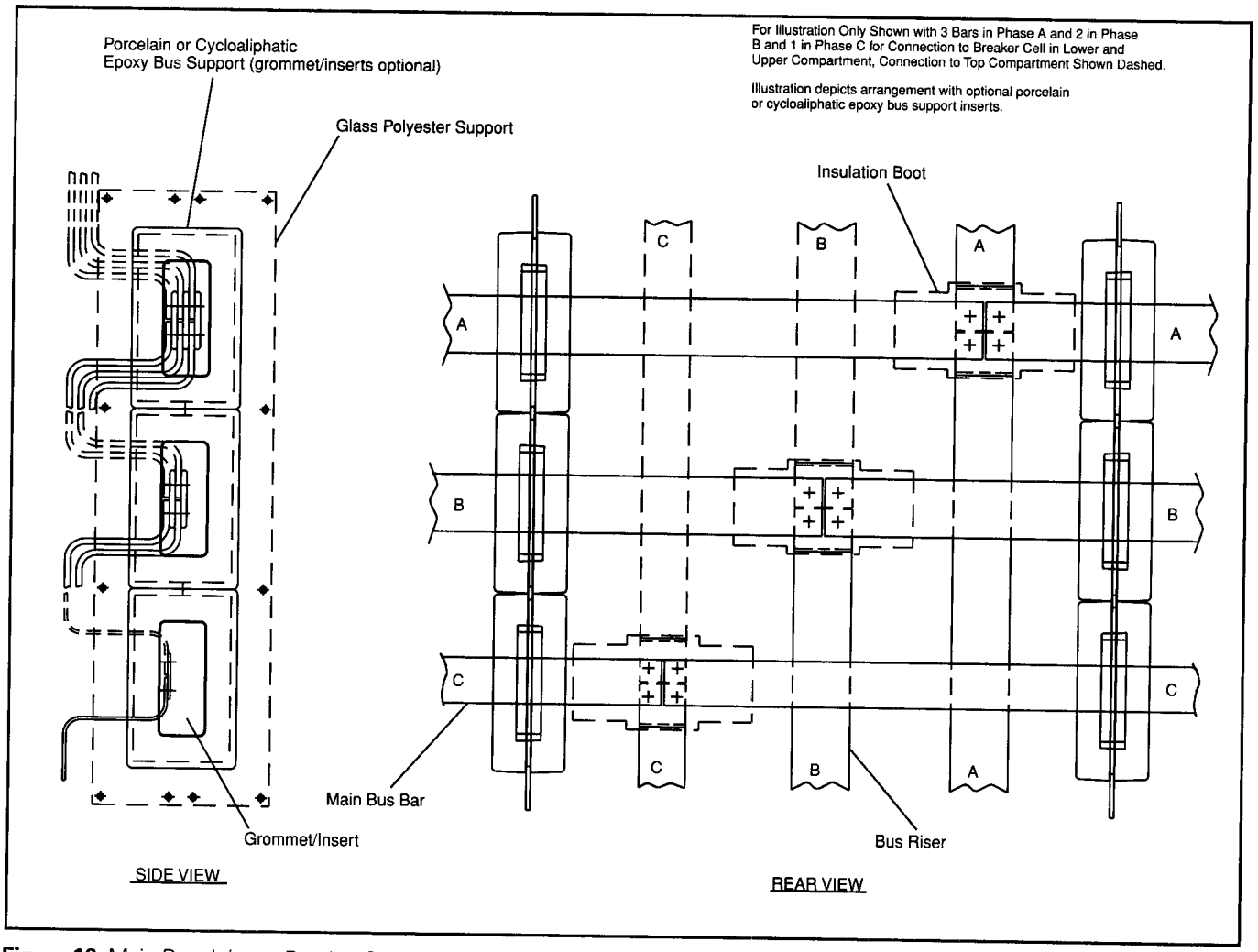


Figure 16. Main Bus Joints—Breaker Section

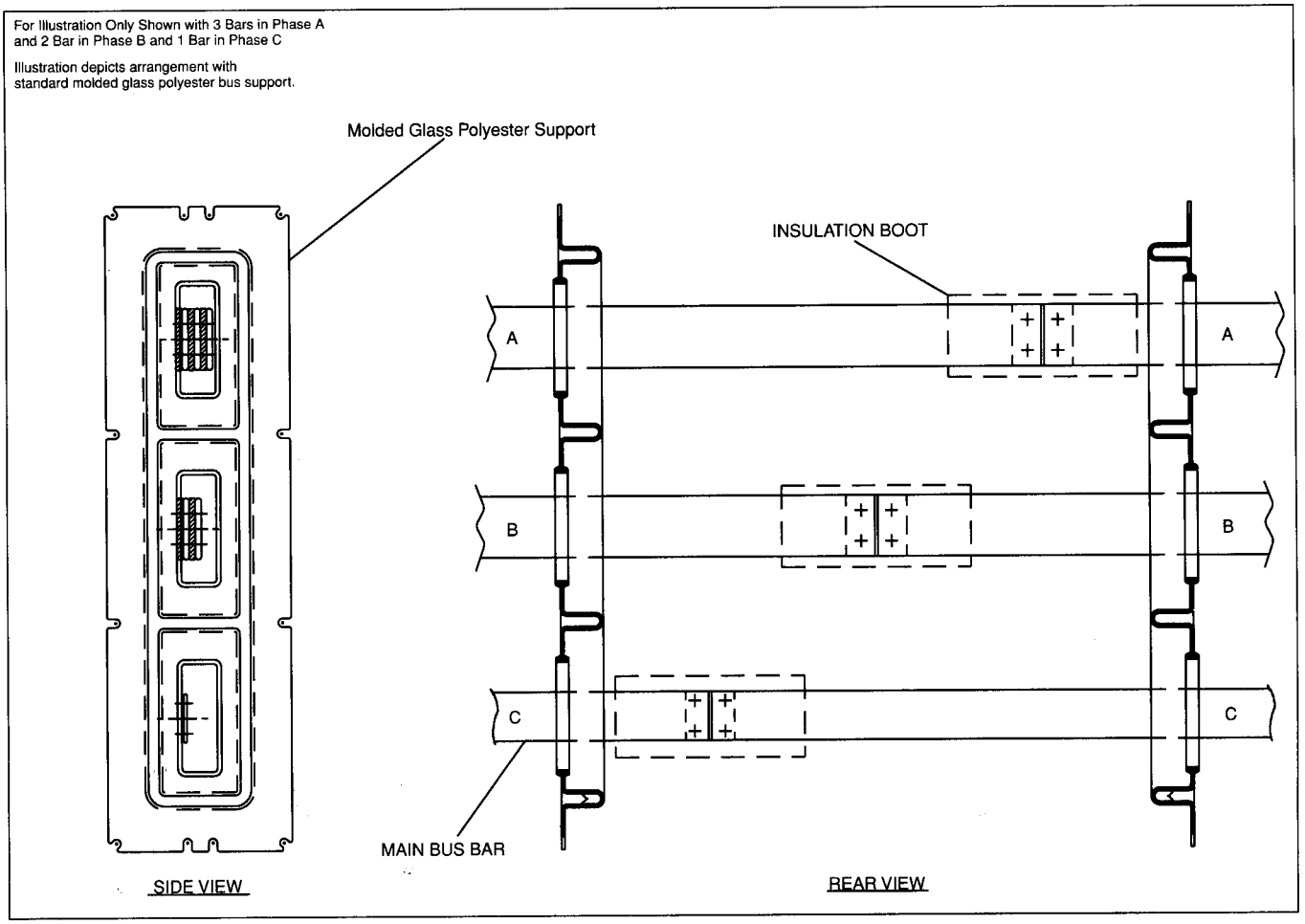


Figure 17. Main Bus Joints—Auxiliary Section

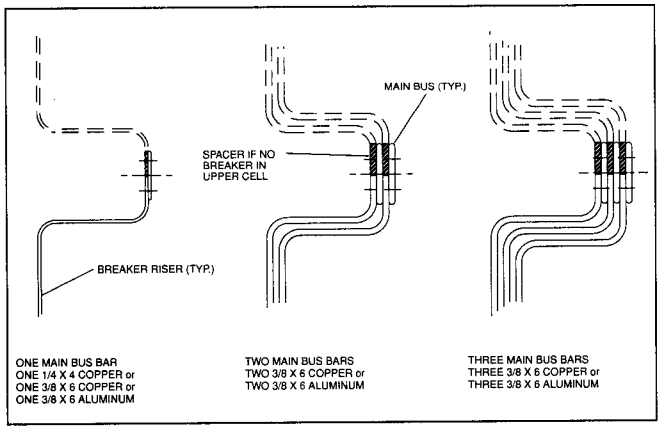
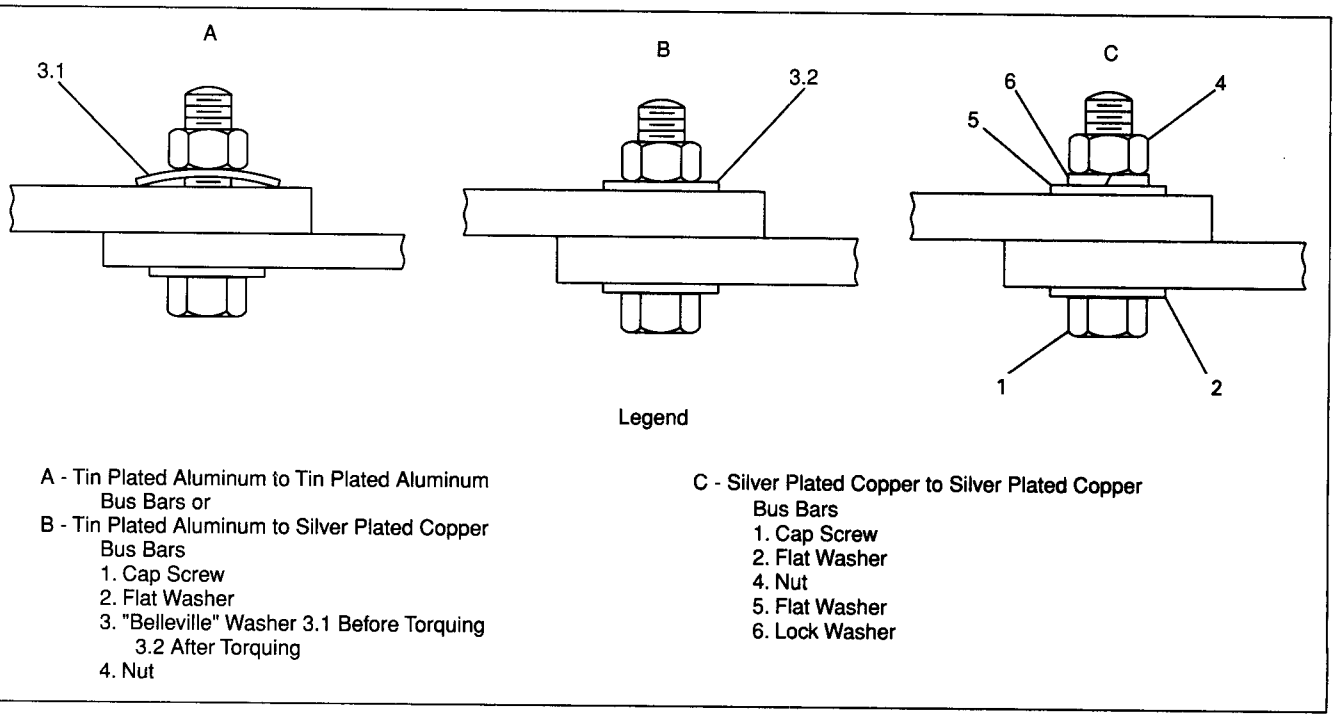


Figure 18. Main Bus Joints Connection Configurations



Legend

A - Tin Plated Aluminum to Tin Plated Aluminum Bus Bars or
B - Tin Plated Aluminum to Silver Plated Copper Bus Bars
1. Cap Screw
2. Flat Washer
3. "Belleville" Washer 3.1 Before Torquing
3.2 After Torquing
4. Nut

C - Silver Plated Copper to Silver Plated Copper Bus Bars
1. Cap Screw
2. Flat Washer
4. Nut
5. Flat Washer
6. Lock Washer

Figure 19. Bus Bar Joint Assembly

Bus Insulation

Bus and connections are insulated in metal-clad switchgear as part of a coordinated insulation system. Air or creep distance plus bus insulation combines to provide the needed insulation level. BUS INSULATION IS NOT DESIGNED TO PREVENT SHOCK.

⚠DANGER

Hazardous voltages.

Will cause death, severe personal injury, and property damage.

Do not contact energized conductors.

De-energize and properly ground high voltage conductors before working on or near them.

Epoxy insulation applied in a fluidized bed process is normally furnished on the bus bars. Bus joints are normally insulated with boots. Taping is also used for bus joint insulation.

The ANSI requirements for bus insulation in metal-clad switchgear are contained in ANSI C37.20.2 clause 6.2.3, which reads as follows:

> This insulating covering is a requirement of metal-clad switchgear and is provided to minimize the possibility of communicating faults and to prevent development of bus faults that would result if foreign objects momentarily contacted bare bus. This insulating covering is usually only a part of the primary insulation system and in such cases the outer surface of this insulating covering will not be at ground potential. It should not be assumed, therefore, that personnel can contact this insulating covering with complete safety.

Bus Joint Insulation - Boots

Standard and repetitive bus bar joints are normally provided with insulation boots installed at the factory. See **Figure 20**. After they are completed in the field, bus bar joints at shipping splits must be insulated as part of the total insulation system. Normally, boots are provided for field completed shipping split joints and are shipped in the location where they will finally be installed. See **Figure 21**.

Grommets are provided for use with the boot when the bus bar is smaller than the opening in the bus bar boot. When required, these grommets are normally mounted along with the bus boot in the final assembly location.

Before removal of the boot to complete the joint, observe the location and orientation of the boot and hardware. This should make reinstallation easier.

Nylon nuts and bolts and flat washers, or reusable plastic rivets are used to hold the boot closed after it is installed. Some boots may use molded-in threaded stems to provide a snap type closure. Carefully remove the insulation boot and save all hardware.

After the bus bar joint has been properly assembled, reinstall the insulation boot. Secure the boot closed with the nylon nuts and bolts. Completed boot installation should be flush with the bus bar insulation and overlap it by at least 1-1/2" (38mm). In those cases where the boot does not close flush with the bus bar insulation or the overlap is less than 1-1/2" (38mm), apply one layer of tape (15-171-987-001) 1/2 lapped, overlapping the bar insulation and boot by 1-1/2" (38mm).

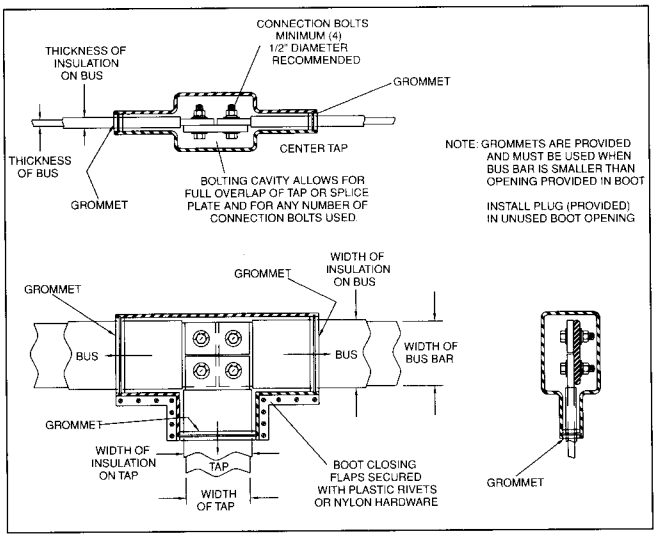
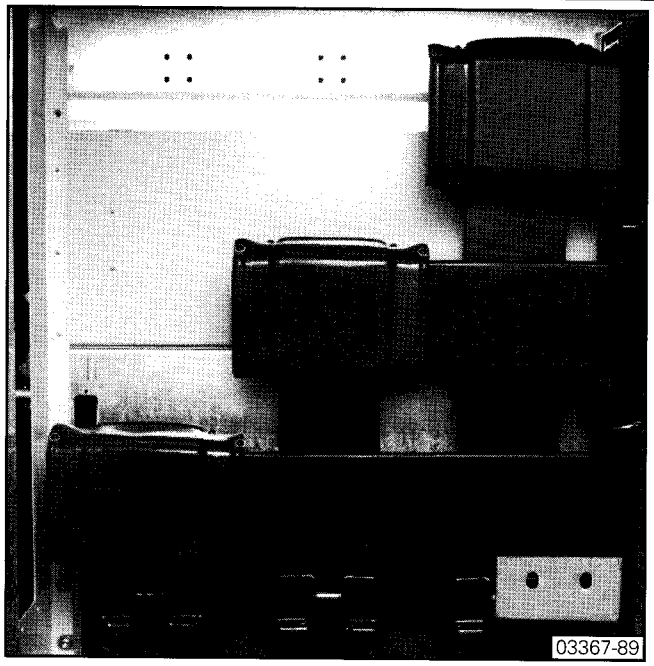
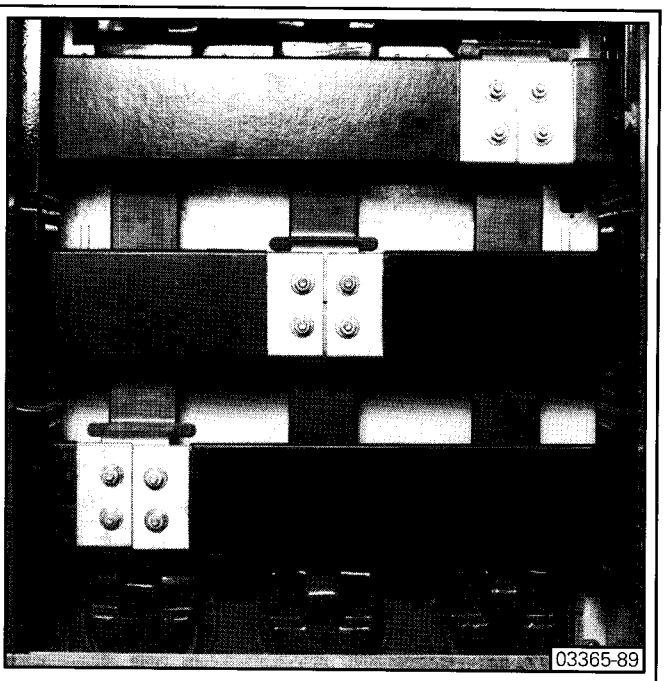


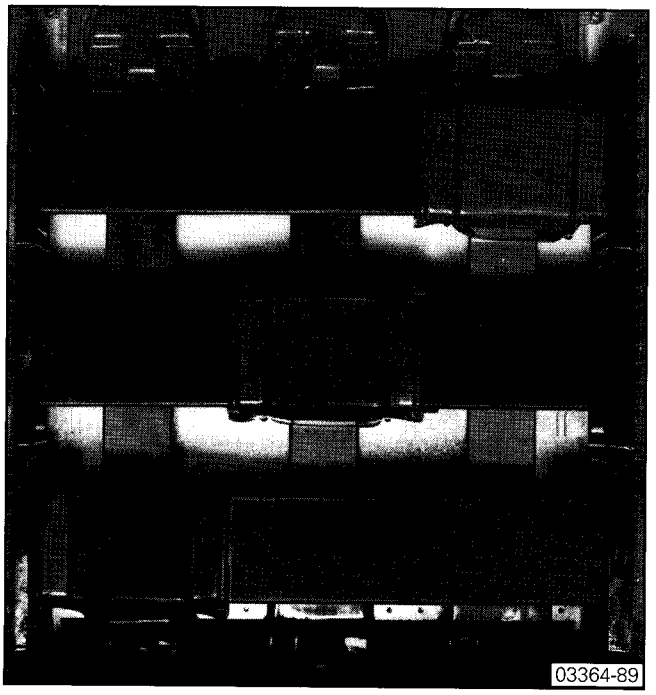
Figure 20. Typical Installation of Insulating Boot



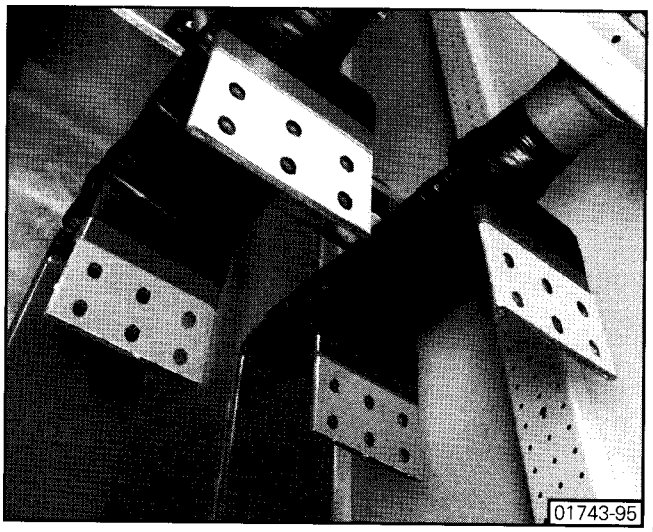
A: Shipping split, as shipped. Insulation boots are factory installed in correct location. Bus bars and hardware are mounted on a temporary shipping bracket in the one of the units to be connected. (Bus bars and hardware may be packed separately in unusual situations).



B: Shipping split assembly in progress. Insulation boots have been removed, and bus bars have been installed. Connection bolts have been correctly torqued. Unit is ready for reinstallation of insulation boots.



C: Insulation boots have been reinstalled. Unit is ready for reinstallation of main bus compartment barrier (designated R in **Figure 25**).



D: Taped bus joint configuration, used for joints where a boot is not available. This illustrates a taped connection for multiple cable terminals. After cables have been installed, the cable terminations and the exposed bus must be insulated.

Figure 21. Connection of Bus at Shipping Split

Bus Joint Insulation - Taping
Insulation boots are normally provided for repetitive or standard bus joint conditions. Where boots are not provided, the bus joints must be carefully taped to the required insulation level as described below. See **Figure 21D**, which depicts taped joints associated with a cable lug mounting arrangement for multiple cables. **Note:** When the cables associated with **Figure 21D** have been installed, the cable terminations and the exposed bus must be insulated.

1. Inspect bolted joints to insure they are correctly assembled, bolt heads in proper direction and hardware has been torqued to proper value. All surfaces must be free of dust, dirt or other foreign material.

2. Apply a mastic pad over nuts and a second pad over the bolt heads. Use either small (15-171-988-001: 3.25" x 4.50" (83mm x 114mm) or large (15-171-988-002: 4.50" x 6.50" (114mm x 164mm)) size pad most suitable for joint involved. Remove backing and press adhesive side down and mold in place covering all sharp projections. Cover hardware and sharp edges of bus bar if any will be against the tape.

3. Apply half-lapped layers of 4" (102mm) wide tape (15-171-987-002) or 1" (25mm) wide tape (15-171-987-001) over the joint. Each layer should overlap the bus bar insulation by at least 1-1/2" (38mm). Stretching of tape 10% to 15% in problem areas may help in eliminating voids and wrinkles.

   For 5kV class equipment, use two half-lapped layers of tape over mastic pads. For 8.25kV and 15kV class equipment, use three half-lapped layers of tape over the mastic pads.

   Avoid excessive pressure on the completed bus joint insulation. If bus joints are on standoff insulators, apply tape per the above procedures except the half-lapped tape should overlap the insulator by at least 2" (51mm).

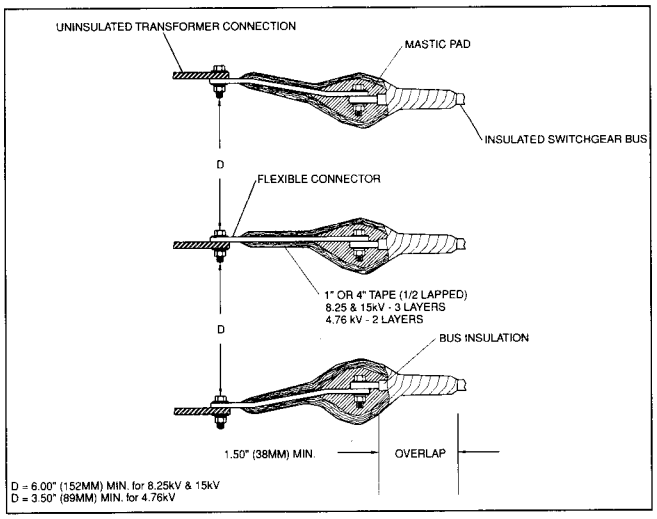


Figure 22. Taped Joint Insulation-Switchgear Bus to Transformer Throat

Transformer Bus Joints - Insulation
The typical transformer to switchgear bus joint shown in **Figure 22** is different from other bus joints in the switchgear main bus. In the transformer bus joints, there is a transition from the fully insulated switchgear system to the transformer, where the spacing between conductors is usually large enough so that the conductors need not be insulated. The use of flexible connectors in this area insures correct alignment of the switchgear conductors to the transformer conductors. If the installed clearance (phase-to-phase or phase-to-ground) is less than 6" (152mm) for 8.25kV and 15kV switchgear (3.5" (89mm) for 5kV switchgear), the joint must be insulated.

Refer to **Figure 22**, and insulate bus joint connections as outlined under "Bus Joint Insulation - Taping".

Primary Cable Connections
All cable connections to metal-clad switchgear must be fully insulated to comply with the ANSI C37.20.2 definition of metal-clad switchgear. Recommendations of the cable supplier should be followed for the installation. Typical termination configuration is shown in **Figure 23**.

Because of considerable variations in installation requirements and available cables, Siemens furnishes a double-bolt, double-clamp, terminal lug as standard. All insulating and terminating materials other than terminal lugs and cable supports are to be furnished by the purchaser.

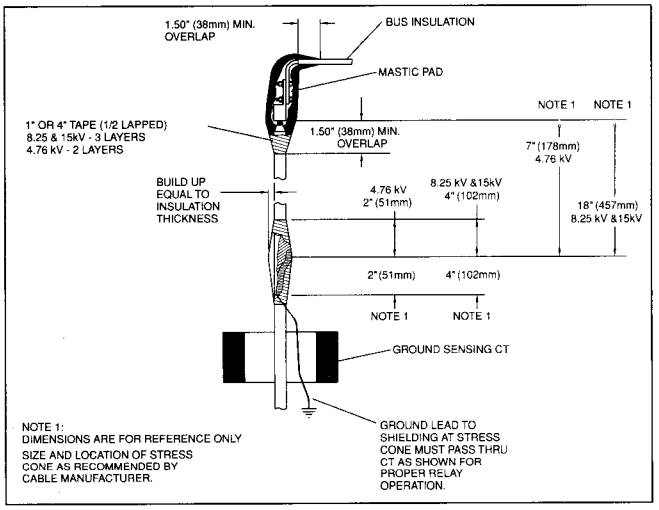


Figure 23. Primary Cable Termination and Insulation

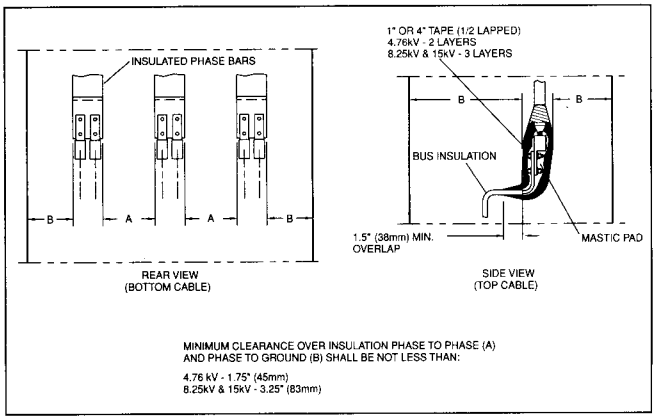


Figure 24. Typical Cable Terminal Mounting and Insulation

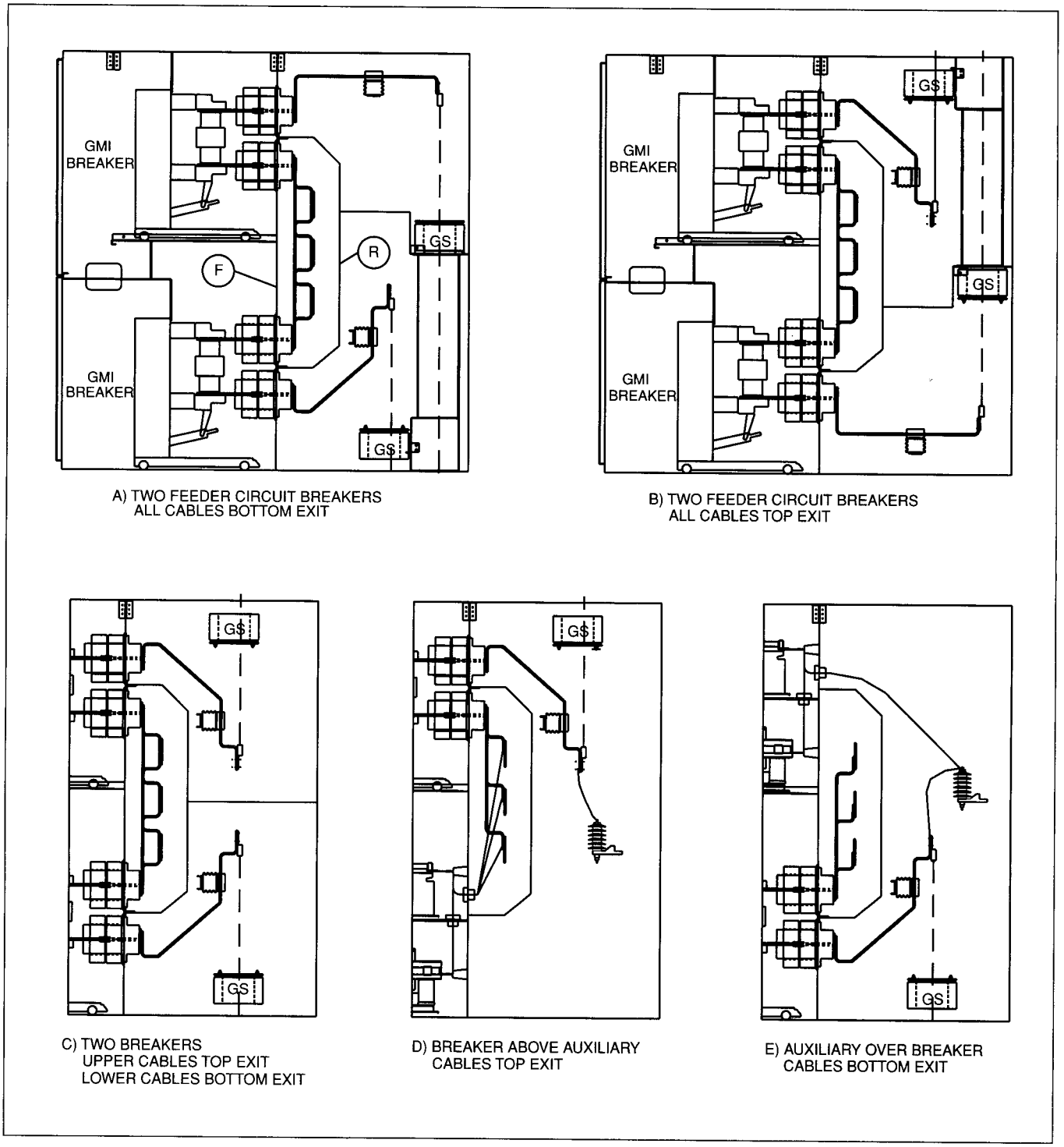


Figure 25. Typical Cable Termination Configurations

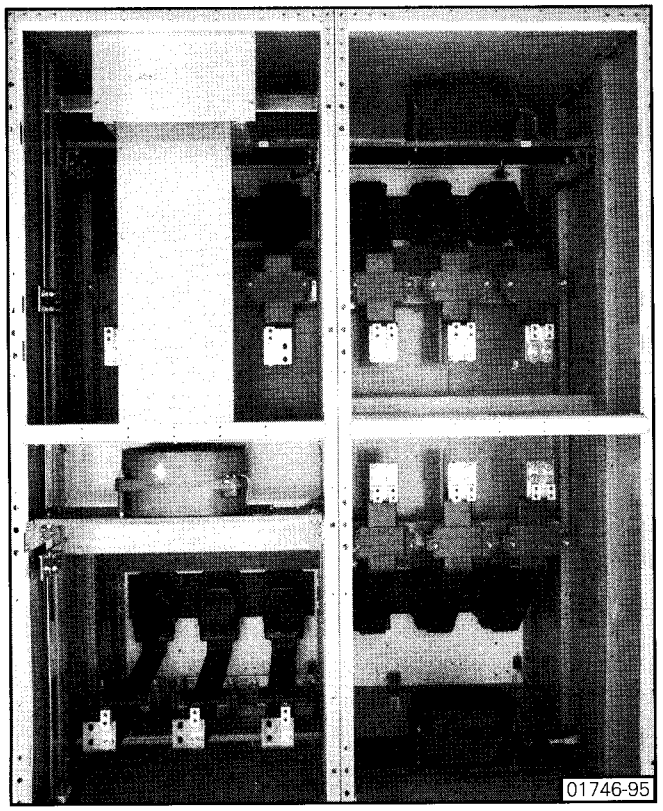


Figure 26. Typical Cable Termination Compartments (Unit on left has top breaker cables exiting top, and bottom breaker cables exiting top through "chimney" or trough. Unit on right has top breaker cables exiting top and bottom breaker cables exiting bottom.)

Secondary Control Wiring

Secondary control wiring is carefully installed and tested at the factory. Inter-group wiring at shipping splits can be readily connected by referring to wire markings. These wires are not terminated and are of sufficient length to be routed to their termination point after cubicles are bolted together. Terminals for these leads are furnished by the purchaser to suit the available crimping tools. Terminal block hardware is furnished with the switchgear. All wiring diagrams needed for installation are furnished in advance.

Wires can be easily traced on wiring diagrams furnished for the switchgear. Each device is illustrated and identified with an alphanumeric code. Each terminal on each device is identified by a number. The wire list adjacent to each device on the diagram indicates the device and terminal number to which each wire is connected at the next connection point.

All secondary control wiring installed by the factory is neatly bundled and cleated to the cubicle side plate. Make all field connections in a similar manner. Check that the circuit breaker, its components, and the hinged front panel clear any additional wiring installed. **Figure 27** shows a typical secondary control cable installation. All purchaser wiring is to be routed behind the cable retainer which is removable for installation purposes. Use plastic or nylon ties to secure all field installed wires to the cubicle structure.

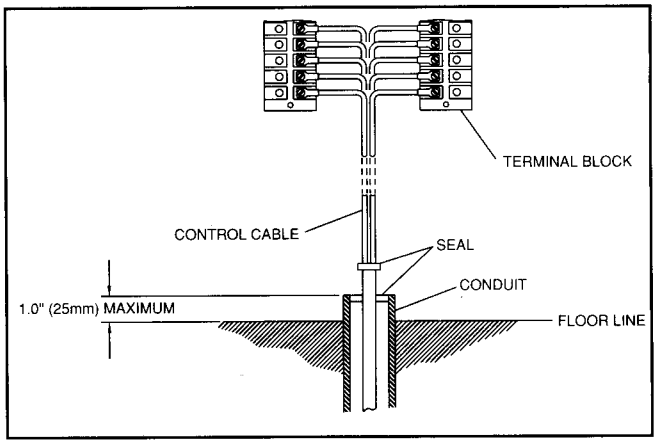


Figure 27. Secondary Control Cable Connections

Ground Connections

A common ground bus is incorporated in all units for properly grounding the equipment after installation.

The ground bus extending through the switchgear is accessible in the primary cable area of each unit. The interunit connector has provisions for two bolts at each end. For ease of assembly, install bottom bolts first. Insure that ground bar to circuit breaker cell is also bolted to interunit bar, as shown in **Figure 28**.

Provision for connecting this ground bus must be made in such a manner that a reliable ground connection is obtained. Consult latest National Electrical Code for ground connection standards.

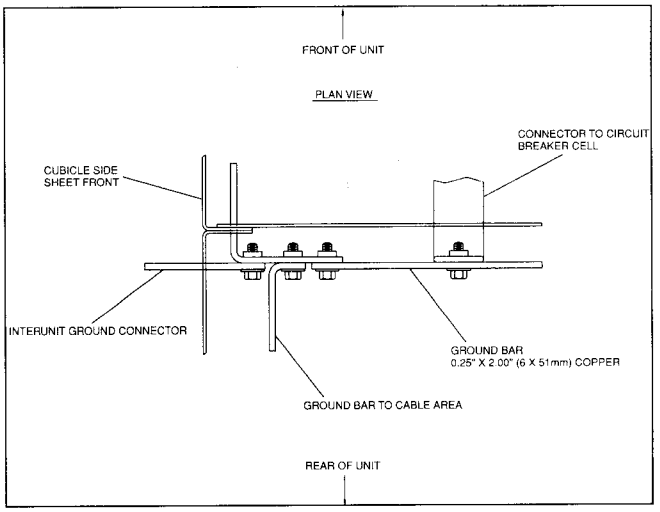


Figure 28. Ground Bus Connection

Temporary Ground Connections

It is recommended that no work be done on current carrying parts until these parts have been disconnected from the system and solidly grounded. One method of solidly grounding the high voltage circuit is by use of a grounding device. This device is placed in a cubicle in the same manner as a breaker and provides a path to ground. It is furnished only when specified in the contract.

Control Power and Voltage Transformers-General Information

When required, voltage transformers (VTs), or a control power transformer (CPT), or fuses for a CPT can be mounted on a withdrawable rollout fuse tray. Each auxiliary cell (A = upper, or B = lower) can contain up to two rollout trays. See **Table 5** for various rollout tray positions. Rollout trays are designed with metal extensions on each end of the primary fuses. These extensions wipe across a flexible copper strap mounted on the cubicle as the rollout tray is withdrawn. This action will ground each side of the primary fuses to remove any residual charge from the fuses or transformers, and grounds the primary fuses when the tray is fully withdrawn.

As the rollout tray is withdrawn, insulating shutters move to cover the cubicle primary disconnect stabs. **Note:** The insulating shutter is only a part of the primary insulation system, and the outer surface of the insulating shutter will not be at ground potential. It should not be assumed, therefore, that personnel can contact the insulating shutter with complete safety.

Voltage Transformers

One, two, or three voltage transformers with primary fuses may be mounted on the rollout tray located in positions C, D, E, and/or F. See the "Operating Sequence" section for disconnecting, connecting or withdrawal instructions.

Typical rollout tray and transformer locations are shown in the side views in **Figure 29**.

Table 5. Rollout Tray and Transformer Positions

Cell	Position	Rollout Tray May Be Used for:
A (Upper)	C	Voltage Transformer (VT)
	D	Voltage Transformer (VT) or Control Power Transformer (CPT) (up to 15kVA single phase) (Fuses for CPT may be installed in position D if position C is empty and the CPT is located in positions E & F)
B (Lower)	E	Voltage Transformer (VT)
	F	Voltage Transformer (VT) or Control Power Transformer (CPT) (up to 15kVA single phase) or Fuses for Control Power Transformer (CPT) with CPT installed in rear of section or remote (over 15kVA single phase, or any three phase)

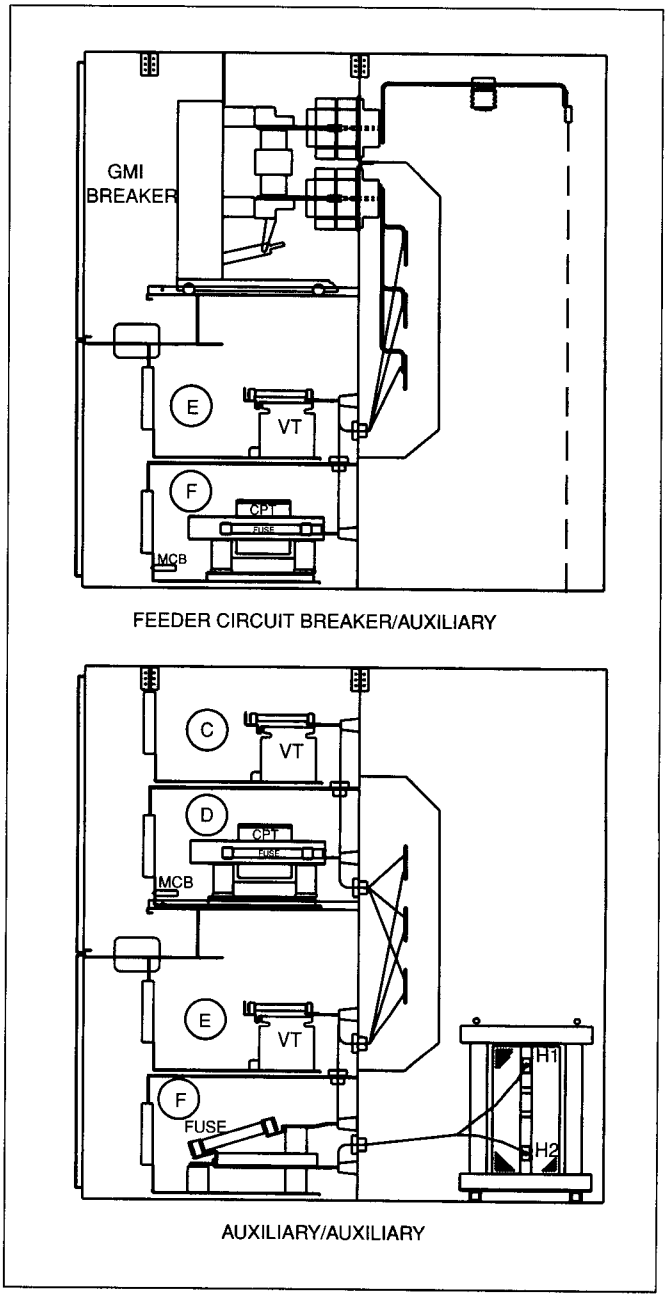
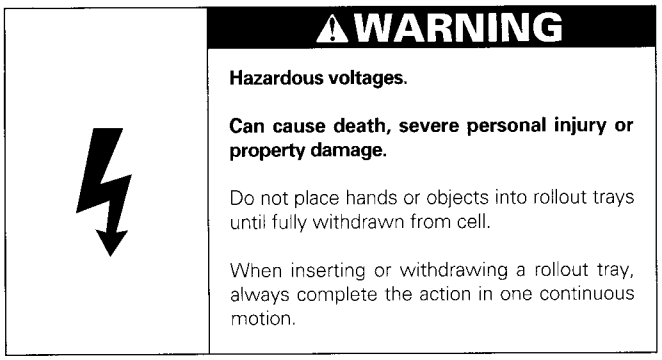


Figure 29. Typical VT, CPT, and CPT Fuse Rollout Locations

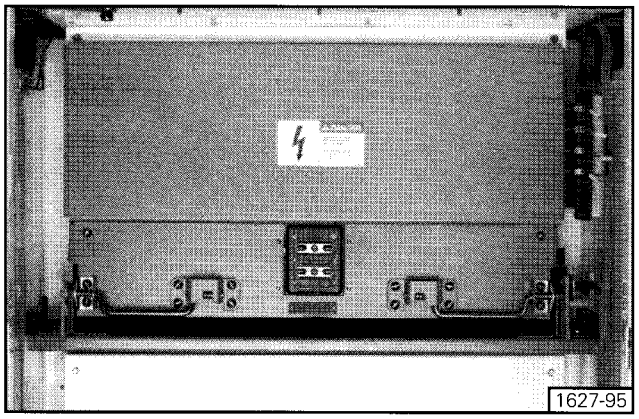
Control Power Transformer
Control power transformers, up to 15kVA single phase, with the associated primary fuses, may be mounted on a rollout tray in positions D and F. CPT's larger than 15kVA single phase, and all three phase CPT's, are stationary mounted, either in the rear of the switchgear section, or in the lower front cell, or remote. If the CPT is located in the rear of the section, the primary fuses are mounted on a rollout fuse tray which is located in position F in the lower front cell. If the CPT is located in the lower front cell, the primary fuses are mounted on a rollout fuse tray which is located in the upper cell in position D, and position C must be empty.

The secondary molded case circuit breaker is normally mounted on the front of the CPT rollout tray, interlocked with the tray so that the circuit breaker must be open before the tray can be withdrawn or inserted. For large units, the secondary molded case circuit breaker may be mounted separately, and key interlocked with the rollout fuse tray so that the secondary circuit breaker must be locked open before the rollout fuse tray can be withdrawn.

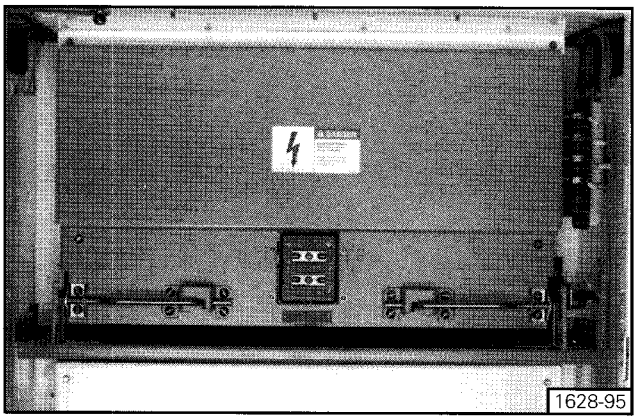
Operating Sequence



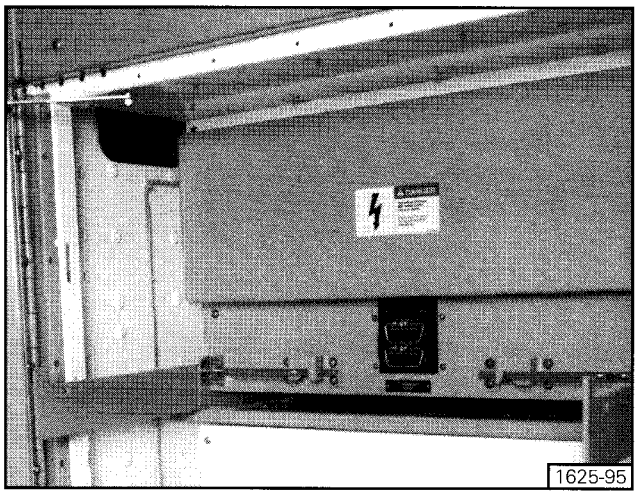
- **To Disconnect VT Rollout** (Refer to **Figure 30**) For disconnecting voltage transformers from the primary circuit, grasp the handle/interlock bar on each side of the rollout tray, and rotate the handle upward while pulling the handle horizontally towards the center of the unit. The handle will lodge in a "notched" area in the mounting bracket, and the interlock portion of the handle will be withdrawn from the guide rails on the side of the cell. When both handles are operated to the raised position, the rollout tray will be free to move. Withdraw the extension rails on each side of the cell to their fully extended position. Then, using the handles on the rollout tray, pull the tray in a smooth motion from the fully inserted (connected) position to the fully withdrawn (disconnected) position.
- **To Connect VT Rollout** Connecting (inserting) the voltage transformer rollout tray is the reverse of the disconnecting operation. The handle/interlock bars must be in their fully raised position, with the interlock bar withdrawn on each side of the rollout. Push the rollout tray in firmly to the fully connected position. Then, push the extension rails in to their fully inserted position. When this is done, holes in the extension rails should align with holes in the cell structure, which will allow the handle/interlock bar to be released, locking the rollout tray into the connected position in the unit.
- **To Disconnect CPT Rollout or CPT Fuses** (Refer to **Figure 31**) Withdrawal of a CPT rollout or a CPT fuse rollout is similar to withdrawal of a VT rollout, except that the secondary circuit breaker must be opened before the rollout tray can be withdrawn. If the secondary molded case circuit breaker is mounted directly on the rollout tray, the circuit breaker will be mechanically interlocked with one of the handle/interlock bars. If the circuit breaker is separately mounted, the circuit breaker will be key interlocked with the handle/interlock bar. Opening of the circuit breaker will allow operation of the key interlock, which will make the key available. This key should then be inserted in the key interlock on the rollout tray, to allow the tray to be withdrawn.
- **To Connect CPT Rollout or CPT Fuses** Connecting (inserting) the control power transformer rollout tray or CPT fuse tray is the reverse of the disconnecting operation. The secondary molded case circuit breaker must be in the open position, and if a key interlock is involved, the key must be inserted in the interlock cylinder on the rollout tray. The handle/interlock bars must be in their fully raised position, with the interlock bar withdrawn on each side of the rollout. Push the rollout tray in firmly to the fully connected position. Then, push the extension rails in to their fully inserted position. When this is done, holes in the extension rails should align with holes in the cell structure, which will allow the handle/interlock bar to be released, locking the rollout tray into the connected position in the unit. Once the rollout tray is fully inserted and the handle/interlock bars fully extended, molded case circuit breaker may be closed, either directly if mounted on the rollout tray, or indirectly if a key interlock is involved.



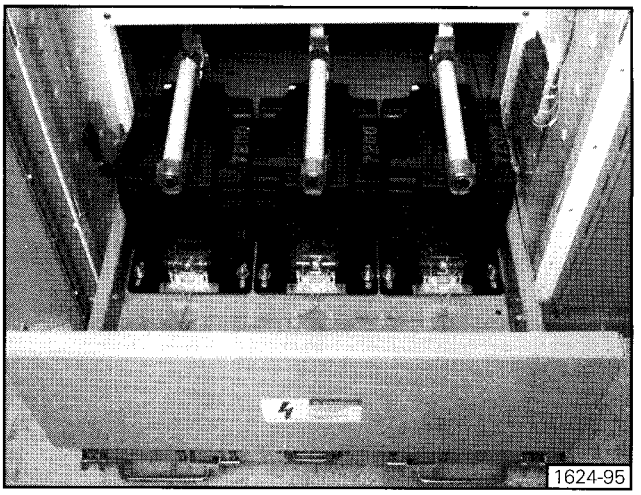
A: VT Rollout Tray in Connected Position. Handle/interlock Bars Fully Extended to Secure Rollout Tray in Cell.



B: Handle/interlock Bars Retracted, to Allow Rollout Tray to be Withdrawn.

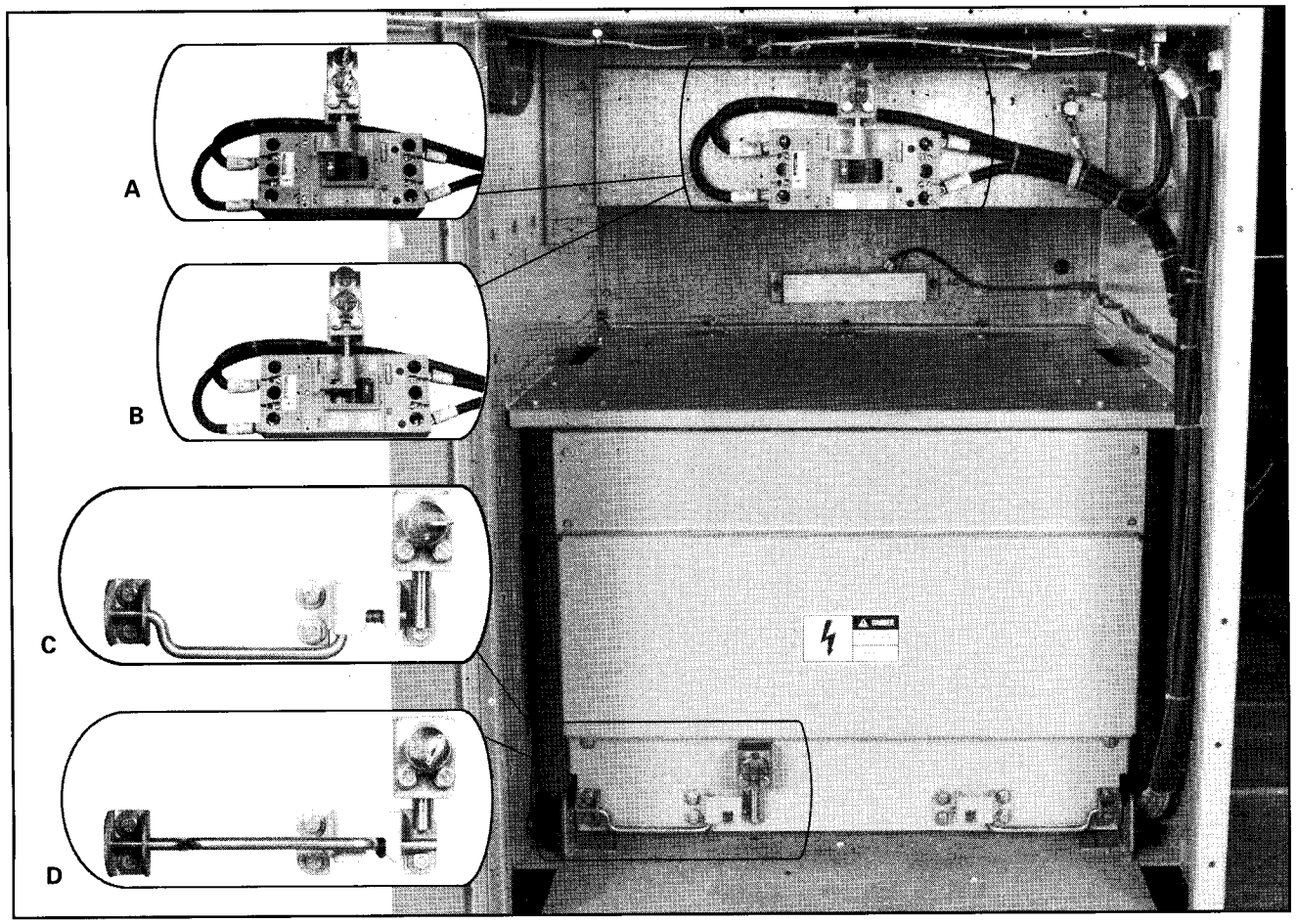


C: Extension Rails Withdrawn to Fully Extended Position.



D: VT Rollout Tray Withdrawn to Allow Inspection of Fuses.

Figure 30. VT Fuse Rollout Tray Operating Sequence



A: Step 1: Secondary breaker is closed. Open secondary breaker. (05092-89)

B: Step 2: Secondary breaker is open. Rotate key interlock, extending interlock to block closing of secondary breaker. Remove key. (05093-89)

C: Step 3: Key interlock on rollout tray is extended, preventing operation of handle/interlock bars. Insert key, rotate key interlock, withdrawing interlock so that handle/interlock bar is free to move. (05091-89)

D: Step 4: Key interlock withdrawn. Operate handle/interlock bar to allow withdrawal of rollout tray. (05090-89)

05102-89

Figure 31. CPT Fuse Rollout Tray with Key Interlocking

Current Transformers

The torroidal current transformers shown installed in a unit in **Figure 32** are the most commonly used type in metal-clad switchgear equipment. The circuit breaker primary studs pass through the transformers when in the CONNECT position. Types MD or MDD current transformers are of the torroidal type mounted in the circuit breaker compartment behind the shutter barrier. Up to two standard or one high accuracy current transformers may be mounted around each primary insulator tube.

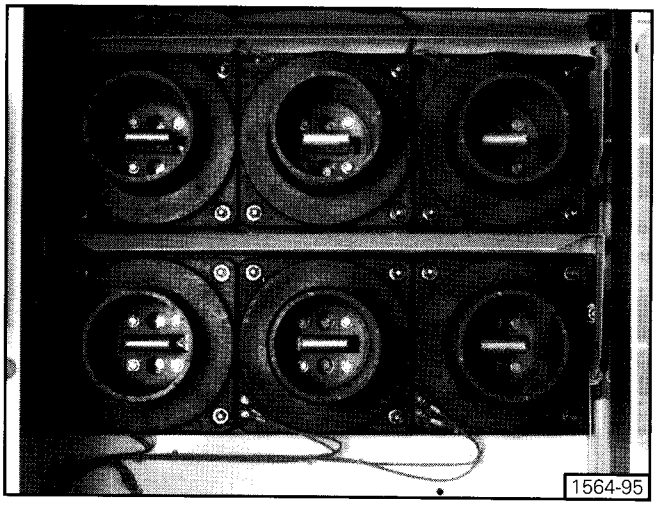


Figure 32. Type MD CT's Installed on Upper and Lower Disconnects (CT Barrier Removed for Photo)

A zero sequence torroidal current transformer can be furnished for ground sensing circuits. This transformer is mounted in the primary cable area at a convenient height for receiving purchaser's cables. Zero sequence current transformers may require that conduits for multiple bottom entrance cables be recessed.

Cell Preparation
The cell contains the positioning, interlocking and operating devices described below and shown in **Figures 33** and **35.** These devices must be checked for placement and freedom of operation.

Circuit Breaker Racking Mechanism
The circuit breaker racking mechanism is centered below the circuit breaker. It functions in conjunction with the trip-free interlock on the circuit breaker, to hold the circuit breaker trip-free between positions. Three positions are provided: DISCONNECT, TEST, and CONNECT.

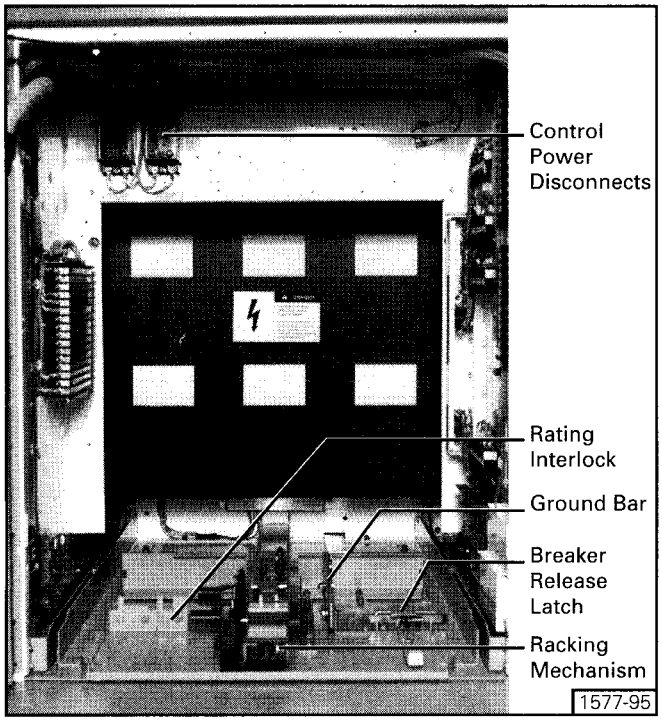


Figure 33. Circuit Breaker Compartment

Interference Blocking Plate
This plate is mounted vertically on the bottom of the cell to allow only the properly rated breaker into the designated cell (e.g., a 1200 ampere circuit breaker to enter a 1200 ampere cell, or a 2000 ampere circuit breaker to enter a 2000 ampere cell), depending on the voltage, interrupting, and close and latch ratings. Normally the cubicle and circuit breaker rating plate combinations will be identical.

⚠WARNING

Hazardous voltages.

Can cause death, severe personal injury or property damage.

Do not insert a circuit breaker into a cell intended for a circuit breaker with ratings above those of the circuit breaker being inserted.

Verify that circuit breakers and cubicles have appropriate ratings and properly located interference blocking plates and angles before attempting to insert a circuit breaker.

The interlock will allow a 2000 ampere circuit breaker to enter a 1200 ampere cell, provided the voltage, interrupting, and close and latch ratings equal or exceed the ratings of the cell.

The coordinating interference plate on the circuit breaker is shown in **Figure 34**.

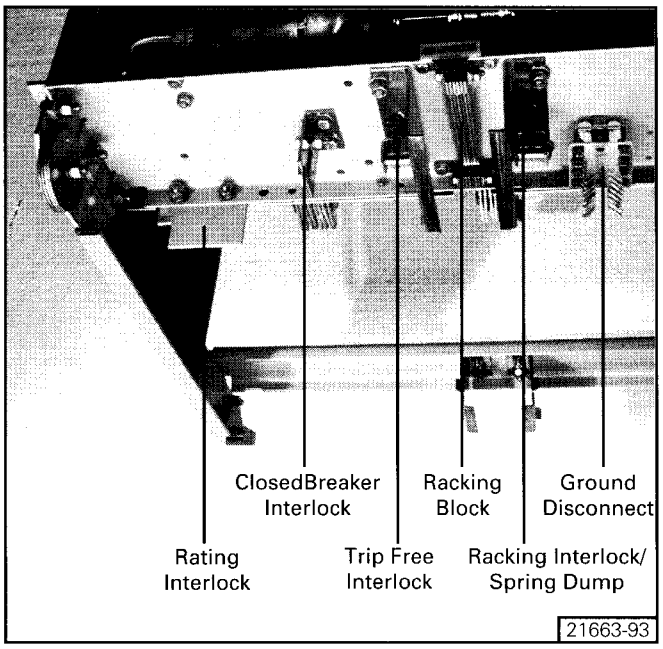


Figure 34. Interlocks on Bottom of Circuit Breaker

Secondary Disconnect
The secondary disconnect contains all the electrical control circuit connections for the circuit breaker. It mates with the secondary disconnect block on the circuit breaker. The circuit breaker contacts slide against the cell contact strips. The secondary contacts are automatically mated in the TEST and CONNECT positions.

Mechanism Operated Cell Switch (MOC)
This switch is operated by a roller on the circuit breaker. The breaker engages the MOC auxiliary switch only in the CONNECT (operating) position unless an optional TEST position pickup is specified in the contract. If a TEST position pickup is included, the breaker will engage the auxiliary switch in both positions. The MOC switch is illustrated in the lower portion of **Figure 35**. Up to 24 stages may be provided.

Truck Operated Cell Switch (TOC)
This switch is operated by an extension of the top plate at the right top corner of the circuit breaker. This switch is operated only as the circuit breaker is moved to or from the CONNECT position. The TOC switch is shown in the upper portion of **Figure 35**. Up to 12 stages may be provided.

Circuit Breaker Ground Connection

A sliding contact multiple finger assembly for grounding the circuit breaker frame is mounted underneath the breaker truck frame, as shown in **Figure 34**. This assembly engages the ground bar mounted in the cell and maintains a solid ground contact with a continuous wipe through all positions. The contact is broken when the breaker passes the DISCONNECT position while being removed from the cell.

Shutter Operation

Two shutter operating levers, one on each side of the breaker cell, are driven down by the engagement of the wheels on the circuit breaker frame. This opens the shutters as the circuit breaker is moved into the CONNECT position and allows the shutters to close when the circuit breaker is withdrawn. The shutters are fully closed with the breaker in the TEST position.

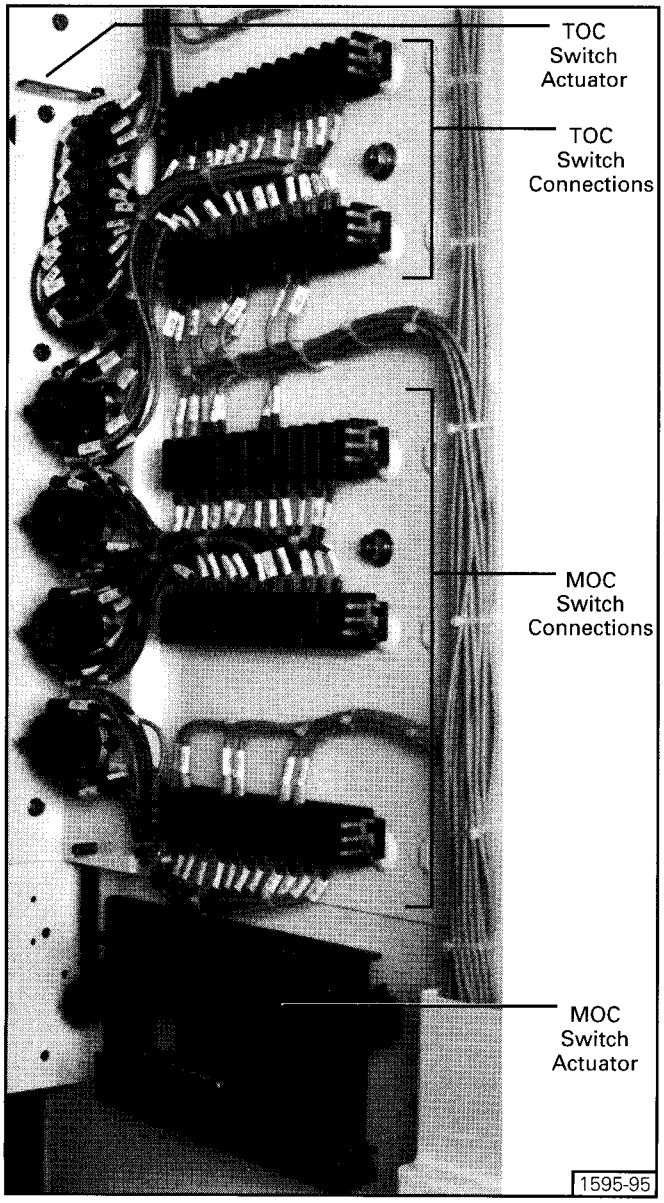


Figure 35. MOC and TOC Switches (cover removed for photo)

Breaker Installation and Removal

Type GMI Vacuum Circuit Breakers are normally shipped installed in the switchgear cells. They are normally shipped with their primary contacts open and the closing springs discharged. However, before racking of a circuit breaker or performing any inspection or maintenance, verify that the circuit breaker is open with closing springs discharged. Refer to instruction manual SG-3258 for information on installation, maintenance, and handling of these circuit breakers.

De-Energizing Control Power to Circuit Breaker

Locate the control power disconnect device associated with the circuit breaker. This disconnect (typically, a pullout type fuse holder) is normally located on the secondary device panel inside the circuit breaker cell. Removal of the fuse holder de-energizes control power to the circuit breaker in the respective switchgear cell. In some switchgear assemblies, a molded case circuit breaker is used in lieu of the pullout type fuse holder. Opening this circuit breaker accomplishes the same result: control power is disconnected.

Spring Discharge Check

Perform the Spring Discharge Check **before** inserting or removing the circuit breaker from the switchgear. Refer to **Figure 36.**

The spring discharge check consists of simply performing the following tasks in the order given. This check assures that both the tripping and closing springs are fully discharged.

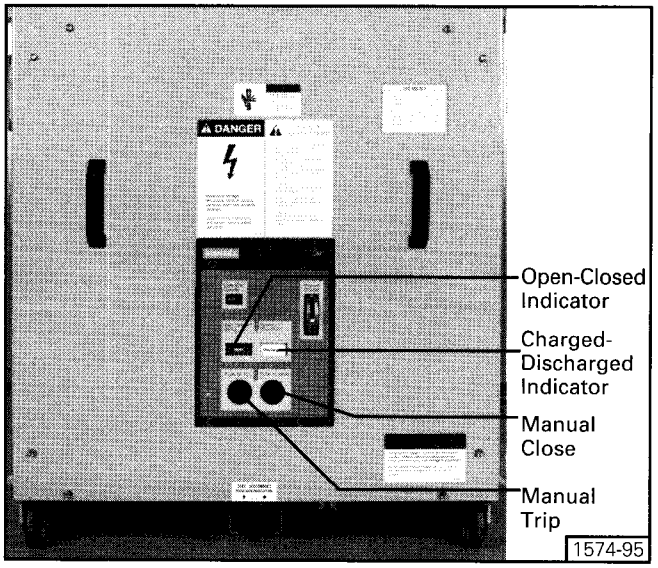


Figure 36. Front Panel Controls of GMI Circuit Breaker

⚠DANGER

Hazardous voltages and high-speed moving parts.

Will cause death, severe personal injury or property damage.

Read instruction manuals, observe safety instructions, and use qualified personnel.

Note: Do not perform Spring Discharge Check if the circuit breaker is in the CONNECT position. Open circuit breaker and rack to the DISCONNECT position, and then perform the Spring Discharge Check.

1. Assure that breaker is not in CONNECT position in cell.
2. Open control power disconnect (e.g., pull fuseholder or open molded case circuit breaker).
3. Press red Trip pushbutton.
4. Press black Close pushbutton.
5. Again press red Trip pushbutton.
6. Verify Spring Condition Indicator shows DISCHARGED.
7. Verify Main Contact Status Indicator shows OPEN.

Removal from Cell in Indoor (if not on raised pad) and Shelter-Clad Outdoor Switchgear

After performing the Spring Discharge Check (with control power de-energized), remove the circuit breaker from its switchgear cubicle.

1. Insert the racking crank on the racking screw on the front of the breaker cell, and push in (see "Racking Crank Engagement Procedure"). This action operates the racking interlock latch. **Figure 37** shows racking of a circuit breaker.
2. Rotate the racking crank **counterclockwise** until the breaker is in the DISCONNECT position.
3. Release the breaker release latch and pull the circuit breaker out from the DISCONNECT position. The breaker can now be removed from cubicle.
4. The circuit breaker is now free to be rolled out on the floor using the handles as shown in **Figure 38.** The wheels of the circuit breaker are virtually at floor level (unless the switchgear is installed on a raised pad), and one person can easily handle the unit.

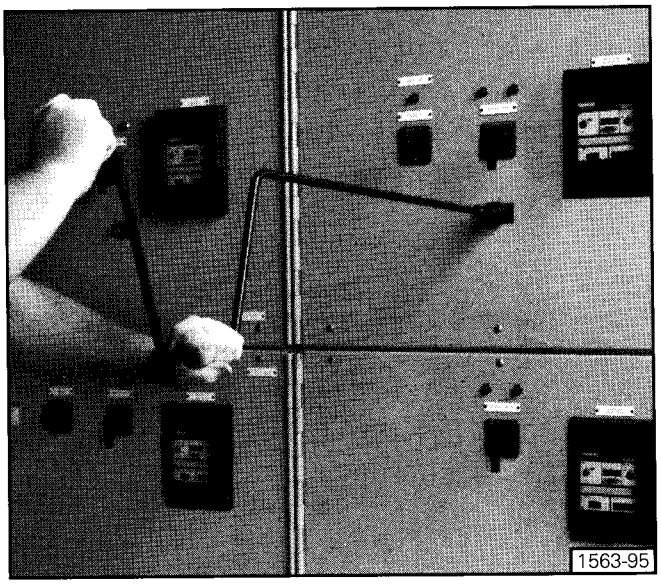


Figure 37. Racking of Circuit Breaker

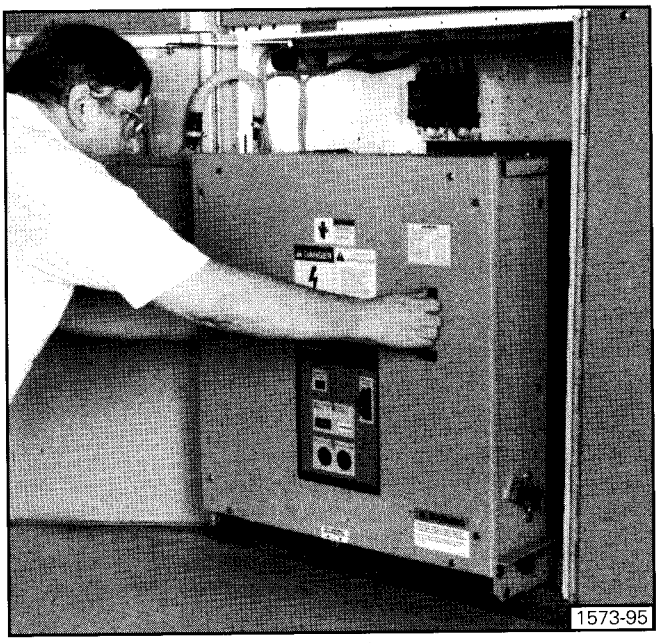


Figure 38. Removal of Circuit Breaker

Removal from Cell in Outdoor Non-Walk-In Enclosures, or for Indoor Switchgear Installed on a Raised Pad
Removal of the breaker from a non-walk-in outdoor switchgear assembly is similar to removal of a breaker at floor level, with several additional steps.

Figure 39 shows one of the two breaker extension rails being inserted into the fixed rails within the breaker cell. The rails engage locking pins in the fixed rails to secure them in position.

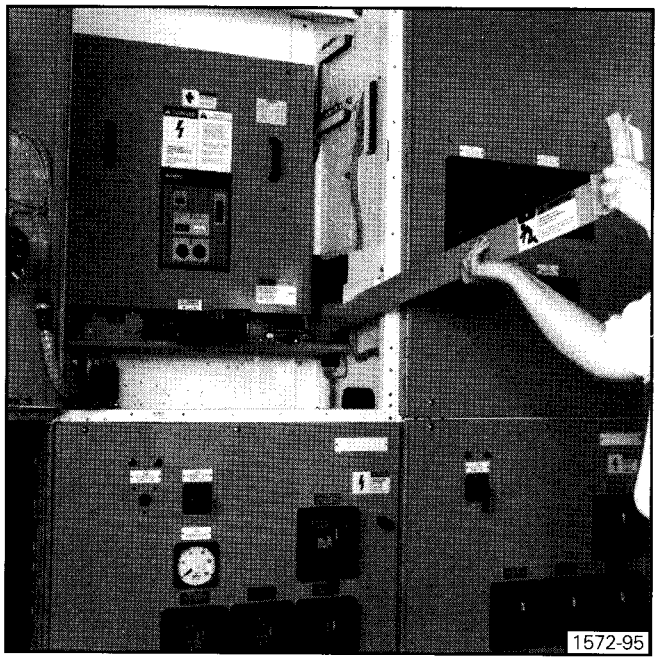


Figure 39. Use of Extension Rails for Removal of Circuit Breaker from Upper Compartment

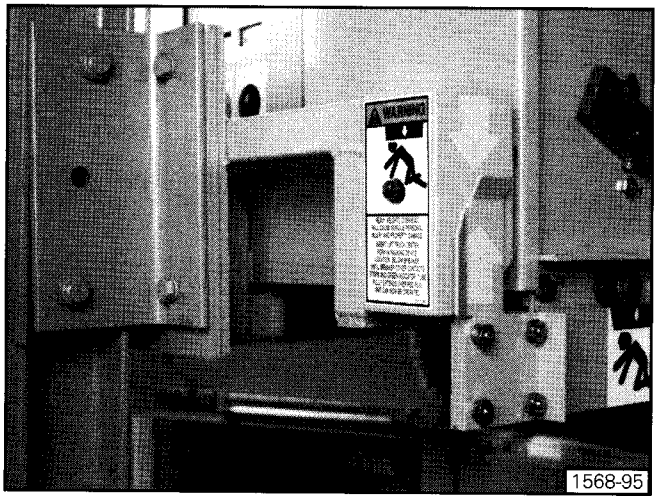


Figure 40. Lift Truck Engaged

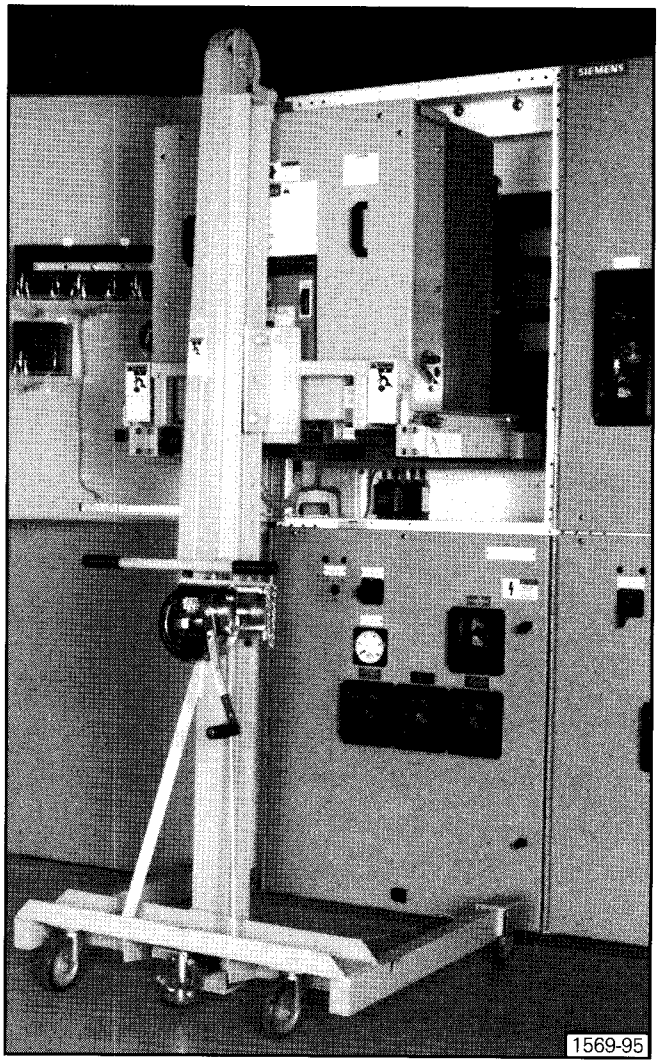


Figure 41. Lift Truck with Circuit Breaker

The procedure for removal of a circuit breaker not located at floor level is:

1. Insert the two extension rails into the fixed rails. Be sure the extension rails are properly secured in place. (This can be done at Step 4 if preferred.)
2. Insert the racking crank on the racking screw on the front of the breaker cell, and push in (see "Racking Crank Engagement Procedure"). This action operates the racking interlock latch.
3. Rotate the racking crank **counterclockwise** until the breaker is in the DISCONNECT position.
4. If you have not yet installed the extension rails, do so now. Note that some difficulty may be experienced installing the extension rails if the circuit breaker is in the DISCONNECT position. If difficulty is encountered, rack the circuit breaker to the TEST position, install the extension rails, and then rack the circuit breaker to the DISCONNECT position.

⚠WARNING

Heavy weight.

Can cause death, serious injury, or property damage.

Always use extension rails to remove or install circuit breaker in cells not installed at floor level.

5. Release the breaker release latch and pull the circuit breaker out from the DISCONNECT position. The breaker is now free to be rolled out on the two extension rails using the handles on the front of the circuit breaker.
6. Remove the breaker from the two extension rails using the approved Siemens breaker lifting device (see **Figures 40** and **41**), or a lifting sling (see **Figure 48**) and a suitable crane.
7. Lift the two extension rails and withdraw them from the switchgear.

Type GMI circuit breakers weigh between 385 and 575 pounds (175-261kg), depending upon their ratings. The breaker can be moved using a properly rated crane and lift sling. A lift sling can be attached to the breaker, and then used to hoist the circuit breaker vertically clear of the extension rails. When clear, remove the rails and lower the circuit breaker to the floor.

⚠WARNING

Heavy weight.

Can cause death, serious injury, or property damage.

Never transport a circuit breaker on a lift truck or other lifting device with the circuit breaker in the raised position.

Racking Crank Engagement Procedure

A crank for racking the drawout circuit breaker is provided as a standard accessory. Racking of a circuit breaker can be accomplished with the drawout compartment front door open or through a small opening (or window) in the front door, with the door closed.

The racking crank consists of an offset handle with a custom socket assembly welded to the opposite end. The socket end of the crank is designed to engage the square shoulder of the racking mechanism shaft and remain engaged during racking by means of two spring plungers located 180 degrees from each other. The spring plungers operate in a manner similar to the retainers on an ordinary mechanic's socket wrench.

The portion of the racking mechanism shaft which is visible is cylindrical, and the square shoulder of the racking mechanism shaft is hidden by a shroud until the engagement procedure starts. The square socket end of the crank will only engage the square portion of the shaft if it is aligned properly.

The suggested procedure to engage the racking mechanism is as follows:

1. The breaker must be open. (The racking shroud cannot be moved if the breaker is closed).
2. Hold the socket end of the crank in one hand and the crank handle in the other hand. Refer to **Figure 42.**
3. Place the socket over the end of the racking mechanism shaft. Align the spring plunger of the socket with the shoulder on the racking mechanism shaft. **Note:** If the socket is not aligned, the socket will not be able to engage. The socket (square) must be aligned with the square shoulder of the racking mechanism shaft.
4. Once alignment is achieved, firmly push the crank and socket assembly toward the racking mechanism.
5. When properly engaged, the crank should remain connected to the racking mechanism, due to the spring plungers. If the crank does not remain in position, adjust the spring plungers clockwise one-half turn. This will increase the contact pressure of the spring plunger.
6. To remove the crank, simply pull the assembly off of the racking mechanism shaft.

Note: If the effort to rack the circuit breaker increases considerably during racking, or if turning of the racking crank requires excessive force, stop racking immediately. Do not try to "force" the racking crank to rotate, or parts of the circuit breaker or racking mechanism could be damaged. Determine the source of the problem and correct it before continuing with the racking.

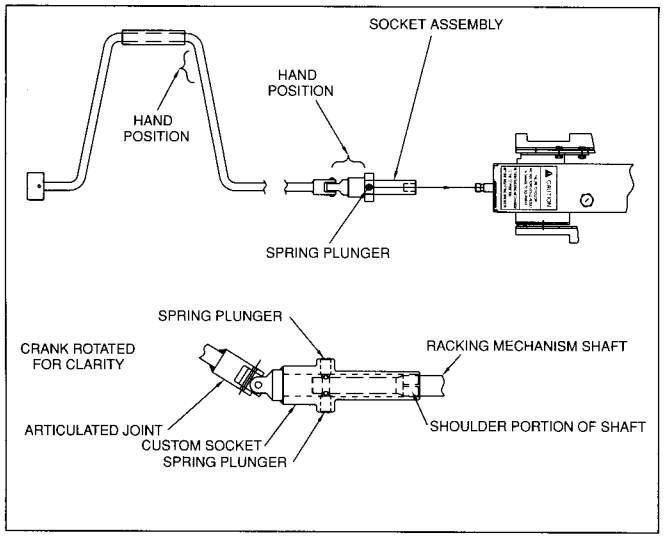


Figure 42. Racking Crank Engagement Procedure

Breaker Racking
When inserting a circuit breaker into a cell, be sure that the racking block is in the lowered position as shown in **Figure 43**. In this position, the racking position indicator should show a green square with the letter "D" for DISCONNECT position. If the racking block is in the raised position, **Figure 44**, use the racking crank to move the racking block to the lowered position.

Important: Failure to follow instructions may result in damage to equipment.

Return racking mechanism to the DISCONNECT position before inserting circuit breaker.

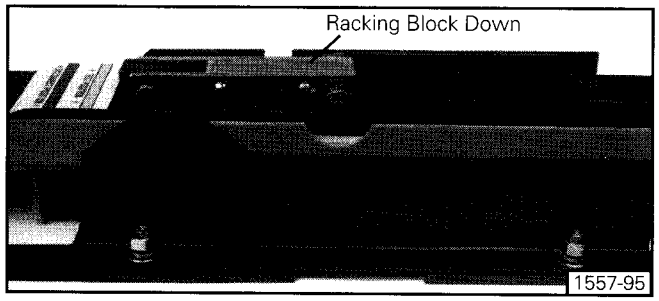


Figure 43. Racking Mechanism with Racking Block Down

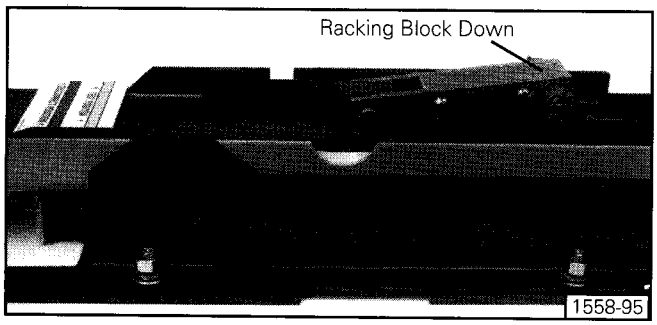


Figure 44. Racking Mechanism with Racking Block Up

The circuit breaker racking method has been designed to be used with the instrument door either open or closed. Moving the breaker between the CONNECT and TEST or DISCONNECT positions with the door closed provides additional protection to the operator and is the recommended procedure.

Racking from DISCONNECT to CONNECT Position
1. Check the position indicator shows "D" for DISCONNECT position.
2. Check that the circuit breaker is fully pushed into the cell to the DISCONNECT position.
3. Check that the circuit breaker is OPEN.
4. Secondary disconnects will automatically connect as the circuit breaker moves to the TEST and CONNECT position.
5. Close instrument door.
6. Insert racking crank through round opening at bottom of door and onto the racking screw (see "Racking Crank Engagement Procedure").
7. Push the racking crank forward to move the closed breaker racking interlock slide back which will allow the socket to engage the hex head on the racking screw. Do not force slide as it is interlocked to prevent sliding forward when the circuit breaker is closed.
8. Rotate the racking crank **clockwise** about 54 turns until a positive stop is felt and the position indicated shows "C" for the CONNECT position. The indicator will show "T" when the circuit breaker is in TEST position.

Racking from CONNECT to TEST or DISCONNECT Position
1. This procedure is essentially the same as racking to connected position procedure except the rotation is counterclockwise.
2. Check that the circuit breaker is open.
3. Close instrument door.
4. Insert racking crank (see "Racking Crank Engagement Procedure") and rotate **counterclockwise** about 54 turns to a positive stop and the position indicator indicates "D" for DISCONNECT position. The intermediate TEST position is indicated by "T".

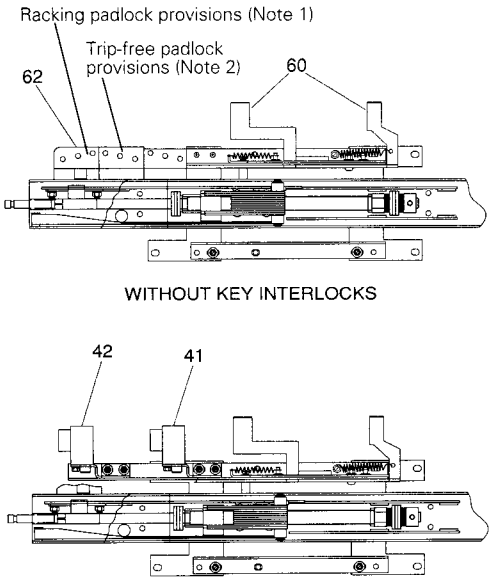
Contact Penetration
Make certain all electrical connections to both the line/load and bus disconnects are de-energized and locked out. This can be verified by blocking the shutters open and using a hot stick potential device to double-check that all disconnects are de-energized. Rack the breaker completely into the CONNECT position and then withdraw it from the cell. Check that the contact wipe is about 3/8" (10mm) on the cell primary disconnects, for all breaker ratings.

Closed Breaker Racking Interlock
The closed breaker racking interlock is designed to prevent a breaker from being racked from TEST to CONNECT and vice-versa with the primary contacts closed. Only an open circuit breaker is to be moved between these positions. Refer to **Figure 45.**

The trip free interlock slide has angle-shaped members (**Figure 45**, item 60) that project from the left side of the racking mechanism and engage an interlock member from the circuit breaker. The circuit breaker interlock extends down to prevent movement of the trip free interlock slide with the circuit breaker closed. When engaged, the racking screw is not accessible to the racking crank until the breaker has been opened.

Note: Racking handle must be removed, allowing the interlock slides to return to their initial position. The breaker may now be closed mechanically or electrically.

Racking Access Interlock
The racking interlock slide (**Figure 45**, item 62) has provisions for three padlocks to prevent engagement of the racking crank to the racking screw. This allows locking of the circuit breaker in DISCONNECT, TEST, or CONNECT positions. Key interlocking (**Figure 45**, item 42) can be provided for racking sequence interlocking of dummy breakers, etc. When the key interlock bolt (on key interlock item 42) is extended, the racking interlock slide (item 62) is held in place, preventing access to the racking screw, thus preventing racking. When locked in the DISCONNECT position, the circuit breaker or dummy can be removed for servicing.



Note 1: Racking padlock provisions– when padlocked, prevents racking of circuit breaker, test device, or dummy breaker element. Suitable for up to three padlocks with up to 3/8" diameter shackle.

Note 2: Trip-free padlock provisions– when padlocked, prevents closing of circuit breaker or test device. suitable for up to three padlocks with up to 3/8" diameter shackle.

Figure 45. Racking Mechanism and Interlocks

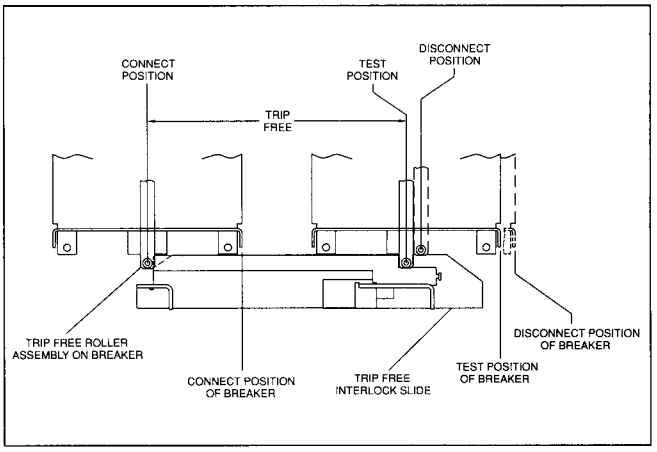


Figure 46. Trip Free Interlock Positions (Viewed from left side of circuit breaker)

Trip-Free Interlock
The trip-free interlock slide prevents a circuit breaker from being closed between the TEST and CONNECT positions by maintaining a mechanical and electrical trip-free condition (**Figure 46**).

As the breaker moves between the TEST and CONNECT positions, the trip-free roller engages the trip-free rail of the racking device. As the roller travels the trip-free rail between positions, the roller activates the trip linkage which holds the circuit breaker in a mechanically trip-free condition.

In order to lock the circuit breaker trip-free in either the TEST or CONNECT positions, the breaker must be opened and the trip-free interlock slide assembly pushed forward to lift the trip-free roller on the breaker. This position permits the use of a key interlock (**Figure 45**, item 41) or padlocks (up to 3) to maintain the mechanism in trip-free position. The circuit breaker can be removed for servicing while interlocked in the trip-free position.

The interlock can be tested by racking the circuit breaker to a position between the TEST and CONNECT position with the closing springs charged. Activating the "close" function manually will cause the springs to discharge and the interlock should prevent the circuit breaker from closing. Activating the "close" function electrically (such as by using the control switch) should cause no operation. This is also true when the breaker is in either the TEST or CONNECT positions and the trip-free interlock slide is pushed forward and key interlocked or padlocked. The breaker will operated trip-free when closing is attempted.

Spring Discharge Interlock
The closing spring discharge interlock prevents the insertion or removal of a circuit breaker with a charged mechanism. The spring dump roller rides up a rail releasing the closing springs while held trip-free. This discharges the closing springs without closing the breaker primary contacts. (**Figure 33**).

Inspection and Testing
Before the equipment is energized, it must be thoroughly inspected and tested. Correct any deviations before energization.

Inspection
Check the following points:
1. High voltage connections properly insulated.
2. Electrical disconnecting contacts, machined parts, shutter, etc., checked for lubrication and operation.
3. Blocking, supports and other temporary ties removed from breakers, instruments, relays, etc.
4. Proper fuses correctly placed.
5. Temporary wiring jumpers (used on the secondaries of current transformers wired to external devices, as shown on wiring diagrams) removed.
6. Ground connections properly made.
7. Incoming primary and secondary connections properly made and checked for shorts or undesired grounds.
8. All equipment which has been removed during assembly has been replaced.
9. Relays coordinated with other relays and protection devices on the system. Refer to relay instructions before making any adjustments. Consult the local utility before making any connections to the power supply.
10. Storage battery fully charged and provided with recharging facilities.
11. Interlocks performing properly.
12. Circuit breakers checked and prepared per instruction books.
13. All filters in vent areas are clean and free of shipping or construction material.

Testing
1. An insulation resistance test is made on the high voltage circuit to be sure that all connections made in the field are properly insulated. An insulation resistance test is also advisable on the control circuit.

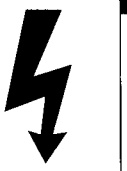
2. A dielectric test, if possible, should be made on the high voltage circuit for one minute at one of the following voltages corresponding to the rated voltage of the equipment. (**Note:** Voltage transformers, control power transformers, surge arresters, and surge capacitors must be disconnected during this test).

Rated Maximum Voltage	Power Frequency Withstand	Field Test Voltage	
kV (rms)	kV (rms)	kV (rms)	kV (dc)
4.76	19	14.25	20.2
8.25	36	27	38.2
15	36	27	38.2

Note: The DC test voltage is given as a reference only for those using DC tests to verify the integrity of connected cable installations without disconnecting the cables from the switchgear. It represents values believed to be appropriate and approximately equivalent to the corresponding power frequency withstand test values specified for each voltage rating of switchgear. The presence of this column in no way implies any requirement for a DC withstand test on AC equipment or that a DC withstand test represents an acceptable alternative to AC withstand tests. When making DC tests, the voltage should be raised to the test value in discrete steps and held for a period of one minute.

In accordance with ANSI C37.20.2 Clause 5.5, Field Dielectric Tests are also recommended when new units are added to an existing installation, or after major field modifications. The equipment should be put in good condition prior to 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, moisture, or other contaminants without being first restored to good condition.

A dielectric test on secondary and control circuits should be made for one minute at 1125 volts AC or 1590 volts DC. The above voltages are in accordance with NEMA Standards. (**Note:** Certain control devices, such as motors and motor circuits, should be tested at 675 volts AC. Electronic devices should be tested at the voltages specified in the instruction manual for the electronic device).



⚠ CAUTION

Excessive test voltages.

May result in damage to equipment.

Do not perform dielectric tests at test voltages exceeding the ratings of the tested equipment.

3. With breaker in the TEST position make the following tests on each unit:
   A. Trip and close the circuit breaker with the control switch.
   B. Trip the breaker by passing sufficient current (or voltage, if applicable) through the coils of protective relays.
   C. Trip and close the breaker from any remote control locations.
   D. Operate auxiliary devices.
   E. Test the phase sequence of polyphase high voltage circuits, particularly those used for motor starting.

Placing Equipment into Service
To place equipment in service for the first time proceed as follows:
1. Check that all circuit breakers are open and all control circuits energized.
2. Connect primary incoming power source to equipment.
3. Check all instruments, relays, meters, etc., during this time.
4. Connect as small a load as possible and observe instruments. **Note:** Allow several minutes before connecting additional load.
5. Gradually connect more load to the equipment while observing instruments until the full load is connected.
6. Check for signs of overheating of primary and secondary circuits and satisfactory operation of all instruments during the first week of operation.

Introduction and Maintenance Intervals

Periodic inspections and maintenance are essential to obtain safe and reliable operation of the switchgear. When Type GM switchgear is operated under "Usual Service Conditions", maintenance and lubrication is recommended at five year intervals. "Usual" and "Unusual" service conditions for Medium Voltage Metal-Clad Switchgear are defined in ANSI C37.20.2, clauses 3 and 7.1. Generally, "usual service conditions" are defined as an environment in which the equipment is not exposed to excessive dust, acid fumes, damaging chemicals, salt air, rapid or frequent changes in temperature, vibration, high humidity, and extremes of temperature.

The definition of "usual service conditions" is subject to a variety of interpretations. Because of this, you are best served by adjusting maintenance and lubrication intervals based on your experience with the equipment in the actual service environment.

Regardless of the length of the maintenance and lubrication interval, Siemens recommends that circuit breakers should be inspected and exercised annually.

⚠DANGER

Hazardous voltages and high-speed moving parts.

Will cause death, personal injury, and property damage.

Do not work on energized equipment. Always de-energize and ground the equipment before working on the equipment.

For the safety of maintenance personnel as well as others who might be exposed to hazards associated with maintenance activities, the safety related work practices of NFPA 70E, parts II and III, should always be followed when working on electrical equipment. Maintenance personnel should be trained in the safety practices, procedures and requirements that pertain to their respective job assignments. This manual should be reviewed and retained in a location readily accessible for reference during maintenance of this equipment.

The user must establish a periodic maintenance program to ensure trouble-free and safe operation. The frequency of inspection, periodic cleaning, and preventive maintenance schedule will depend upon the operation conditions. NFPA Publication 70B, "Electrical Equipment Maintenance" may be used as a guide to establish such a program. **A preventive maintenance program is not intended to cover reconditioning or major repair, but should be designed to reveal, if possible, the need for such actions in time to prevent malfunctions during operation.**

Switchgear assemblies are enclosed on all sides and top with sheet metal. Access into the enclosure is provided by doors or removable covers. Although the bus and connections are insulated in metal-clad switchgear assemblies, it is a coordinated insulation system; insulation plus air or creep distance equals a given insulation level.

⚠DANGER

Hazardous voltages.

Will cause death, severe personal injury, and property damage.

Do not contact energized conductors. Before working on or near high voltage conductors within switchgear, be sure they are de-energized and properly grounded.

See ANSI C37.20.2, clause 6.2.3, which reads as follows:

> This insulating covering is a requirement of metal-clad switchgear and is provided to minimize the possibility of communicating faults and to prevent development of bus faults that would result if foreign objects momentarily contacted bare bus. This insulating covering is usually only a part of the primary insulation system and in such cases the outer surface of this insulating covering will not be at ground potential. It should not be assumed, therefore, that personnel can contact this insulating covering with complete safety.

Recommended Hand Tools

Type GM switchgear and type GMI circuit breakers use both standard American and metric fasteners. American fasteners are used in most locations in the switchgear cubicles.

Recommended Maintenance and Lubrication

Periodic maintenance and lubrication should include all the tasks shown in **Table 6**.

⚠WARNING

Failure to maintain the equipment could result in death, serious injury or product failure, and can prevent successful functioning of connected apparatus.

The instructions contained herein should be carefully reviewed, understood, and followed.

The maintenance tasks in **Table 6** must be performed regularly.

Table 6. Maintenance Tasks

1. Before any maintenance work is performed within primary compartments, make certain that the equipment is completely de-energized, tested, grounded, tagged or properly identified and released for work in an authorized manner.
2. Before starting work on the switchgear, the following should be completed on any equipment that will affect the area of the work:
   - A. Disable remote control and automatic transfer schemes.
   - B. De-energize all direct and back feed power and control sources, test and ground.
   - C. Disconnect all voltage and control power transformers.
   - D. Open all disconnects.
3. Include the following items in your inspection procedure:
   - A. Check general condition of switchgear installation.
   - B. Inspect switchgear interior for accumulation of dust, dirt or any foreign matter.
   - C. Clean air filters by washing in any mild household detergent.
   - D. Examine indicating lamps and replace as required.
   - E. Check terminal block contacts for loose connections.
   - F. Check instrument and control switches and inspect their contacts.
   - G. Check for proper condition of instrument transformers. Replace burned out fuses, if any. Check primary and secondary connections.
   - H. Remove dust from all insulators and insulation.
   - I. Inspect bus bars and connections for proper condition. If bus bars are overheating check for poor or loose connections or for overload.
   - J. Examine automatic shutters for proper operation.
   - K. Examine all safety interlocks.
   - L. Perform maintenance of circuit breakers as outlined on circuit breaker instruction manual.
   - M. Check space heaters and thermostat (if equipped) for proper operation.
   - N. Maintain other equipment per their respective instruction book requirements.
   - O. Lubricate mechanisms, contacts, and other moving components.
   - P. Replace, reassemble, re-insulate, return all items to proper operating conditions and remove grounds prior to energization.

The list of tasks in **Table 6** does not represent an exhaustive survey of maintenance steps necessary to ensure safe operation of the equipment. Particular applications may require further procedures. Should further information be desired or should particular problems arise which are not covered sufficiently for the Purchaser's purposes, the matter should be referred to the local Siemens sales office.

The use of unauthorized parts in the repair of the equipment, or tampering by unqualified personnel will result in dangerous conditions which can cause death, serious injury or equipment damage. Follow all safety instructions contained herein.

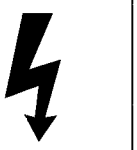
Lubrication

It is essential that switchgear be lubricated carefully and properly to guard against corrosion and to insure that all operating parts work freely.

A tube lubricant for this purpose, is furnished by Siemens packed with accessories. Old grease should be removed annually and parts relubricated. Relubricate at more frequent intervals if required. Lubricant Part No. 15-171-370-001.

Moving Parts

Lubricate shutter guide, bearings, rollout fuse truck moving parts, etc., with dry spray lubricant Siemens Part No. 15-171-270-001. Note: Use of lubricant not suitable for the application will make the mechanism very difficult to operate.



⚠DANGER

Hazardous voltages.

Will cause death, personal injury, and property damage.

Do not open shutters unless both line/load and bus are first de-energized.

Electrical Contacts

Lubricate stationary silver-surfaced contacts with electrical contact lubricant Part No. 15-171-370-002 prior to use, as follows:

1. Wipe contacts clean.
2. Apply lubricant to contact surfaces.
3. Wipe off excess lubricant, leaving a film. Avoid getting lubricant on insulation.

Cleaning Insulation

Most of the plastics and synthetics used in insulation systems are attacked by solvents containing aromatics or halogenated hydrocarbons. The use of these may cause crazing and deformation of the material reducing the dielectric strength. ISOPROPYL ALCOHOL IS THE ONLY RECOMMENDED SOLVENT CLEANER.

Maintenance

⚠DANGER

Hazardous voltages.

Can cause death, personal injury, and property damage.

Use only recommended solvents for cleaning insulation materials.

Corrosive Atmospheres

This switchgear is designed to give top performance when installed in normal indoor or outdoor locations. Where abnormal conditions, such as corrosive atmospheres, are encountered, special precautions must be taken to minimize their effect. Exposed metallic surfaces, non-insulated bus bars, disconnect switches, primary and secondary disconnecting contacts, wire ends, instrument terminals, etc., must all be protected. At each maintenance inspection, all of the old grease should be wiped off of the contacts and new lubricant applied to all sliding surfaces. Apply the contact lubricant in a layer .03-.06" (1-2mm) thick. Use only Siemens Electrical Contact Lubricant, Part No. 15-171-370-002, available in 8 oz. (.23kg) tubes. Other exposed components can be protected with a coat of glyptol or other corrosion-resistant coating.

When old grease becomes dirty, wipe the part clean and apply new grease immediately.

Relays and Instruments

To insure satisfactory operation of relays and instruments do not leave device covers off longer than necessary. When a cover has been broken, cover the device temporarily and replace broken glass as soon as possible.

Equipment Surfaces

Inspect the painted surfaces and touch up scratches as necessary. Touchup paint is available from Siemens. This paint matches the unit and is thinned and ready for use in one pint (473mm^3) spray cans.

Split Plug Jumper Test Device
When specified, a split plug jumper test device is supplied. This device allows a circuit breaker to be operated from the control switch on the instrument panel while the circuit breaker is outside of and adjacent to its cell.

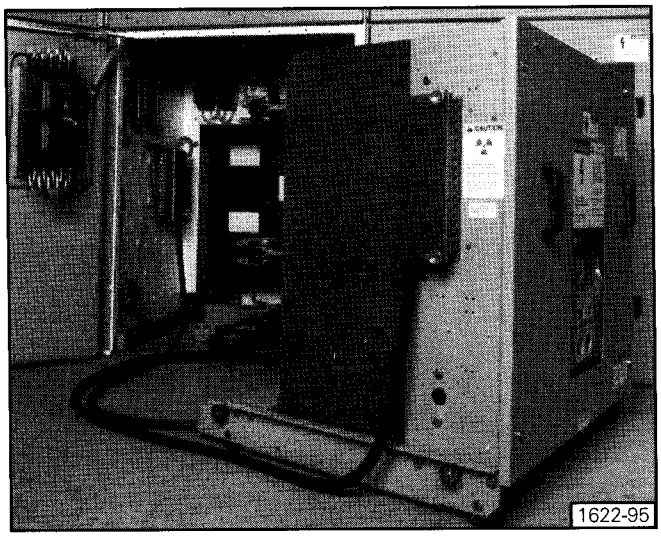


Figure 47. Split Plug Jumper

The split plug jumper consists of a length of flexible cable with terminal plugs on each end. These terminals can be connected to the secondary disconnects on the circuit breaker and in the cell. When connected the circuit breaker can be opened or closed electrically from the instrument panel control switch.

Test Cabinet
When specified, a test cabinet is supplied. This device allows a circuit breaker to be operated from a control switch in a cabinet, which is wall mounted by the purchaser. A length of flexible cable is connected to the cabinet and has a terminal plug on the other end which may be connected to the secondary disconnects on the circuit breaker. When connected, the circuit breaker can be opened or closed electrically from the control switch on the test cabinet, which is connected to a suitable power supply by purchaser.

Lift Truck
When specified, a lift truck is supplied (see **Figure 41**) for handling circuit breakers. The lift truck is useful whenever circuit breakers are installed above floor level. For Shelter-Clad installations, the lift truck is normally stored in the aisle area, as it does not conveniently pass through the aisle doorway.

Lift Sling
If a lift truck is not provided, a lift sling is supplied as standard when circuit breakers are installed above floor level. The lift sling is suitable for use with any crane which has an adequate capacity (750 lbs. or 340kg minimum). **Figure 48** shows a lift sling being used to lift a circuit breaker.

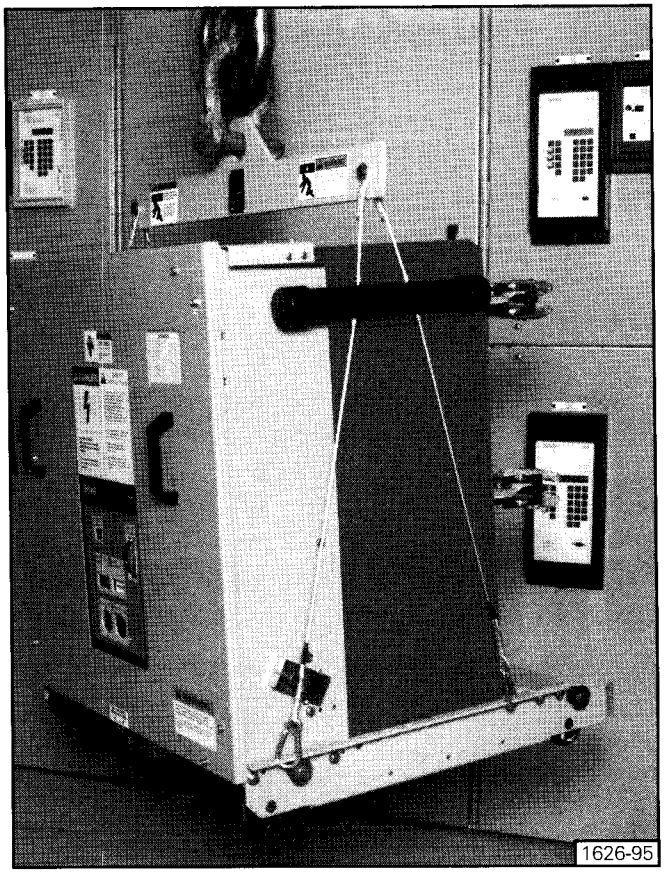


Figure 48. Lift Sling in Use to Handle Circuit Breaker

Electric Racking Accessory
An optional electric racking accessory is available. The accessory consists of a motor drive enclosure which installs on mounting brackets on the switchgear front panel of a circuit breaker compartment. The unit includes a power cord, which can be connected to a convenient power source in the vicinity of the switchgear. Instructions for mounting the racking accessory and for racking of circuit breakers are provided on a label on the racking accessory.

Type 3EF Surge Limiters

The type 3EF Surge Limiter is used with vacuum circuit breakers and contactors to prevent the development of excessive overvoltages due to multiple reignitions or virtual current chopping. This is primarily of concern during the starting of motors and the switching of reactive loads. Surge limiters are recommended in the applications shown in **Table 7**. If surge limiters are provided, and an overvoltage does occur, the magnitude of the voltages will be limited to the values indicated in **Table 8**. Recommended service voltages for each limiter are also shown in this table.

Surge limiters are intended to be used in cable network systems to protect motors, transformers, and reactors from the effects of voltage surges associated with vacuum breaker operations. If lightning or switching surges may be present, the equipment must be properly protected by means of surge arrestors.

The surge limiters must be disconnected from the equipment before any high potential testing is performed. The one-minute test period for the application of these test voltages to switchgear may damage the surge limiters.

Table 7. Type 3EF Surge Limiter Application Recommendations

Protected (Load) Equipment	Surge Limiter Recommended
Liquid transformers	No
Dry type transformers, Standard BIL	Yes [1]
Dry type transformers 5kV with 60kV BIL	No
Dry type transformers 7kV or 15kV with 95kV BIL	No
Motors Locked Rotor Current < 600A	Yes [2]
Motors Locked Rotor Current > 600A	No
Reactors	Yes
Capacitors	No

1 Surge limiter not necessary if surge capacitors or surge arrestors are located at transformer terminals.

2 Surge limiter not necessary if surge capacitors or surge arrestors are located at machine terminals.

Table 8. Type 3EF Surge Limiter Data

Rated Voltage	kV	3.6	6	7.5	11	15
MCOV of ZnO element	kV	2.6	3.9	5.2	9.1	10.4
Series Gap Sparkover Voltage 1.2 x 50 wave	kV	8	10	15	25	31
0.5kA Switching Surge Discharge Voltage 8 x 20 wave	kV	8	10	15	25	31
1.5kA Switching Surge Discharge Voltage 8 x 20 wave	kV	8.3	12.4	16.5	28.9	33.0
Grounded Wye System Applications	kV	2.4 4.16	6.9 7.2	8.32	12.0 12.47 13.2 13.8	—
Delta System Applications	kV	2.4	4.16 4.8	4.8 6.9	6.9 7.2 8.3	12.0 12.47 13.2 13.8
High Resistance Grounded Wye System Applications	kV	2.4	4.16	6.9	6.9 7.2 8.32	12.0 12.47 13.2 13.8

SIEMENS

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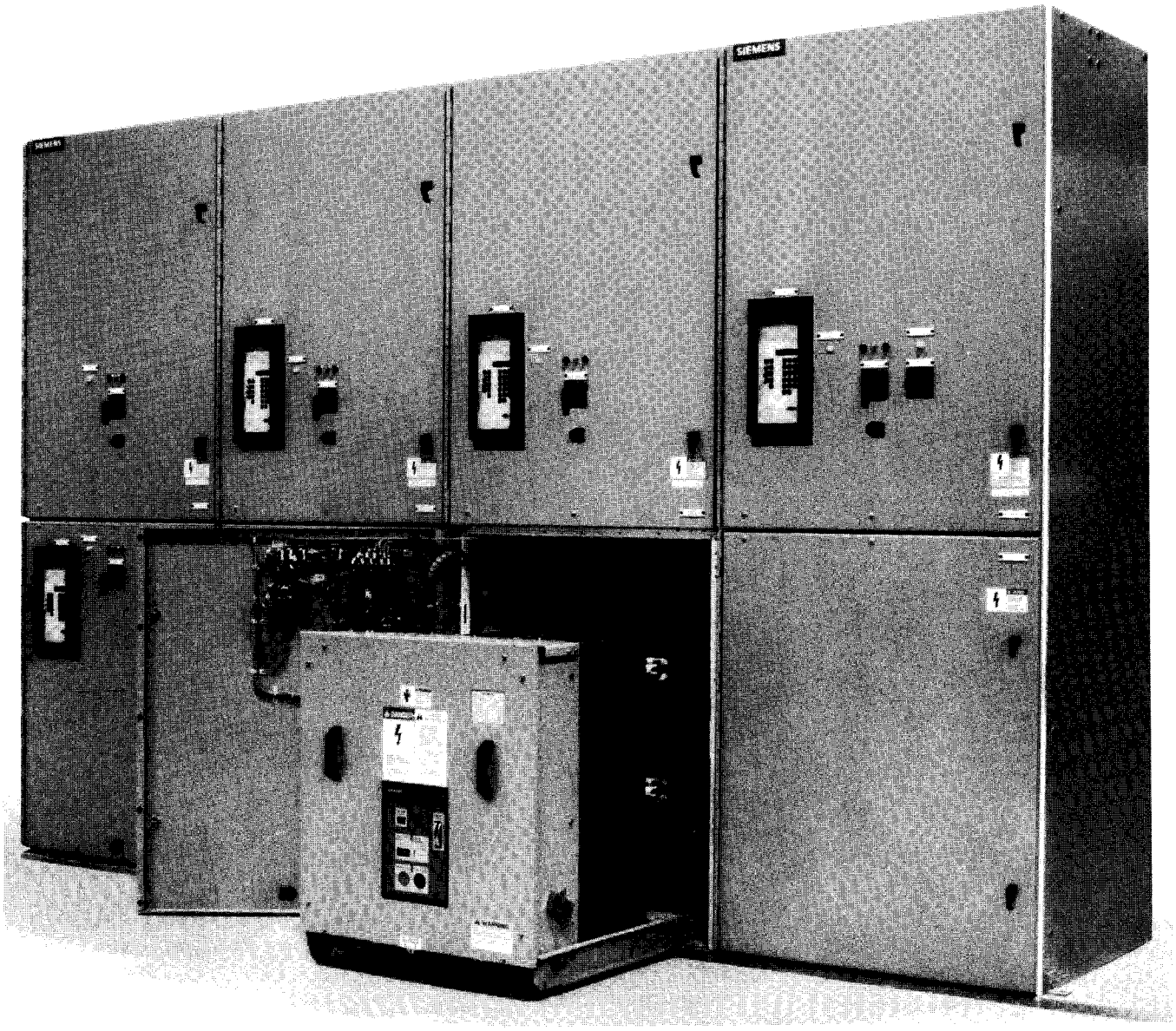
SIEMENS

5kV and 15kV Metal-Clad Switchgear

Type GM

Instructions
Installation
Operation
Maintenance
SGIM-3258C



⚠ DANGER

Hazardous voltages and high-speed moving parts.

Will cause death, serious personal injury or equipment damage.

Always de-energize and ground the equipment before maintenance. Read and understand this instruction manual before using equipment. Maintenance should be performed only by qualified personnel. The use of unauthorized parts in the repair of the equipment or tampering by unqualified personnel will result in dangerous conditions which will cause severe personal injury or equipment damage. Follow all safety instructions contained herein.

IMPORTANT

The information contained herein is general in nature and not intended for specific application purposes. It does not relieve the user of responsibility to use sound practices in application, installation, operation, and maintenance of the equipment purchased. Siemens reserves the right to make changes in the specifications shown herein or to make improvements at any time without notice or obligations. Should a conflict arise between the general information contained in this publication and the contents of drawings or supplementary material or both, the latter shall take precedence.

QUALIFIED PERSON

For the purpose of this manual a qualified person is one who is familiar with the installation, construction or operation of the equipment and the hazards involved. In addition, this person has the following qualifications:

(a) **is trained and authorized** to de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.

(b) **is trained** in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.

(c) **is trained** in rendering first aid.

NOTE

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

The contents of this instruction manual shall not become part of or modify any prior or existing agreement, commitment or relationship. The sales contract contains the entire obligation of Siemens Power Transmission & Distribution^{LLC}. The warranty contained in the contract between the parties is the sole warranty of Siemens Power Transmission & Distribution^{LLC}. Any statements contained herein do not create new warranties or modify the existing warranty.

5kV and 15kV Metal-Clad Switchgear

Table of Contents

Cover 1571-95

Introduction and Safety

Introduction
The GM family of 5-15kV Metal-Clad Switchgear is designed to meet all the applicable ANSI, NEMA and IEEE standards. Successful application and operation of this equipment depends as much upon proper installation and maintenance by the user as it does upon the careful design and fabrication by Siemens.

The purpose of this Instruction Manual is to assist the user in developing safe and efficient procedures for the installation, maintenance and use of the equipment.

Contact the nearest Siemens representative if any additional information is desired.

⚠DANGER

Hazardous voltages and high-speed moving parts.

Will cause death, personal injury or property damage.

To avoid electrical shock, burns and entanglement in moving parts this equipment must be installed, operated and maintained only by qualified persons thoroughly familiar with the equipment, instruction manuals and drawings. Read and understand this instruction manual before using equipment.

Qualified Person
For the purpose of this manual a **Qualified Person** is one who is familiar with the installation, construction or operation of the equipment and the hazards involved. In addition, this person has the following qualifications:

- Training and authorization to energize, de-energize, clear, ground and tag circuits and equipment in accordance with established safety practices.

- Training in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses, face shields, flash clothing, etc., in accordance with established safety procedures.

- Training in rendering first aid.

Signal Words
The signal words "**Danger**", "**Warning**" and "**Caution**" used in this manual indicate the degree of hazard that may be encountered by the user. These words are defined as:

Danger - Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

Warning - Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

Caution - indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

Dangerous Procedures
In addition to other procedures described in this manual as dangerous, user personnel must adhere to the following:

1. Always work on de-energized equipment. Always de-energize a breaker, and remove it from the switchgear before performing any tests, maintenance or repair.

2. Always perform maintenance on the breaker after the spring-charged mechanisms are discharged.

3. Always let an interlock device or safety mechanism perform its function without forcing or defeating the device.

Field Service Operation
Siemens can provide competent, well-trained Field Service Representatives to provide technical guidance and advisory assistance for the installation, overhaul, repair and maintenance of Siemens equipment, processes and systems. Contact regional service centers, sales offices or the factory for details, or telephone Siemens Field Service at 1-800-241-4453.

General Description

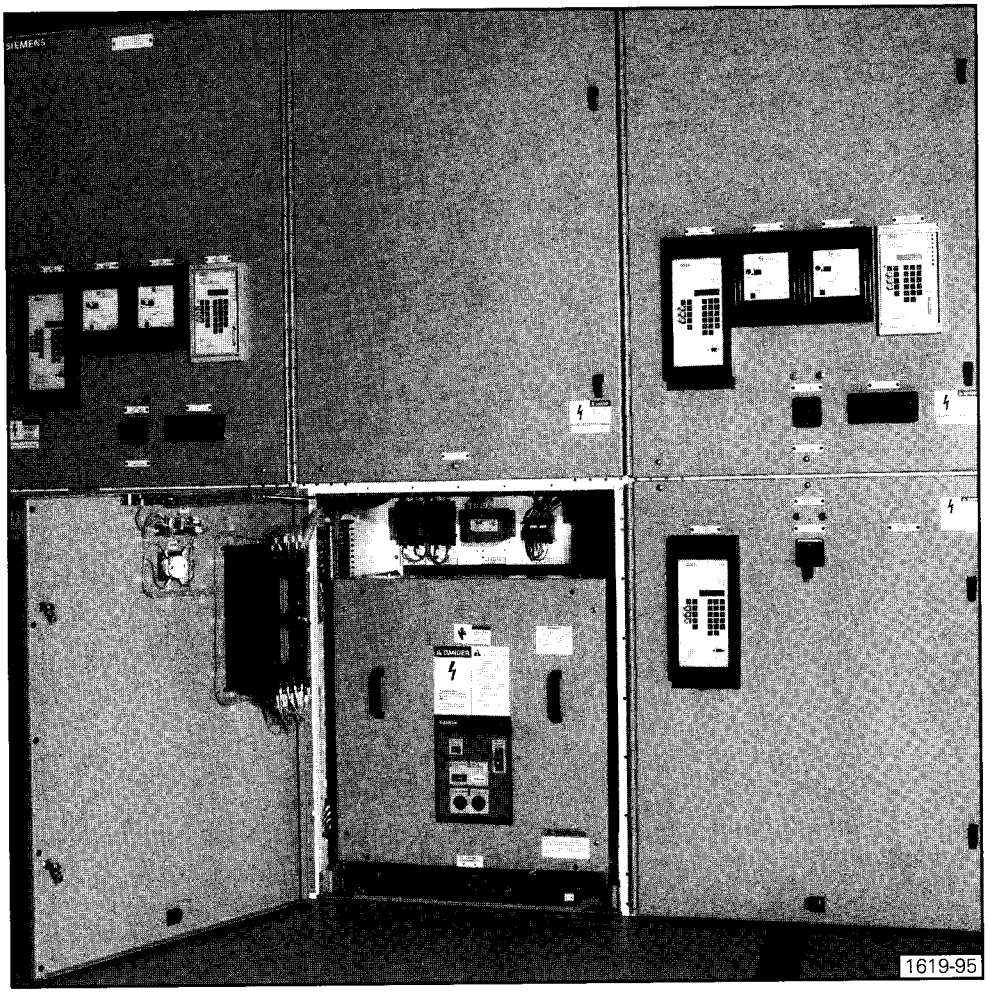


Figure 1. Typical Indoor Type GM Switchgear

Introduction

The successful performance and application of Metal-Clad Switchgear depends as much on proper installation and maintenance as it does on good design, careful manufacture and correct application.

Siemens Type GM Metal-Clad Switchgear is precision built equipment designed to function efficiently under normal operating conditions. It is designed and manufactured to operate within the ANSI C37 standards for Metal-Clad Switchgear. Performance requirements of these standards have been met or exceeded by these designs. The principal standard which applies to this class of switchgear is ANSI C37.20.2, Metal-Clad Switchgear.

The instructions included in this manual are provided to aid you in obtaining longer and more economical service from your Siemens switchgear. For proper installation and operation, this information should be distributed to your operators and engineers.

By carefully following these instructions, difficulties should be avoided. However, they are not intended to cover all details of variations that may be encountered in connection with the installation, operation and maintenance of this equipment.

Should additional information be desired, including replacement instruction books, contact your Siemens representative.

General Description

Scope
These instructions cover the installation, operation and maintenance of Siemens type GM metal-clad switchgear assemblies, using vacuum horizontal drawout circuit breakers. The equipment designs described in this manual include indoor, Shelter-Clad walk-in aisle outdoor, and non-walk-in outdoor configurations for application up to 15kV. A typical indoor switchgear assembly is shown in **Figure 1**. All diagrams, descriptions and instructions apply to all the above classes and designs unless noted otherwise.

Standard construction details of the switchgear, auxiliary equipment and necessary accessories are given in the appropriate sections. Special mechanical and electrical devices, furnished in accordance with purchase order requirements, are covered by supplementary instructions submitted with this instruction book.

The equipment furnished has been designed to operate in a system having the circuit capacity specified by the purchaser. If for any reason the equipment is later used in a different system, or if the short-circuit capacity of the system is increased, the momentary rating of the switchgear, the interrupting capacity of the circuit breakers and the bus capacity must be checked. Failure on the part of the user to receive approval of intended changes from Siemens may cause voiding the warranty.

General Description
The switchgear described in this manual is of the metal-clad type, as defined in ANSI C37.20.2. All parts are completely enclosed within grounded metal barriers. Secondary control devices and primary circuits are isolated from each other by shutters or barriers. Primary bus and joints are completely encased with insulation materials to suit the voltage class of the equipment.

Siemens switchgear carries a type designation, or class, as shown in **Table 1**. These designations may appear on drawings and familiarity with them will simplify communications with the factory.

Indoor equipment is arranged with upper and lower compartments in the front of the equipment. Generally, either or both compartments may contain a drawout circuit breaker, located behind a front panel which is used for relays, instruments, and similar devices. The front panel may be opened to provide access to the circuit breaker or interior auxiliary equipment, such as voltage transformers, or control power transformers. Typical indoor switchgear is shown in **Figure 1**.

Table 1. Switchgear Designation

DESIGN	TYPE
Indoor	GM
Shelter-Clad Single Aisle Outdoor	SGM
Shelter-Clad Common Aisle Outdoor	SGM
Non-Walk-In Outdoor	OGM

Shelter-Clad outdoor equipment consists of indoor equipment enclosed in a weather resistant housing complete with an illuminated, walk-in aisle. Circuit breakers can be moved inside the aisle and control devices checked without exposure to the elements.

Non-Walk-In outdoor switchgear consists of indoor equipment enclosed in a weather resistant housing complete with a gasketed outer door over the inner front panels. Circuit breakers can be moved outside of the cubicles with the use of a lift truck or similar handling device. Non-Walk-In outdoor equipment is used where it is felt that an enclosed service aisle is unnecessary, or space does not permit its use.

Receiving, Handling & Storage

Receiving
Each group of type GM metal-clad switchgear is securely blocked and braced for shipment. It is crated, boxed, or covered as required by shipping conditions. Whatever method of shipment, every precaution is taken to insure its safe arrival. If special handling is required, it is so indicated. Relatively delicate instruments are included and the switchgear assembly must be handled carefully when unloading.

Normally, the switchgear is shipped with the associated type GMI vacuum circuit breakers installed in their respective units, in the CONNECT position. Refer to instruction manual SG-3268 for information concerning the type GMI circuit breakers.

Identification
When the shipment includes more than one shipping group or equipment for more than one substation, marking tags are attached to each crate or package for identification. The drawing number on the tag is also on the shipping list. The shipping list identifies the contents with the unit numbers included in the shipping group. Refer to the general arrangement drawing for the location of each unit within the group lineup. Use this information to simplify the assembly operation and save unnecessary handling.

Inspection and Unpacking
Inspect the equipment as soon as possible after receiving for any damage that may have occurred in transit. Before unpacking, examine the package itself, as a damaged package may indicate an area of damage within. Be careful when unpacking equipment. The use of sledge hammers and crowbars may damage the finish, if not the equipment itself. Use nail pullers. After unpacking, examine equipment for any possible damage. Check the shipping manifest to be certain that all items have been received. If there is a shortage, make certain it is noted on the freight bill and contact the carrier immediately. Notify the Siemens sales office of any shortage or damage.

Shipping Damage Claims

Important: The way visible shipping damage is treated by consignee prior to signing the delivery receipt can determine the outcome of the damage claim to be filed.

Notification to carrier within the 15 day limit on concealed damage is essential if loss resulting from unsettled claims is to be eliminated or minimized.

1. When shipment arrives, note whether equipment is properly protected from the elements. Note trailer number on which the equipment arrived. Note blocking of equipment. During unloading, make sure count agrees with delivery receipt.

2. Make immediate inspection for visible damage upon arrival, and prior to disturbing or removing packaging or protective wrapping. This should be done prior to unloading when possible. When total inspection cannot be made on vehicles prior to unloading, close inspection during unloading must be performed and visible damage noted on the delivery receipt. Take pictures if possible.

3. Any visible damage must be noted on the delivery receipt and acknowledged with the driver's signature. The damage should be detailed as much as possible. It is essential that a notation "Possible internal damage, subject to inspection" be included on delivery receipt. If the driver will not sign the delivery receipt with damage noted, the shipment should not be signed for by the consignee or his agent.

4. Notify the Siemens sales office immediately of any damage.

5. Arrange for a carrier inspection of damage immediately.

   Important: Do not move equipment from the place it was set when unloading. Also, do not remove or disturb packaging or protective wrapping prior to carrier damage inspection. Equipment must be inspected by carrier prior to handling after receipt. This eliminates loss due to claims by carrier that equipment was damaged or further damaged on site after unloading.

6. Be sure equipment is properly protected from any further damage by covering it properly after unloading.

7. If practical, make further inspection for possible concealed damage while the carrier's inspector is on site. If inspection for concealed damage is not practical at the time the carrier's inspector is present, it must be done within 15 days of receipt of equipment. If concealed damage is found, the carrier must again be notified and inspection made prior to taking any corrective action to repair. Also notify Siemens sales office immediately.

8. Obtain the original of the carrier inspection report and forward it along with a copy of the noted delivery receipt to the Siemens sales office. Approval must be obtained by Siemens from the carrier before any repair work can be performed. Before approval can be obtained, Siemens must have the documents. The carrier inspection report and/or driver's signature on the delivery receipt does not constitute approval to repair.

Note: Any adverse judgment as to whether the equipment was properly loaded or properly prepared by shipper for over-the-road travel cannot be made at the destination. Shipments are not released from the factory without a clear bill of lading. Approved methods are employed for preparation, loading, blocking and tarping of the equipment before it leaves the Siemens factory. Therefore, if the equipment is received in a damaged condition, this damage to the equipment had to occur while enroute due to conditions beyond Siemens control. If the procedure outlined above is not followed by the consignee, purchaser, or his agent, Siemens cannot be held liable for repairs. Siemens will not be held liable for repairs in any case where the work was performed prior to authorization from Siemens.

Receiving, Handling & Storage

Lifting and Moving
There are a number of methods that can be used in handling the switchgear which when properly employed will not damage the switchgear sections. The handling method used will be determined by conditions and available equipment at the installation site. Lifting with a crane is the preferred method of handling, however, overhead obstructions or low ceilings often dictate the method to be used. Rollers, jacks or fork lift trucks may be used prior to removal of wooden skids.

⚠WARNING

Heavy Weight.

Can cause death, personal injury, or property damage.

Observe all handling instructions in this instruction manual to prevent tipping or dropping of equipment.

Each group of switchgear has provisions for attaching lifting equipment. Though the lift points vary in location on indoor, Shelter-Clad outdoor, and non-walk-in outdoor designs, all are designed for use with a crane of adequate height and capacity. To estimate the maximum required crane capacity, multiply the number of sections to be lifted by 5,000 pounds.

A drawing pocket (or holder) is provided on each lineup of switchgear. This drawing pocket includes a general arrangement drawing of the switchgear lineup, plus a drawing with installation and handling instructions for the equipment. The drawing pocket is normally located at the left end of the lineup. Review this information carefully before moving the equipment.

Indoor Switchgear
Before removing the protective packing materials, indoor equipment may be moved by crane with lift cables attached through the packaging to the lifting bars on the top of the switchgear. If crane facilities are unavailable, or if tight spaces prevent use of a crane, rollers under the skids may be used.

Lifting Indoor Switchgear with Crane
Recommended lifting of indoor switchgear is by means of cables connected to an overhead crane. The cables are connected to the eyes in the top lifting bars. One set of lifting bars is located near the front of the switchgear, while another set of lift bars is located closer to the middle of the switchgear, as illustrated in **Figure 2**. A crane with sufficient height should be used so the load angle (from horizontal) on the lifting cables will be at least 45 degrees, when viewed from the front or the rear. A lesser angle could cause the equipment to be damaged. The lifting cables must have spreaders from front to rear to prevent twisting the lift bars.

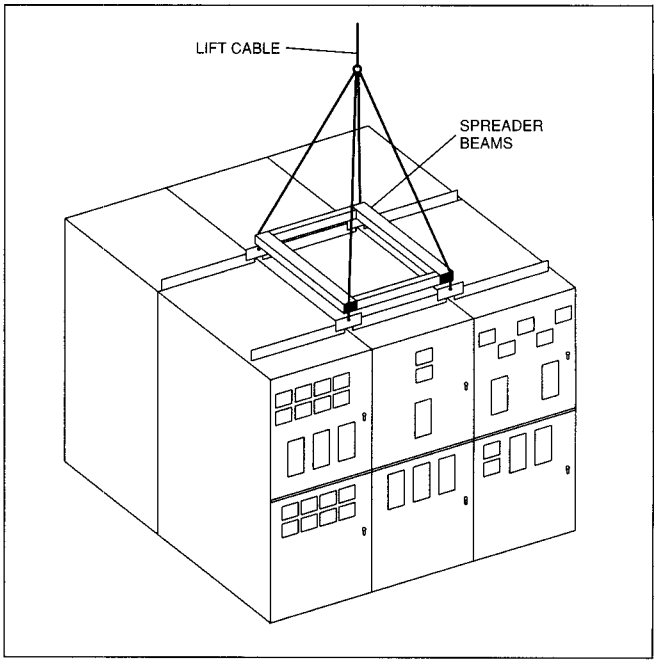


Figure 2. Lifting Indoor Switchgear - with Crane

Moving Switchgear in Obstructed Areas without a Crane
Within buildings and obstructed areas, where a crane cannot be used, move switchgear with rollers, cribbing, jacks and other such equipment as may be required to meet the situation. Forklift trucks should be used with discretion as improper lift points could cause extreme damage to equipment. For this reason, **use of a forklift truck to handle or move switchgear is not recommended.**

Jacks may be used to lift switchgear which is properly supported by sturdy timbers.

To prevent distortion of the cubicles, rollers and cribbing of equal height must be used in sufficient number to evenly distribute the load.

Figure 3 shows a method of using jacks on indoor switchgear to facilitate the use of rollers under the shipping skid. Care must be used to prevent damage to instruments and to maintain the stability of the timbers.

Remove rollers and lower switchgear carefully. Leave wooden skids (when provided) in place during moving operation until final location is reached.

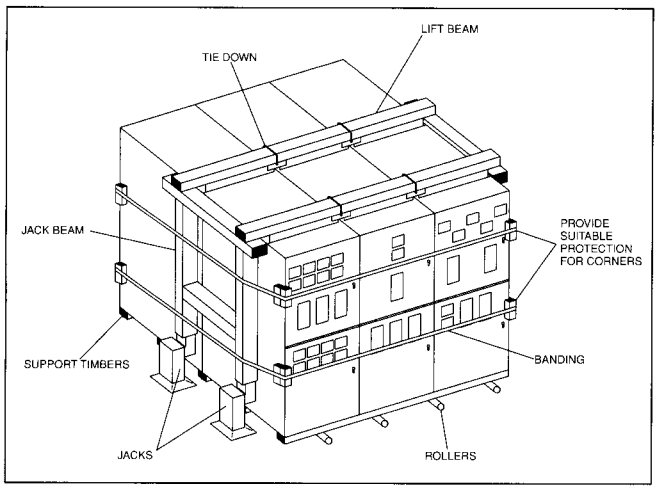


Figure 3. Moving Switchgear with Jacks and Rollers

Figure 4 shows a method of moving the switchgear into the final position, after it has been moved near to the final position using another method.

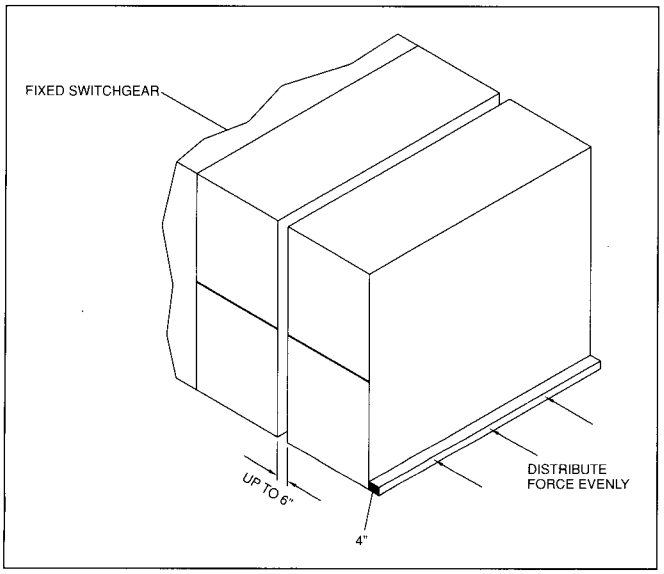


Figure 4. Moving Switchgear in Obstructed Areas without a Crane—Final Positioning

Outdoor Switchgear

The method of lifting non-walk-in or Shelter-Clad outdoor equipment is shown in **Figure 5**. The load angles (from horizontal) on the lifting cables, as viewed from the front or rear, must be at least 45 degrees. A lesser angle could damage the equipment. The lifting cables must have spreaders front to back and side to side to protect the equipment.

The recommended lifting pipe size (Ref. ASTM A-53) is type XXS 2-1/2" nominal (2.875" (73mm) OD, 1.771" (45mm) ID). The lifting pipe should be at least 18" (457mm) longer than the depth of the switchgear, and should include adequate means to prevent the lifting cables from slipping off of the lifting pipe during use.

Figure 6 shows a method of using jacks on outdoor switchgear to facilitate the use of rollers under the shipping skid. Care must be used with this method to prevent damage to the doors and to maintain stability of the timbers. Refer to previous section for additional information.

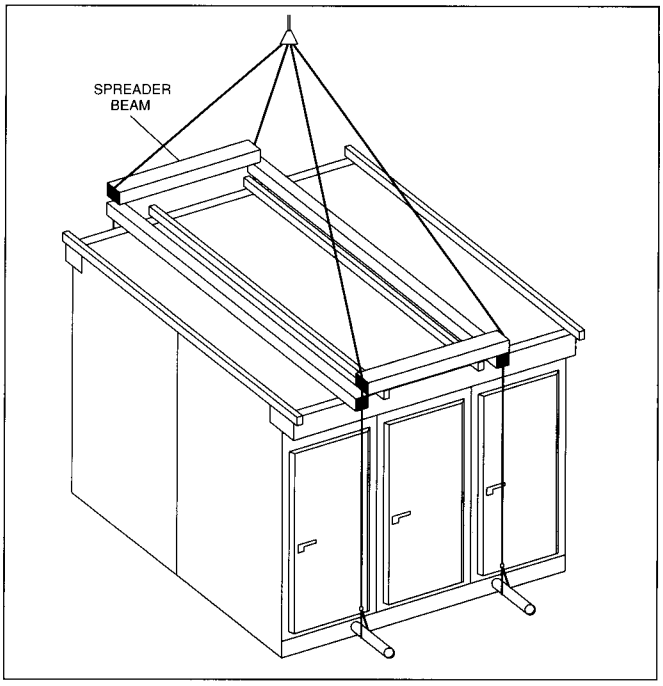


Figure 5. Lifting Outdoor Switchgear with Crane

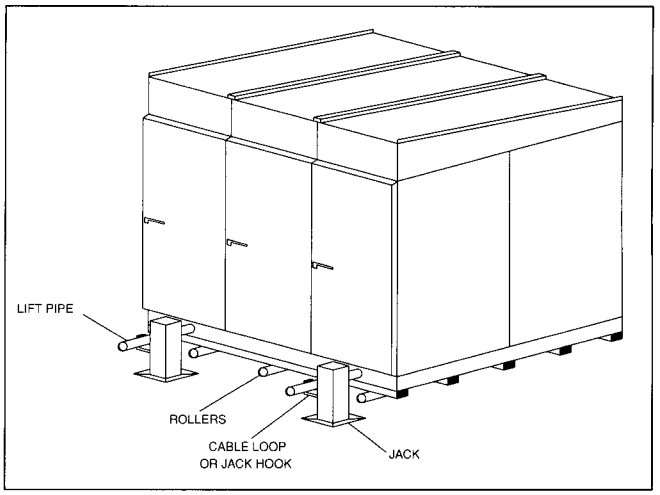


Figure 6. Moving Outdoor Switchgear with Jacks and Rollers

Receiving, Handling & Storage

Final Movement of Assembly
Proper final movement and connection of the assembly requires that several items be completed:

1. Preplan sequence of installation movements and connections.
2. Where equipment must be slid into final location, start with the left end shipping group and continue in sequence. Secondary conduits which stub-up above floor level may block sliding.
3. Protect equipment and external items from damage during movement. Be sure to have smooth, unobstructed surfaces where the equipment is to be slid. Keep access openings clear.
4. Prepare for the connections across shipping splits before the equipment is moved into final position. Interunit bus supports and bus joint boots should be removed using side, rear and front access options as required. Note the mounting position and orientation and save hardware for use in reinstallation.
5. Thread coiled wires across shipping splits into interunit wire trough prior to moving equipment into its final position.
6. Where top lift capability is available, shipping pallets and other packaging materials may be removed before the last move into the final position.
7. Where top lift capability is not available, protect the switchgear bottom with support timbers and move with jacks and rollers just to the side of its final position. Remove rollers, shipping pallets and other packaging materials and remove jacking facilities. Clear any obstructions. The equipment may be slid sideways up to 6 inches (152mm) to join the shipping split. Any sliding force must be carefully applied across the bottom 4 inches (100mm) of the switchgear side with proper cribbing to fully distribute the force across the full depth of side. See **Figure 4**.
8. See "Installation" section for additional important information.

Storage: Indoor Switchgear
When switchgear is not to be installed immediately, it should be unpacked, inspected within 15 days of receipt and stored in a clean dry location. Indoor switchgear is neither weather resistant nor drip resistant. Therefore, it should be stored indoors. If it is to be kept in a humid or unheated area, provide an adequate covering and place a heat source of approximately 500 watts output within each vertical section to prevent condensation. Space heaters are not standard equipment on indoor switchgear. Lubricate any moving parts such as hinges, shutters, etc., if storage is for an extensive period of time. When batteries are supplied, connect them to a charger.

Storage: Shelter-Clad Outdoor Switchgear
When it is necessary to store Shelter-Clad outdoor equipment in a location exposing it to the weather, or in a humid location, energize the space heaters provided within the sections and make certain that louvers and vents are uncovered to allow air to circulate. If at all possible, erect the aisle section and install the switchgear at the permanent location even though it may be some time before the equipment is used. If the equipment cannot be erected at the permanent location immediately, cover shipping splits to protect from the elements.

Regardless of what method of storage is used, remove the aisle wall from in front of instrument panels to gain access to the space heater circuit so that heaters can be energized. Refer to wiring diagram drawing for space heater circuit connections. Replace the aisle wall and seal from the elements, or cover for protection from the weather. Connect batteries (if provided) to a charger. Lubricate hinges, shutters, and other moving parts.

Storage: Non-Walk-In Outdoor Switchgear
When it is necessary to store non-walk-in outdoor switchgear in an area exposed to the weather or under humid conditions, energize the space heaters provided and make certain that louvers and vents are uncovered to allow air to circulate. If at all possible, erect the switchgear at the permanent location even though it may be some time before the equipment is used. If the equipment cannot be erected at the permanent location immediately, cover shipping splits to protect from the elements.

Access to the heater circuit is gained by opening the door to the instrument panel compartment. Refer to wiring diagram drawing for space heater circuit connections. Connect batteries (if provided) to a charger. Lubricate hinges, shutters, and other moving parts.

Storage: Type GMI Vacuum Circuit Breakers and Lift Truck
Vacuum circuit breakers, if not installed in their respective switchgear compartments, must be stored indoors. Outdoor storage of circuit breakers (other than inside their respective switchgear compartments) is NOT RECOMMENDED.

If furnished, the lift truck for handling circuit breakers should be stored indoors. The lifting mechanism can be damaged by extended outdoor storage. For short term (30 days or less) storage, the lift truck may be stored outdoors, provided that it is adequately covered to protect it from the weather.

Installation

Preparation for Installation
Prior to installation of switchgear, study this instruction book and the switchgear drawings, such as general arrangement, three line diagram, schematic diagrams, wiring diagrams, installation instruction drawing, panel arrangement and panel arrangement bill of material, nameplate engraving list, and accessories drawing. Special attention should be given to the foundation information contained in this manual as well as the information provided on the equipment drawings. Be sure that the foundation conforms to the requirements described in this manual and the general arrangement drawing.

Foundation-General Requirements
Prior to installation of the switchgear, careful design, planning and construction of the foundation or base on which the switchgear will rest must be made. A thorough analysis and careful construction may alleviate many problems at the time of installation, and during operation. It is important that a true and level surface be provided, capable of supporting the weight of the switchgear and other related equipment.

If the switchgear cannot be lowered over conduits because of headroom or other restrictions, conduit couplings may be grouted in flush with foundation, and conduit nipples added after the switchgear is in place.

Conduits should be capped during construction to prevent entry of dirt, moisture and vermin.

All sill channels, bed plates, shims and anchoring hardware are furnished by purchaser unless covered by contract.

Indoor Foundations
As it is difficult to obtain a true and level floor on a concrete slab, it is highly recommended that 4" (minimum) sill channels be grouted into the floor as shown in **Figure 7**. The surface of the sills should be slightly above floor level. The surfaces of the sills must be level and in the same horizontal plane within 1/16" (1.6mm). There should be no projection above this plane within the area covered by the switchgear. If the floor or sills do not meet this requirement, it will be necessary to use shims when installing the switchgear on the mounting surface.

Figure 7 illustrates the location for sill channels for anchoring indoor switchgear. Cubicles may be anchored to sills by use of 1/2" (or 12mm) diameter anchor bolts, or welded in position.

Outdoor Foundations
Whichever type of foundation is used (e.g., concrete slab, sill channels, piers or pilings), it must have smooth and level surfaces. Surfaces supporting the switchgear must be in the same horizontal plane within 1/16" (1.6mm). If these conditions are not met, it will be necessary to use shims when installing the switchgear.

For outdoor switchgear, support shall be provided at each end and at the side of every second cubicle, so that the span between supports does not exceed 36" (914mm). Refer to **Figures 8** and **10**, and the switchgear general arrangement drawing for locations of support and anchoring points. If pilings are used, the diameter is to be determined by purchaser, however, they should not be less than 12" (305mm) diameter for sufficient contact, room for anchor bolts, and grouting in of bed plates (if used). All shipping splits must be properly supported.

Any conduits which are installed in concrete must be perpendicular to switchgear mounting surface. Conduits should extend a minimum of 6-3/4" (171mm) to a maximum of 7-1/2" (190mm) above mounting surface. This will allow the conduit to enter the cubicle and exclude entry of water and rodents.

Figures 8-9 show the method of anchoring outdoor Shelter-Clad (walk-in) switchgear, and **Figure 10** shows the method of anchoring outdoor non-walk-in switchgear.

Important: In the switchgear primary entrance area, steel reinforcing rods or mesh in concrete must not pass through the space shown on the general arrangement drawing, even though cored or bored holes in concrete may miss rods or mesh. A single phase of a system should not be encircled by ferrous metals.

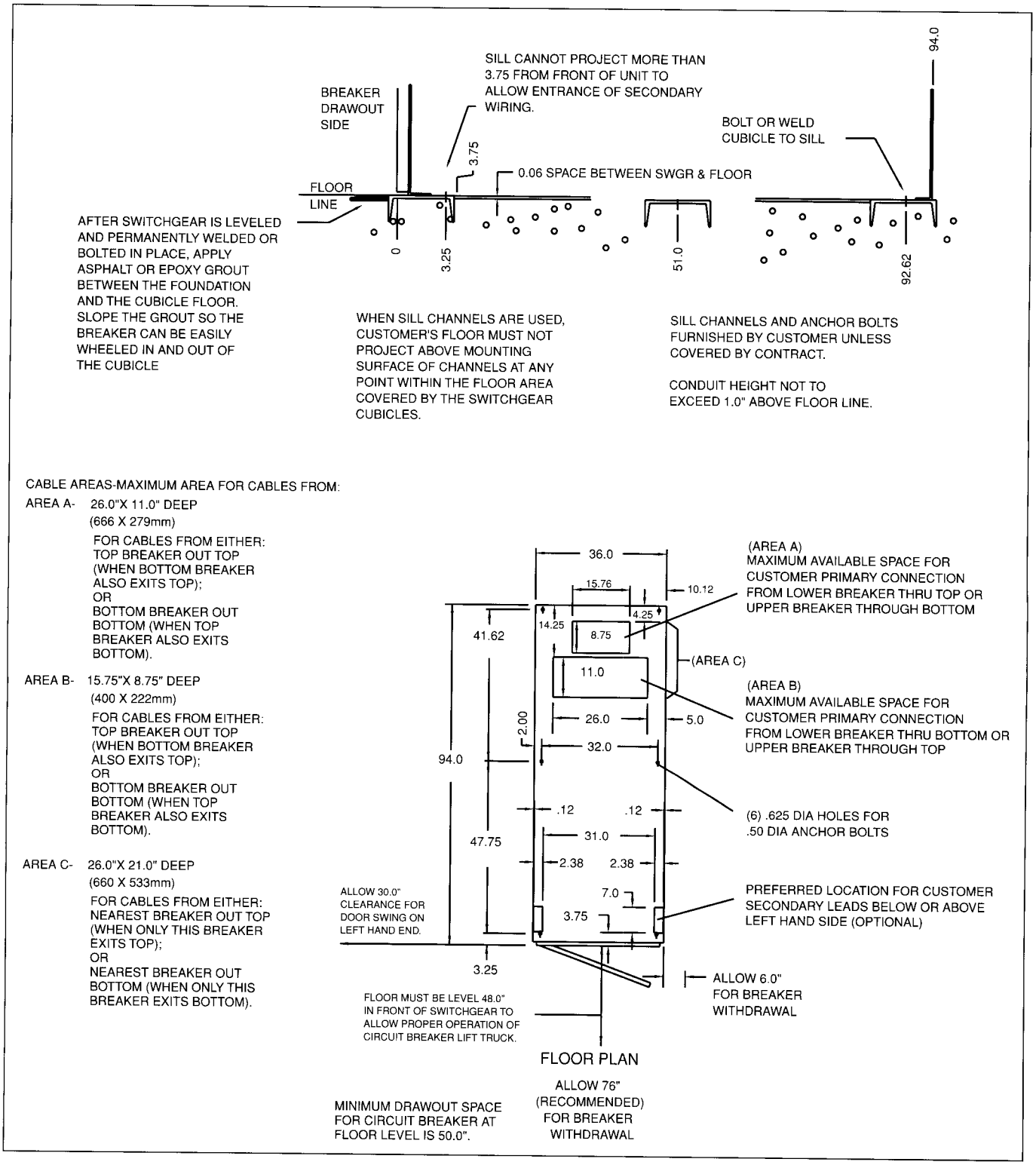


Figure 7. Anchoring Indoor GM Switchgear

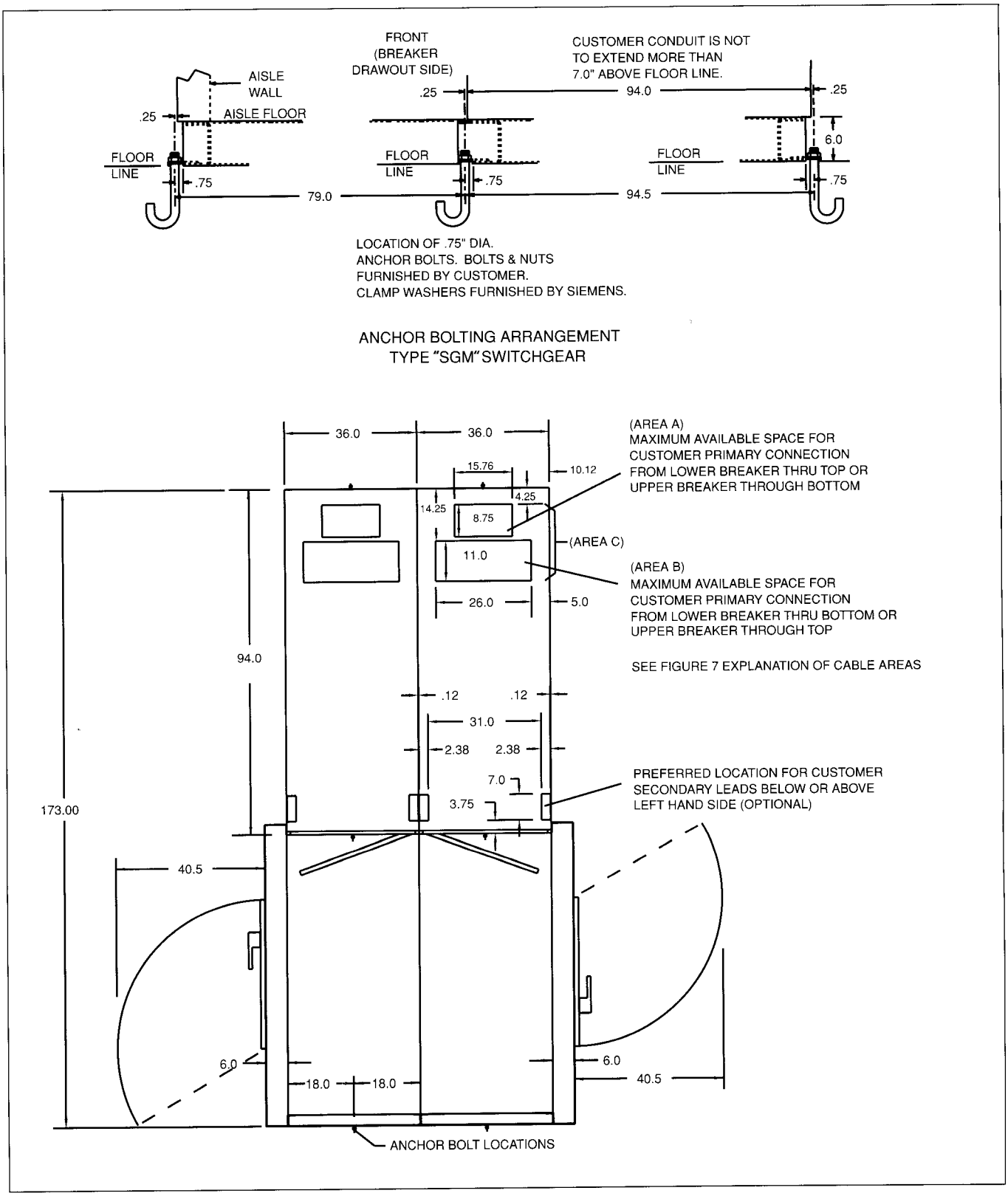


Figure 8. Anchoring Outdoor SGM Shelter-Clad (single aisle) Switchgear

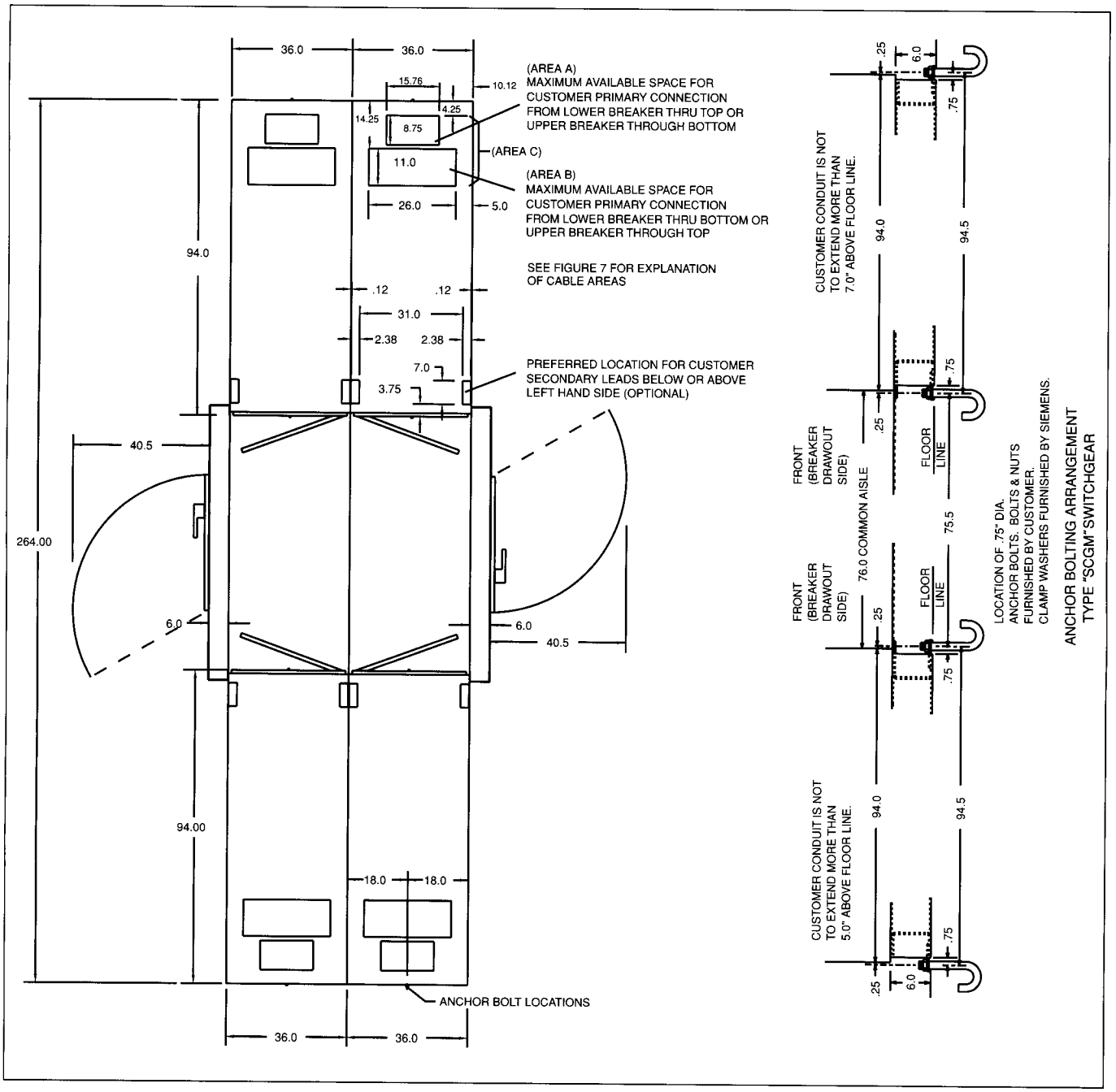


Figure 9. Anchoring Outdoor SGM Shelter-Clad (common aisle) Switchgear

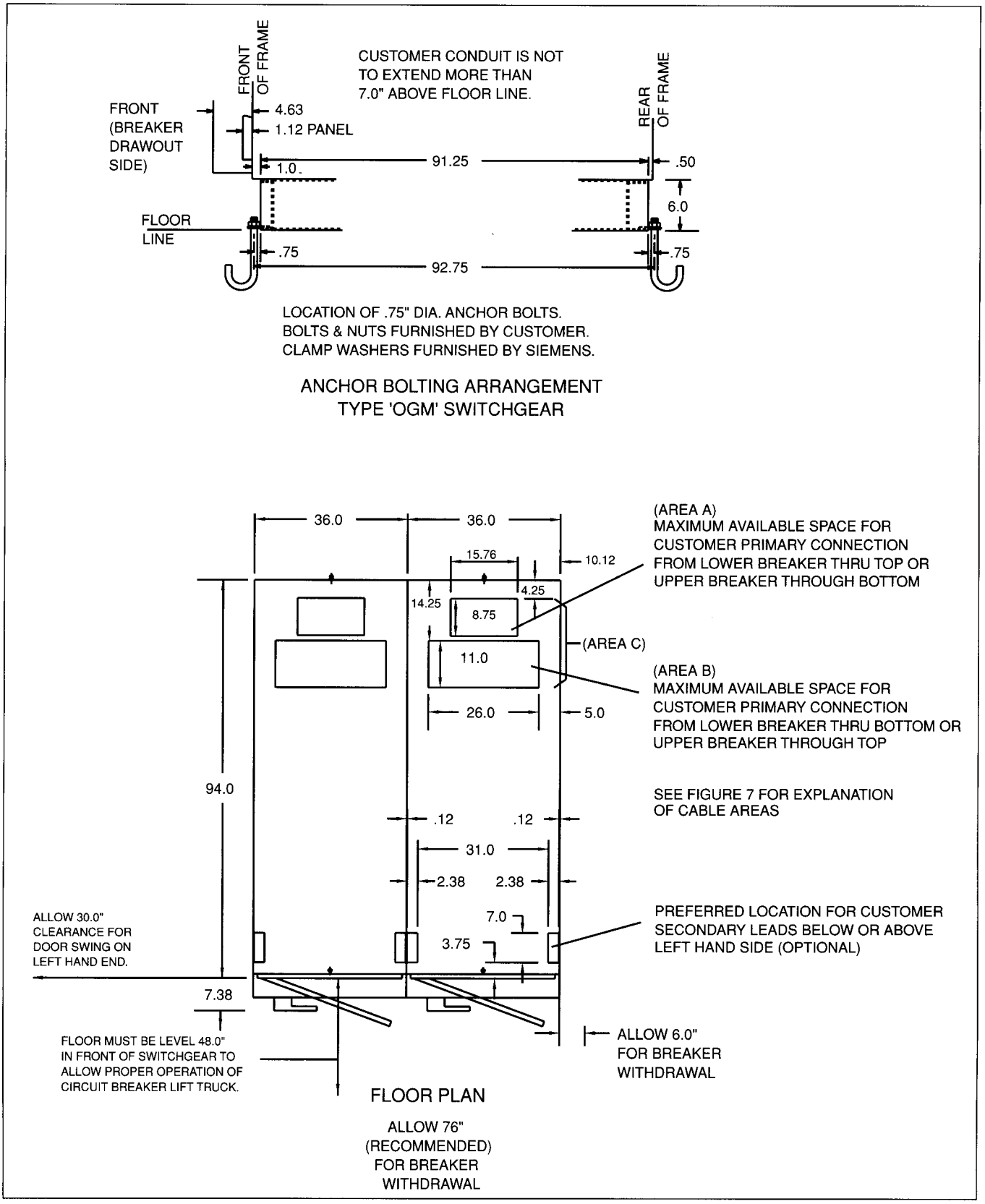


Figure 10. Anchoring Outdoor OGM Non-Walk-In Switchgear

Installation

Installing Shipping Sections
The proper method of installation depends on whether the switchgear has been shipped as one complete group, or in two or more shipping sections. The general arrangement drawings will indicate the shipping sections, cubicle numbers and their location within the switchgear lineup. Sections are assembled and wired in accordance with the arrangement as in the final installation.

Before setting and erecting the cubicles, determine the correct location of each shipping group on the general arrangement drawing. Sweep the mounting surface to remove all dirt and debris.

Installing Switchgear with Throat Connection to Power Transformer
When a transformer is connected to switchgear using a throat connection, the switchgear should be positioned next to the transformer as shown in **Figure 11**. It is very desirable that the switchgear be placed in position first, and then position the transformer.

If the transformer must be positioned first, conduit couplings should be provided in the switchgear foundation, so that the conduits do not extend more than approximately 2" (51mm) above the switchgear mounting surface. The switchgear should be positioned near the transformer, and just high enough to clear the secondary conduits, but low enough that the throat on the switchgear will clear the opening in the transformer terminal chamber (throat). When the switchgear is properly positioned so that the switchgear throat will fit into the transformer throat, move the switchgear toward the transformer until the switchgear throat extends approximately 2" (51mm) into the transformer throat, and the switchgear anchor bolts and conduits are correctly aligned. With all points now in alignment, conduit caps and floor plate conduit covers removed, carefully lower the switchgear into its permanent position. After all leveling and anchoring operations for the switchgear are complete, draw the sliding throat collar of the switchgear throat into place against the transformer throat. Tighten the throat hardware only enough to compress the gasket.

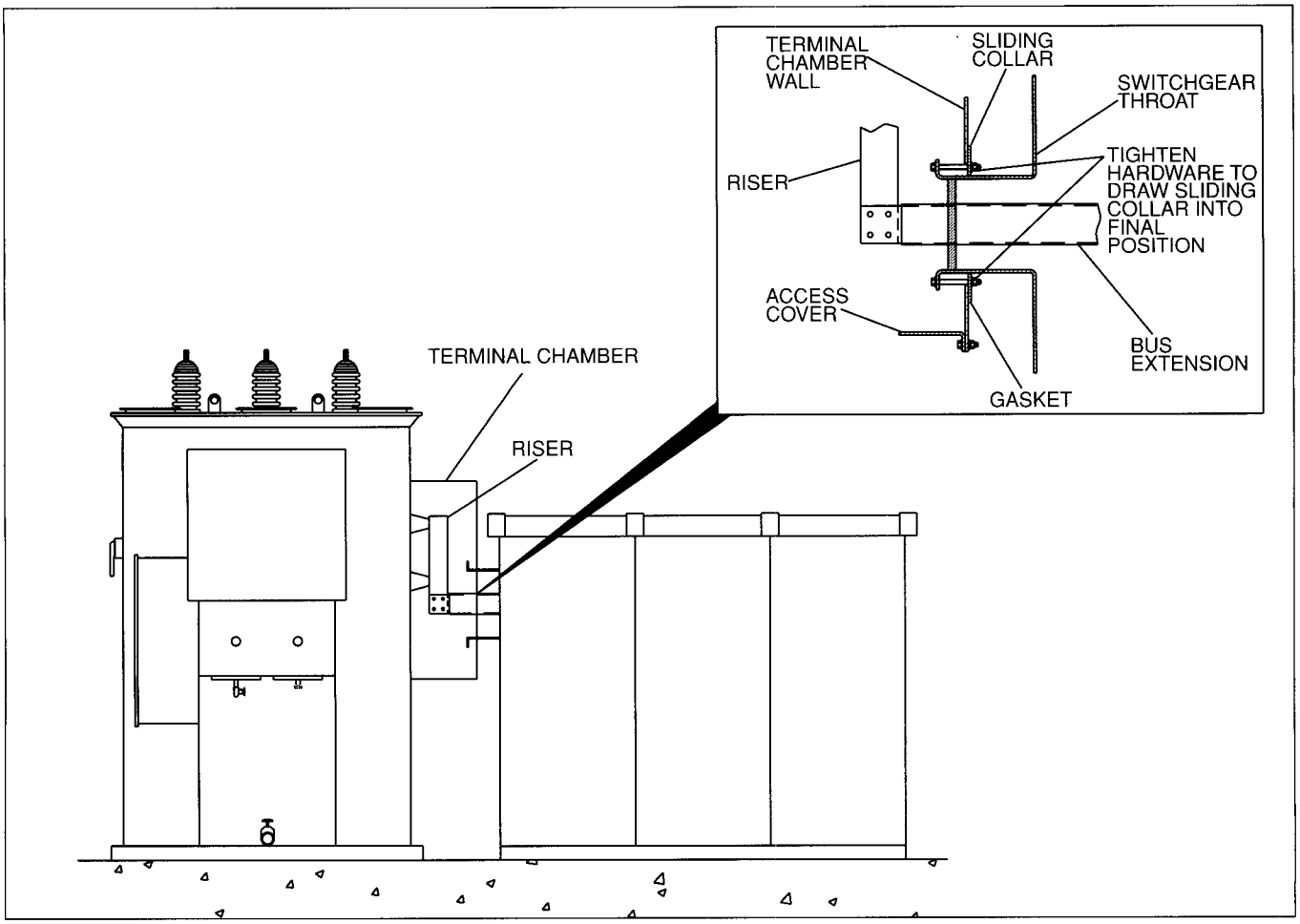


Figure 11. Connecting Transformer and Switchgear for Typical Outdoor Installation

Installation

Anchoring, Leveling, and Assembling Indoor Switchgear
Indoor switchgear shipping groups are held in true alignment by bolts holding the vertical sections to each other.

The entire shipping group is to be anchored and leveled as a single element without loosening any hardware until entire shipping group is leveled and anchored.

1. The switchgear equipment was accurately aligned at the factory. This care insures proper operation and fit of mating parts. Supporting surfaces for the switchgear at each anchoring bolt locations must be level and in the same plane within 0.06" (1.6mm). There must not be any projection above this plane within the area covered by the switchgear cubicles.

   If purchaser's floor or grouted sill channels do not meet this requirement, it will be necessary to shim in the following manner. The six (6) anchor bolt locations in each cubicle must freely rest in firm contact with the mounting support surfaces. There must not be any projection or obstruction in other areas which may distort the cubicle.

   Do not force cubicle in firm contact by drawing down anchoring bolts as such drastic means will distort cubicles. Add 4" (100mm) square shims adjacent to anchor bolts until firm contact is achieved. Check each anchor bolt location, 6 per cubicle. (See **Figure 7**)

2. Tighten anchor bolts or weld to sills.

3. If the lineup consists of multiple groups, move the next group into position, with the front of units in line and tight against the adjacent group. Do not bolt groups together at this time. Check that the cubicles are in firm contact with the foundation at each corner and anchor point, and that bolt holes are in alignment. Add 4" (100mm) square shims as necessary. Tighten the anchor bolts. Now bolt groups together.

4. After installation is complete, the lifting bar between units may be removed and the unit lift bars pushed down inside the units. Note that bolts inside the units which clamp the lift bars in place must be loose to allow movement of the lift bar.

Anchoring and Leveling Outdoor Shelter-Clad Switchgear
In Shelter-Clad arrangements, the switchgear (as shipped) is true and in correct position relative to its support base. The formed floor sections are a permanent part of the switchgear, and are not to be loosened or moved from position.

Verify the anchor bolt locations in the concrete and all points shown in the general arrangement plan view. Sweep the foundation to make certain it is free of pebbles and other debris. Check the general arrangement drawing for positioning of the switchgear and sequence of installation if arrangement consists of more than one shipping group.

Single aisle Shelter-Clad cubicles are shipped with the aisle wall covering the breaker drawout compartment. This wall may be removed before moving the switchgear into position on its foundation, if conduit clearances are in doubt, of if the aisle is to be assembled immediately after leveling.

1. Remove seal material at top of aisle wall.

2. Unbolt, remove, and scrap the 1-1/4" plate and 1-1/4" angle.

3. Support wall with crane or other means. (Allow approximately 125 lb. (57kg) per unit) and remove the two angles at each end of the group which hold the aisle wall in place. These angles can now be scrapped. Carefully lay aside aisle wall until needed for aisle assembly.

4. Remove nuts from all anchor bolts, remove caps from all secondary conduit stubs, and remove covers from secondary openings in cubicle floor plates.

   The arrangement may consist of a single complete shipping group, or may be split into a number of shipping sections for a long lineup. Refer to the general arrangement drawing for instructions as to which shipping group should be installed first, and in what sequence the remaining groups are to be installed. Move the first group into position as shown on the general arrangement drawing.

5. The switchgear equipment was accurately aligned at the factory. This care insures proper operation and fit of mating parts. Supporting surfaces for the switchgear's 6" (152mm) base must be level and in the same plane within 0.06" (1.6mm). If concrete, grouted channels, pier supports, etc., do not meet this requirement, or if there is any projection higher than the support points in line with the base, shims must be installed in the following manner to provide an equivalent true surface for switchgear support.

   Outdoor switchgear groups which have been assembled on a 6" (162mm) base must be supported along this base with a span between support points not exceeding 36" (914mm). If shims are required, use 4" (100mm) square strips placed between the bottom of the base and the foundation, in the anchor bolt area where they will be clamped firmly in place. Do not force cubicle in firm contact by drawing down anchoring bolts as such drastic means will distort cubicles.

6. Add clamp washers and nuts to anchor bolts and tighten securely.

7. Check all breaker compartments for free movement of the shutters.

8. Move the next group into position. The front edge of the cubicle base should be in line with those of the previously installed group. This will insure a good fit with the aisle floor plates. Make certain that the end of the group being installed is tightly against the previously installed group. Repeat steps 5, 6, and 7 and install all shipping split hardware.

Assembly of Single Aisle Shelter-Clad Switchgear
Figure 12 illustrates the assembly of single aisle Shelter-Clad switchgear, and **Table 2** lists the standard components supplied. The item numbers in the table are used in all instructions pertaining to this procedure.

Assemble as follows:

1. Temporarily support the aisle wall assembly in its permanent position as shown in the general arrangement drawing.
2. Put roof covers in place to hold top of aisle wall in place. Do not tighten hardware.
3. Align the ends of the aisle wall, aisle channel and switchgear. Place floor plate in position between the switchgear and wall. Install each set next to the end position between the switchgear and the wall. With floor plate set tightly against the switchgear floor plates, bolt floor plates in position. Tighten anchor bolts to secure channel locations.
4. With roof cover hardware loose, plumb front wall and tighten attaching hardware.
5. Install all floor plates.
6. Caulk aisle walls.

   Set door assemblies in place. Bolt the door to the aisle wall and to the side plate of the cubicle.

> **Note:** Place lift truck (if supplied) for upper cell breakers inside the aisle enclosure before installation of the last door assembly to the enclosure. The lift truck is wider and higher than the hinged aisle door opening, which prevents convenient entrance of the lift truck if the door assemblies are in place.

7. Put all roof covers in place and bolt to the adjoining roof cover with 3/8" hardware.
8. Set roof channels over roof cover joints. Bolt to clips welded to roof with retainer nuts.
9. Drill cable cover to suit conduit installation. Bolt the cover in place.
10. Mount aisle conduit, switches, receptacle and wire to the junction boxes. See conduit arrangement.
11. If equipment consists of more than one shipping group, caulk each vertical shipping split at the back of the switchgear with metal filler provided.

Assembly of Common Aisle Shelter-Clad Switchgear
Figure 13 illustrates the assembly of single aisle Shelter-Clad switchgear, and **Table 3** lists the standard components supplied. The item numbers in the table are used in all instructions pertaining to this procedure.

Assemble as follows:

1. Install all floor plates.
2. Caulk at joints.
3. Raise door assemblies into place. Bolt doors to side plates of cubicles.

> **Note:** Place lift truck (if supplied) for upper cell breakers inside the aisle enclosure before installation of the last door assembly to the enclosure. The lift truck is wider and higher than the hinged aisle door opening, which prevents convenient entrance of the lift truck if the door assemblies are in place.

4. Mount aisle conduit, switches, receptacle and wire to the junction boxes. See conduit arrangement.
5. Place roof decks in position and fasten with bolts provided.
6. Fasten the roof decks together with 3/8" hardware.
7. Set channel-shaped covers over the joints of roof decks and bolt to clips welded to roof with retainer nuts.
8. Tighten all bolts to complete assembly.
9. Drill cable cover to suit conduit. Bolt the cover in place.
10. If equipment consists of more than one shipping group, caulk each vertical shipping split at the back of the switchgear with metal filler provided.

Assembly of Single Aisle Shelter-Clad Switchgear with Work Space
Figure 14 illustrates the assembly of single aisle Shelter-Clad switchgear with an attached Work Space area, and **Table 4** lists the standard components supplied. The item numbers in the table are used in all instructions pertaining to this procedure.

Assemble as follows:

1. Mount aisle end plate at the end opposite the work space.
2. Move aisle wall to its permanent location as indicated on the general arrangement drawing.
3. Mount the end plate and proceed.
4. Put the work space floor plate base in position as indicated.
5. Assemble aisle walls. See general arrangement drawing for location of special panels for fans, etc. Apply caulking at the joints of the wall sections.
6. Bolt work space rear plates (item 56) together, in a manner similar to the aisle wall sections, and then bolt to the switchgear unit.
7. Caulk at joints.
8. Install end plate and attach to switchgear.

Note: Place lift truck (if supplied) for upper cell breakers inside the aisle enclosure before installation of the last door assembly to the enclosure. The lift truck is wider and higher than the hinged aisle door opening, which prevents convenient entrance of the lift truck if the door assemblies are in place.

9. Install aisle floor plates in the same manner as for single aisle layouts.

10. Install roof support (item 78) from cubicles to end of work space area.

11. Put all roof decks in place and bolt to the top of the end plate and to the roof support. Leave hardware finger tight until step 13 is complete.

12. Fasten roof decks together with 3/8" hardware.

13. Mount trim angle. Tighten all hardware.

14. Set roof channels over roof deck joints, bolt to clips welded to roof with retainer nuts.

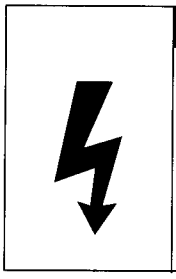
15. Mount aisle conduit, switches, receptacle and wire to the junction boxes. See conduit arrangement.

16. If equipment consists of more than one shipping group, caulk each vertical shipping split at the back of the switchgear with metal filler provided.

Expanding Length of Existing Shelter-Clad Switchgear by Addition of Units

The new extended foundation, be it slab, pier or pilings, must be constructed in the same careful manner as described under "Outdoor Foundations". The new foundation must be level and in the same plane within 0.06" (1.6mm) as the existing foundation.

Certain items will be removed from the existing installation as described in the following instructions. Remove these items carefully and store them for re-mounting in the expanded setup.



⚠DANGER

Hazardous voltages and high-speed moving parts.

Will cause death, severe personal injury or property damage.

Do not work on energized equipment. Always de-energize and ground the equipment before working on the equipment.

1. Remove the channel-shaped covers over roof joints from both aisle and switchgear unit.

2. Remove the trim angle from the outer edge of the roof deck.

3. Remove the back plates to provide access to the hardware securing the end cover. Remove the end cover with associated parts and save for later re-installation.

4. Disconnect aisle conduit.

5. Remove all hardware securing the side plate to the switchgear frame and hardware securing aisle end plate to the aisle wall. It may be necessary to tap a knife blade down the vertical seam between the aisle wall and the end plate to cut the caulking. Remove the side plates from both switchgear and aisle.

6. The lineup is now ready for installation of the new unit or units. If the foundation was carefully constructed there should be no problems with lineup of the base or matching the level of existing equipment.

7. With new units in true alignment with existing and properly leveled, bolt units together with 1/2" hardware provided.

8. Run aisle wiring from the terminal block in existing end units, through the barrier and header to the junction box area.

9. Mount other parts removed from existing equipment and caulk all external seams with metal filler.

10. Make all electrical connections as instructed in installation manual or shown on drawings.

11. Caulk each vertical split at back of switchgear between the existing equipment and the new addition with metal filler. Replace bus compartment barriers and install back plates.

Anchoring, Leveling, and Assembling Conventional Outdoor (Non-Walk-In) Switchgear

In conventional outdoor (non-walk-in) arrangements the switchgear (as shipped) is true and in correct position relative to its support base. The formed floor base sections are a permanent part of the switchgear, and are not to be loosened or moved from position.

Verify the anchor bolt locations in the concrete and all points shown in the general arrangement plan view. Sweep the foundation to make certain it is free of pebbles and other debris. Check the general arrangement drawing for positioning of the switchgear and sequence of installation if arrangement consists of more than one shipping group.

1. Remove nuts from all anchor bolts, remove caps from all secondary conduit stubs, and remove covers from secondary openings in cubicle floor plates.

   The arrangement may consist of a single complete shipping group, or may be split into a number of shipping sections for a long lineup. Refer to the general arrangement drawing for instructions as to which shipping group should be installed first, and in what sequence the remaining groups are to be installed. Move the first group into position as shown on the general arrangement drawing.

2. The switchgear equipment was accurately aligned at the factory. This care insures proper operation and fit of mating parts. Supporting surfaces for the switchgear's 6" (152mm) base must be level and in the same plane within 0.06" (1.6mm). If concrete, grouted channels, pier supports, etc. do not meet this requirement, or if there is any projection higher than the support points in line with the base, shims must be installed in the following manner to provide an equivalent true surface for switchgear support.

   Outdoor switchgear groups which have been assembled on a 6" (162mm) base must be supported along this base with a span between support points not exceeding 36" (914mm). If shims are required, use 4" (100mm) square strips placed between the bottom of the base and the foundation, in the anchor bolt area where they will be clamped firmly in place. Do not force cubicle in firm contact by drawing down anchoring bolts as such drastic means will distort cubicles.

3. Add clamp washers and nuts to anchor bolts and tighten securely.

4. Check all breaker compartments for free movement of the shutters.

5. Move the next group into position. The front edge of the cubicle base should be in line with those of the previously installed group. This will insure a good fit with the aisle floor plates. Make certain that the end of the group being installed is tightly against the previously installed group. Repeat steps 3, 4, and 5 and install all shipping split hardware.

Expanding Length of Existing Conventional Outdoor (Non-Walk-In) Switchgear by Addition of Units

Expanding the length of existing conventional outdoor switchgear by field addition of units should be handled in the same manner as Shelter-Clad switchgear with the exception that there is no aisle with which to be concerned. Follow the instructions given under "Expanding Length of Existing Shelter-Clad Switchgear by Addition of Units". However, note that only roof channels, bus compartment barriers, and end plates need to be removed on conventional switchgear.

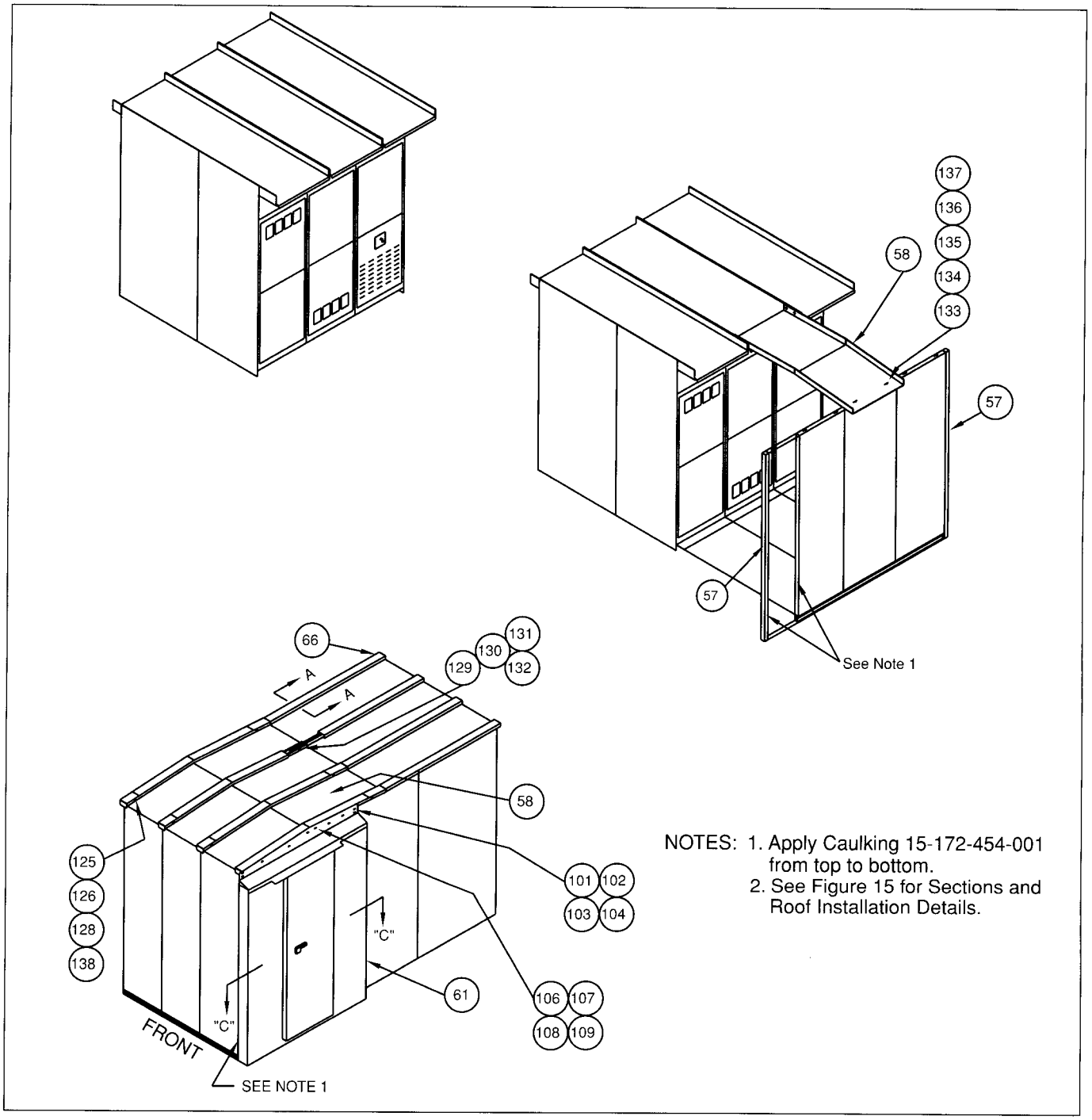


Figure 12. Single Aisle (SGM) Field Assembly

Table 2. Single Aisle (SGM) Field Assembly Components

Item No	Part Name	Part Number
54	Aisle floor assembly	18-748-411-501
57	Aisle wall spacer	18-658-130-048
58	Aisle roof	18-808-034-501
60	Aisle roof spacer	18-658-106-037
61	Housing assembly 6"	18-483-740-501
63	Aisle roof trim angle	18-740-698-124

Item No	Part Name	Part Number
64	Aisle roof cap	18-740-698-119
65	Aisle roof end cap	18-740-698-118
66	Equipment roof cap	18-741-143-501
101-113	Aisle end hardware	18-658-583-823
125-138	Aisle roof & floor hardware	18-658-583-824

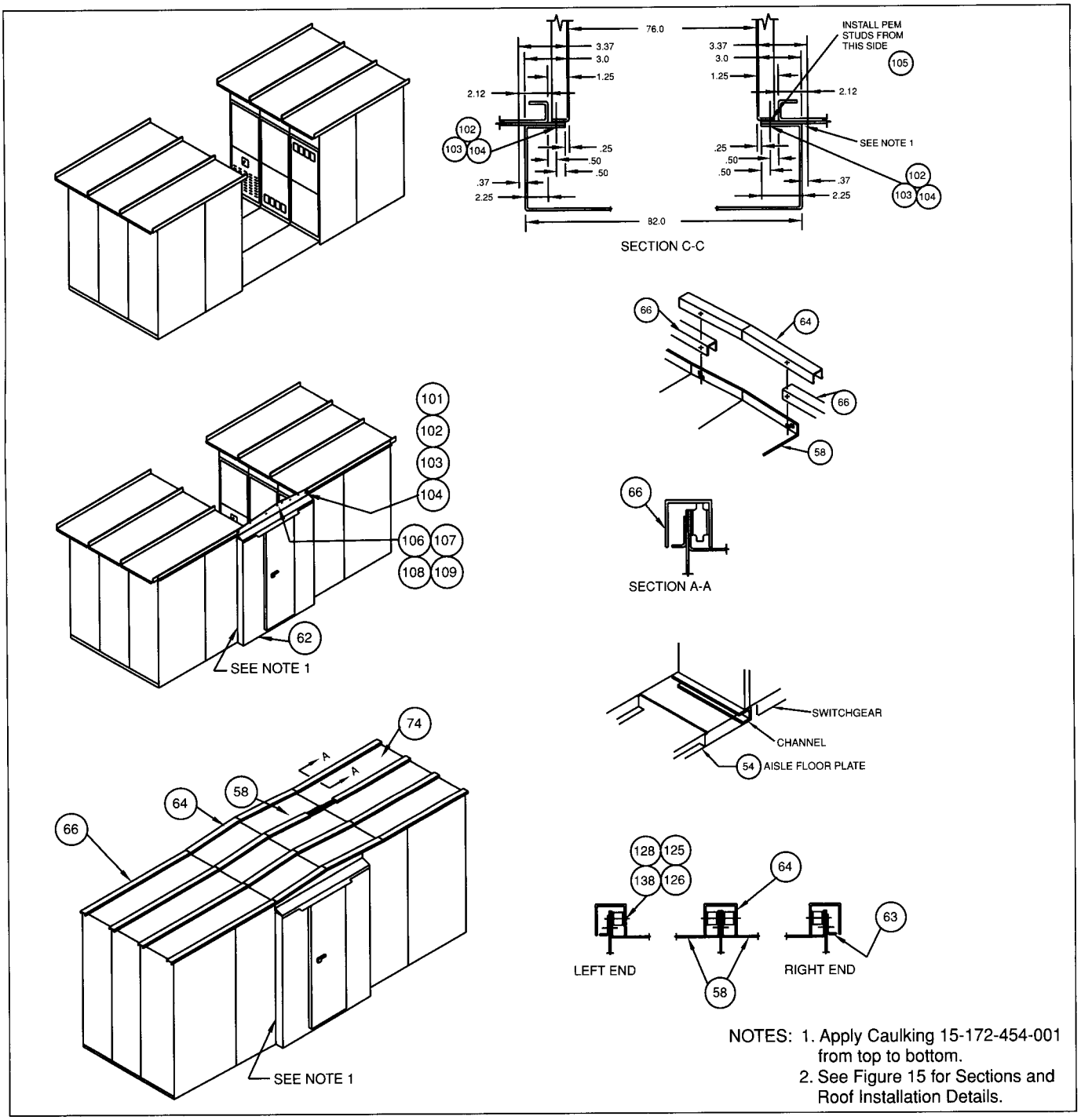


Figure 13. Common Aisle (SGM) Field Assembly

Table 3. Common Aisle (SGM) Field Assembly Components

Item No	Part Name	Part Number
54	Aisle floor assembly	18-748-412-501
58	Aisle roof	18-808-034-501
61	Housing assembly 6"	18-483-740-501
63	Aisle roof trim angle	18-740-698-124

Item No	Part Name	Part Number
64	Aisle roof cap	18-740-698-119
66	Equipment roof cap	18-741-143-501
101-113	Aisle end hardware	18-658-583-823
125-138	Aisle roof & floor hardware	18-658-583-824

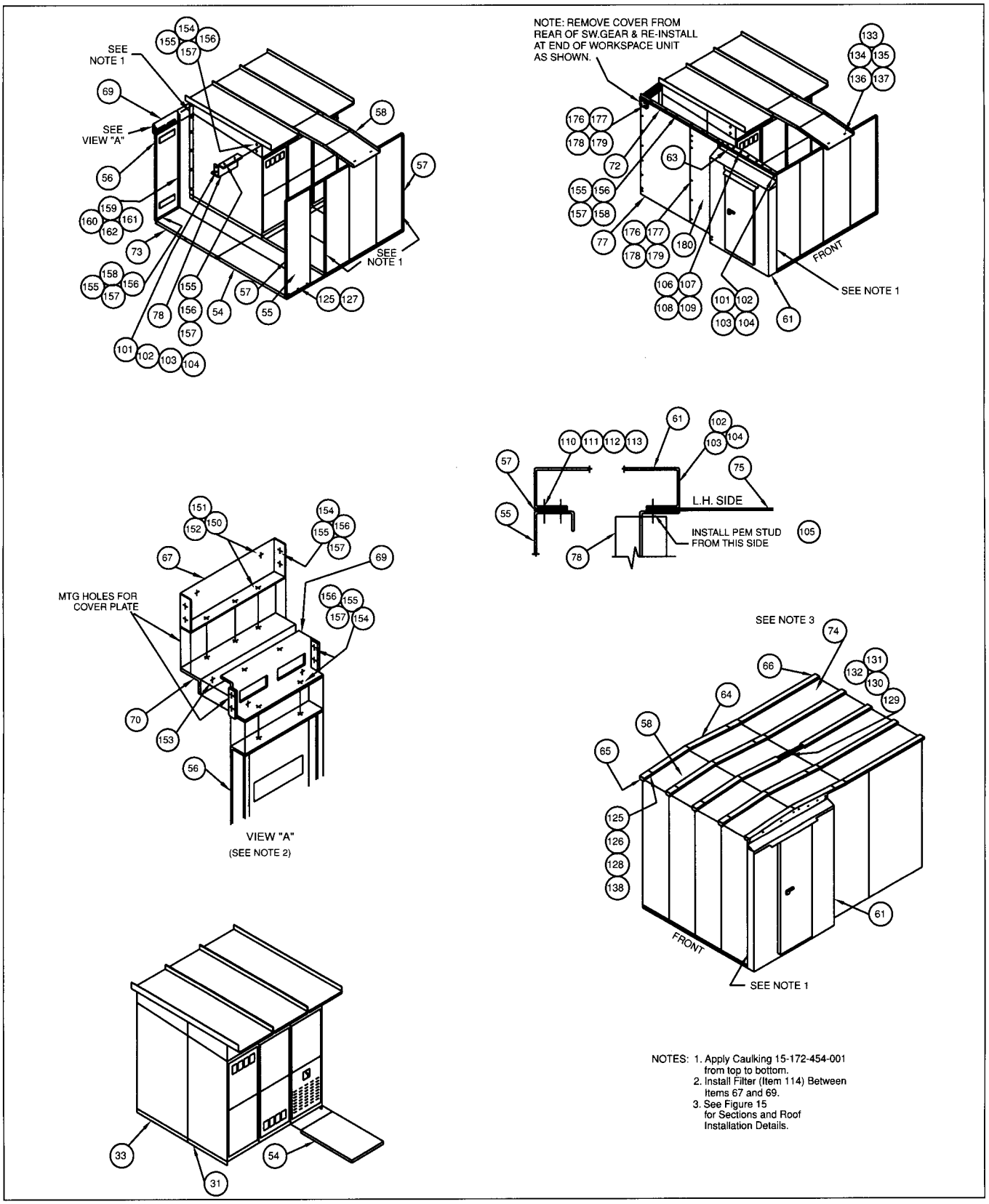


Figure 14. Single Aisle (SGM) with Work Space Field Assembly

7.B.1. On copper-copper bus joints, place a flat washer against the bar with a lockwasher between the flat washer and the nut.

7.B.2. On copper-aluminum or aluminum-aluminum bus joints, a "Belleville" spring washer is placed under the nut, with the concave side of the spring washer against the bus bar.

7.C. Spacers are required at certain bus joints to insure the cross sectional area of the joint. The conditions where these spacers are required vary with the type of bus joint. Refer to **Figure 18**.

8. Torque the .50" SAE Grade No. 5 cap screws to 50-75 lb-ft. (68-102 Nm) torque. (If special hardware is required by an order, other torque values will be supplied with field assembly drawings.)

9. Install insulation boots or tape joints where required per instructions in following sections.

10. Connect ground bus. See **Figure 28**. Insert bar in side wall opening to overlap the ground bus in adjacent cubicles.

11. Torque the 0.38" SAE Grade 5 cap screw used in the ground bus to 25-40 lb-ft. (34 to 54 Nm).

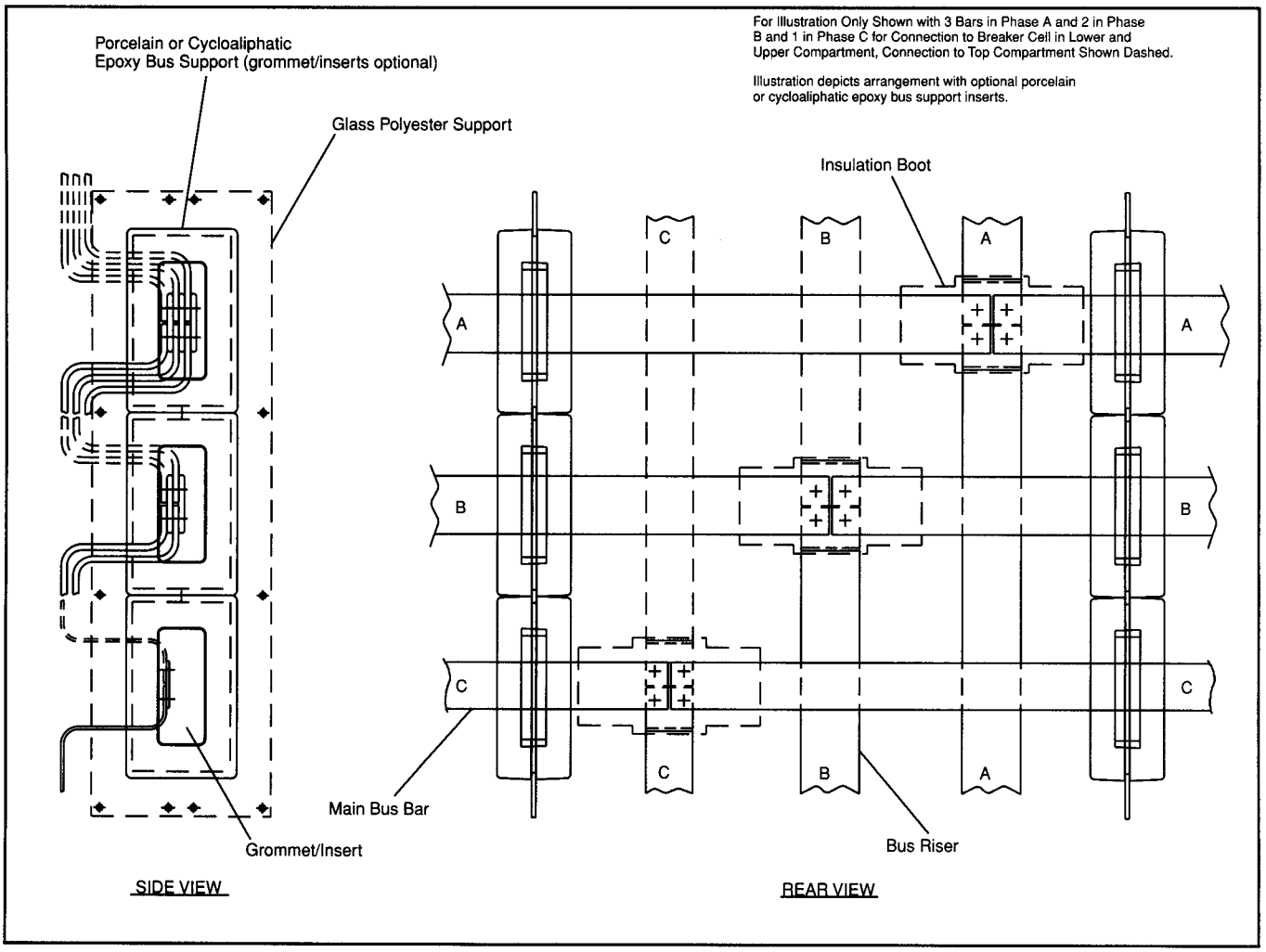


Figure 16. Main Bus Joints—Breaker Section

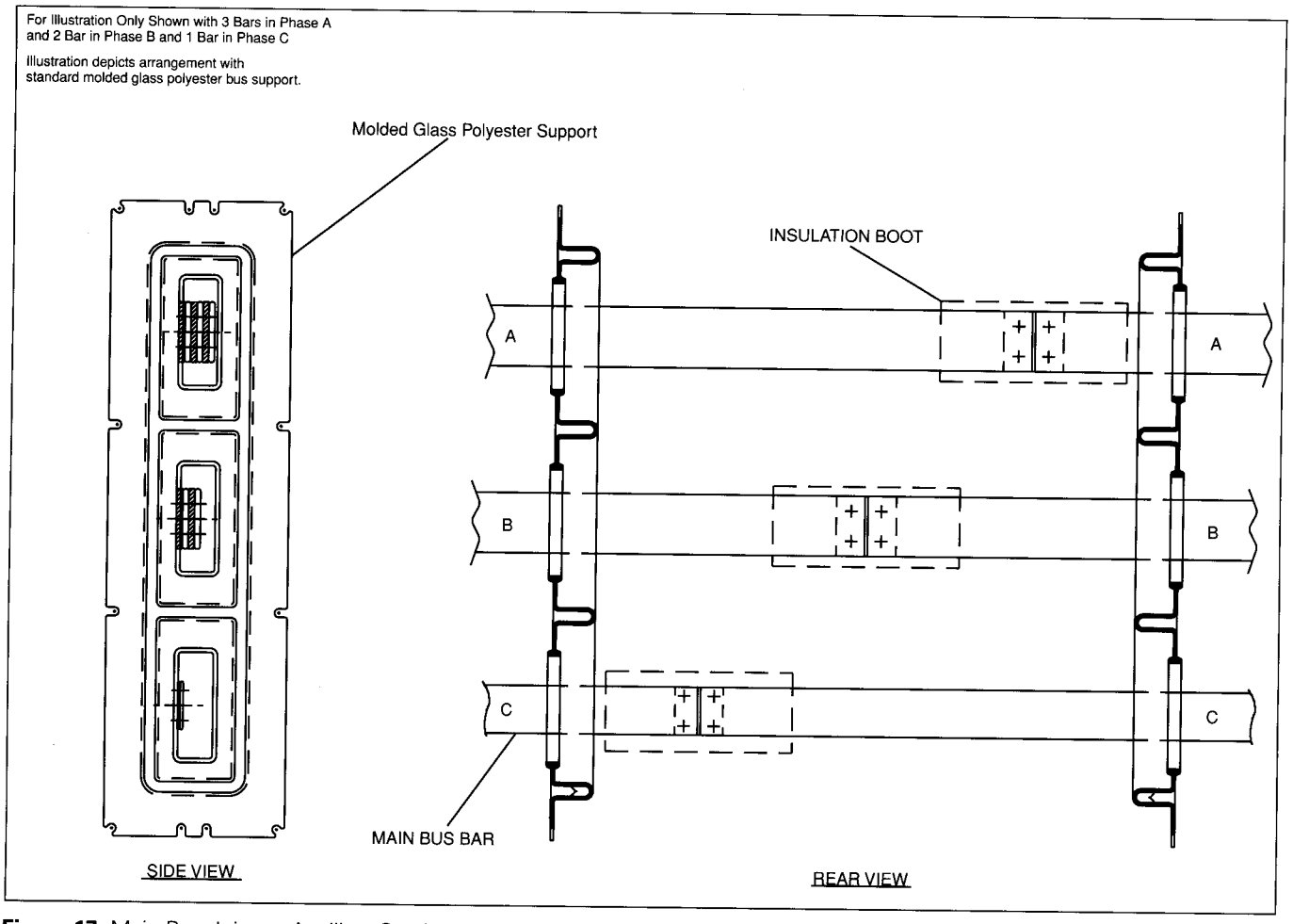


Figure 17. Main Bus Joints—Auxiliary Section

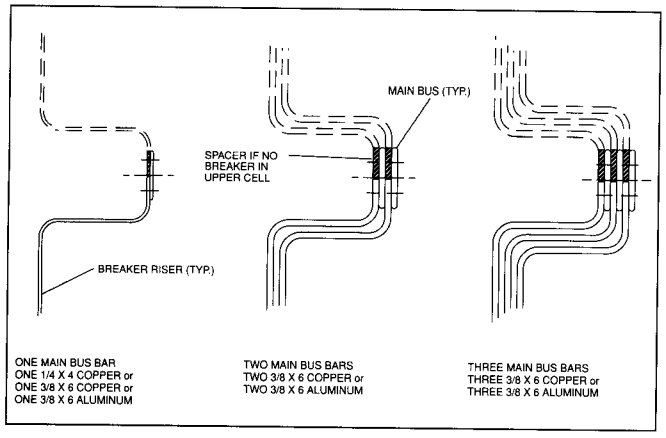


Figure 18. Main Bus Joints Connection Configurations

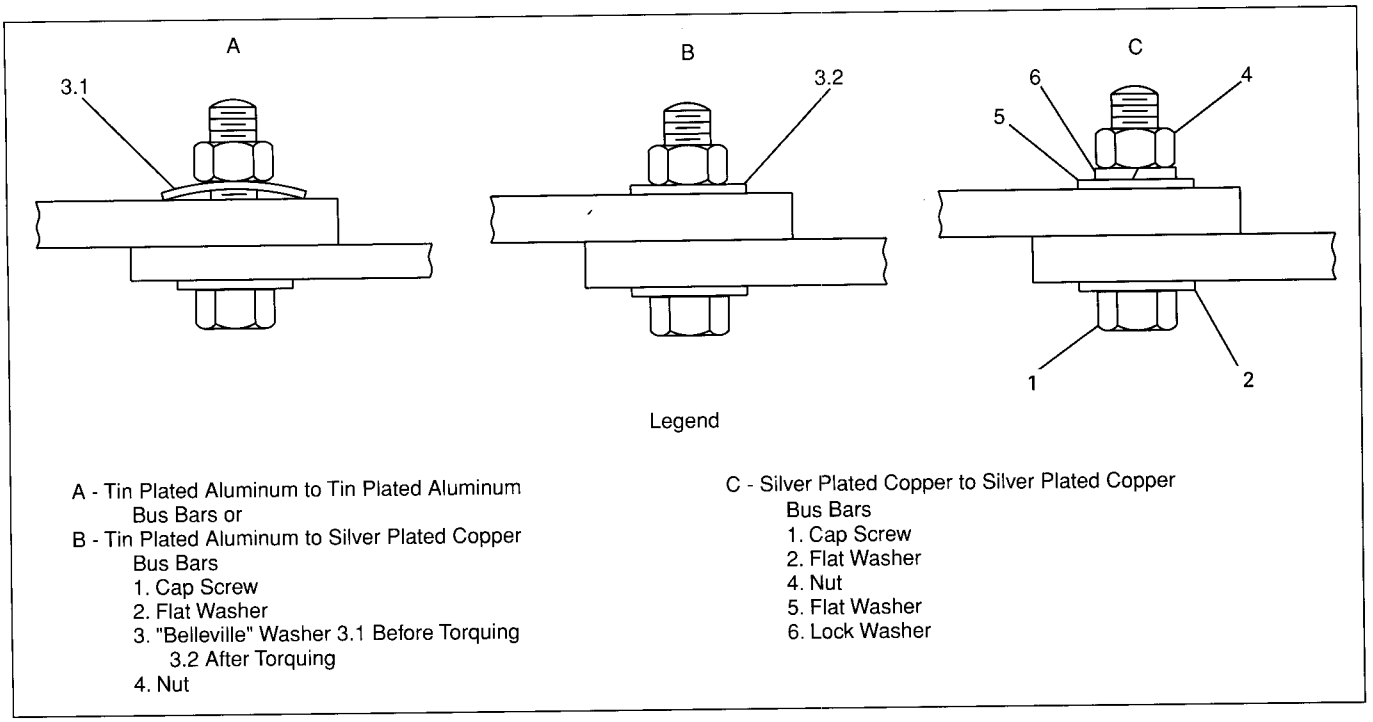


Figure 19. Bus Bar Joint Assembly

Bus Insulation

Bus and connections are insulated in metal-clad switchgear as part of a coordinated insulation system. Air or creep distance plus bus insulation combines to provide the needed insulation level. BUS INSULATION IS NOT DESIGNED TO PREVENT SHOCK.

⚠DANGER

Hazardous voltages.

Will cause death, severe personal injury, and property damage.

Do not contact energized conductors.

De-energize and properly ground high voltage conductors before working on or near them.

Epoxy insulation applied in a fluidized bed process is normally furnished on the bus bars. Bus joints are normally insulated with boots. Taping is also used for bus joint insulation.

The ANSI requirements for bus insulation in metal-clad switchgear are contained in ANSI C37.20.2 clause 6.2.3, which reads as follows:

> This insulating covering is a requirement of metal-clad switchgear and is provided to minimize the possibility of communicating faults and to prevent development of bus faults that would result if foreign objects momentarily contacted bare bus. This insulating covering is usually only a part of the primary insulation system and in such cases the outer surface of this insulating covering will not be at ground potential. It should not be assumed, therefore, that personnel can contact this insulating covering with complete safety.

Bus Joint Insulation - Boots

Standard and repetitive bus bar joints are normally provided with insulation boots installed at the factory. See **Figure 20**. After they are completed in the field, bus bar joints at shipping splits must be insulated as part of the total insulation system. Normally, boots are provided for field completed shipping split joints and are shipped in the location where they will finally be installed. See **Figure 21**.

Grommets are provided for use with the boot when the bus bar is smaller than the opening in the bus bar boot. When required, these grommets are normally mounted along with the bus boot in the final assembly location.

Before removal of the boot to complete the joint, observe the location and orientation of the boot and hardware. This should make reinstallation easier.

Nylon nuts and bolts and flat washers, or reusable plastic rivets are used to hold the boot closed after it is installed. Some boots may use molded-in threaded stems to provide a snap type closure. Carefully remove the insulation boot and save all hardware.

After the bus bar joint has been properly assembled, reinstall the insulation boot. Secure the boot closed with the nylon nuts and bolts. Completed boot installation should be flush with the bus bar insulation and overlap it by at least 1-1/2" (38mm). In those cases where the boot does not close flush with the bus bar insulation or the overlap is less than 1-1/2" (38mm), apply one layer of tape (15-171-987-001) 1/2 lapped, overlapping the bar insulation and boot by 1-1/2" (38mm).

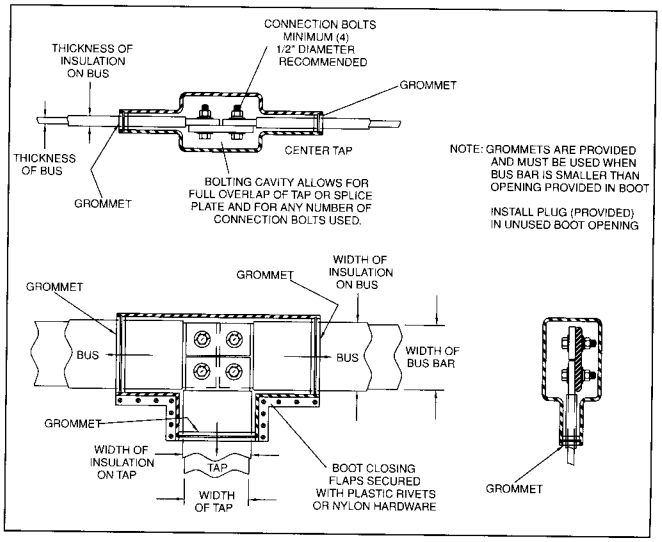
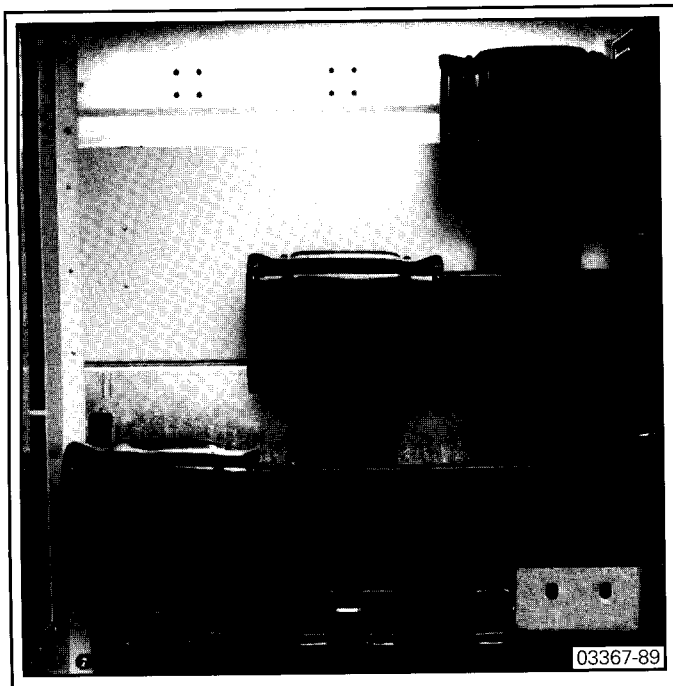
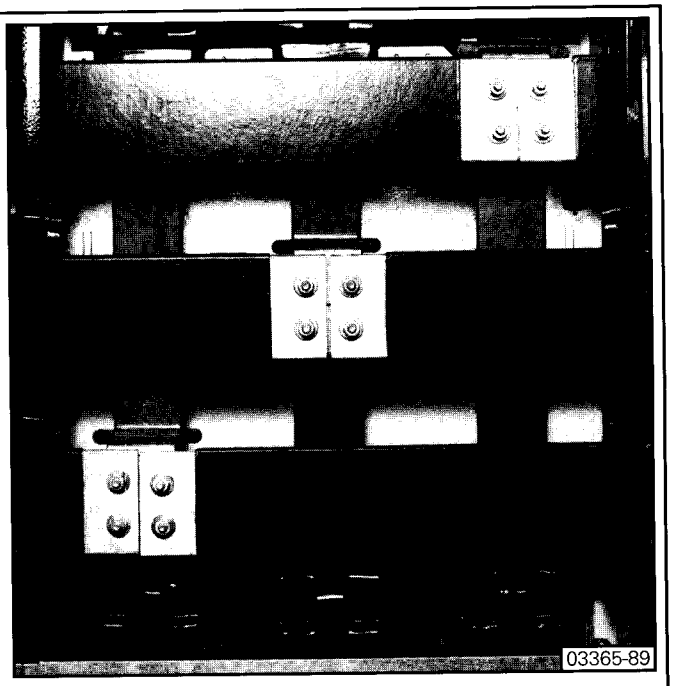


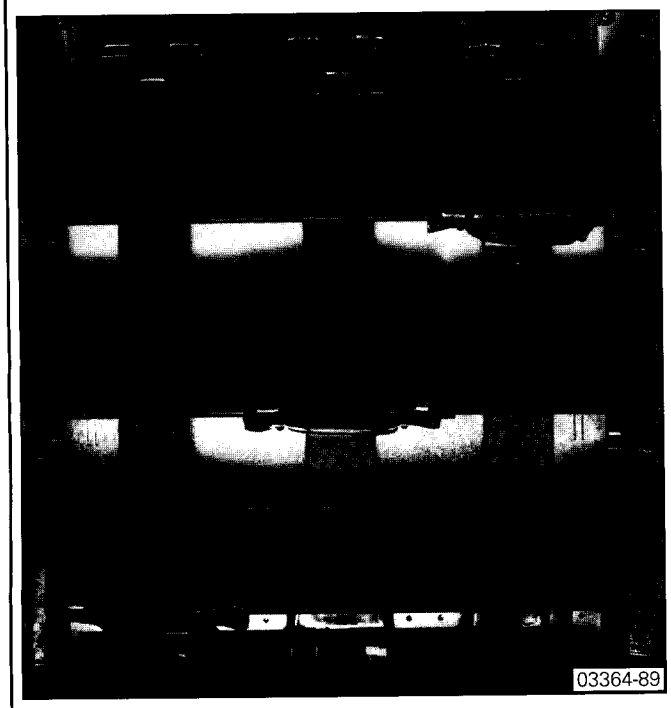
Figure 20. Typical Installation of Insulating Boot



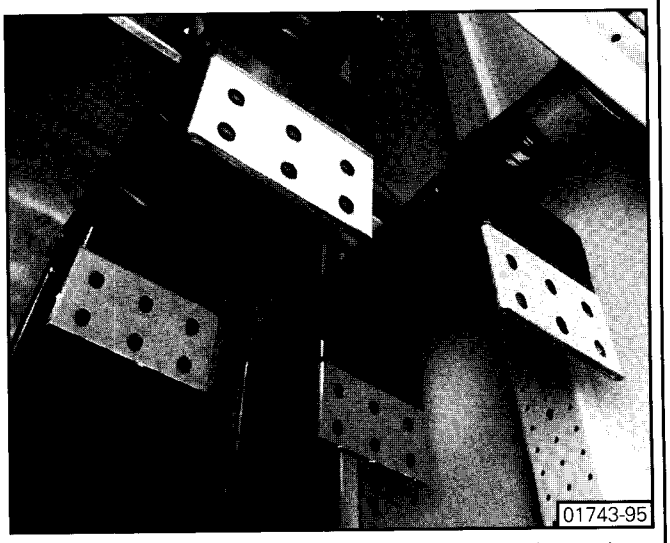
A: Shipping split, as shipped. Insulation boots are factory installed in correct location. Bus bars and hardware are mounted on a temporary shipping bracket in the one of the units to be connected. (Bus bars and hardware may be packed separately in unusual situations).



B: Shipping split assembly in progress. Insulation boots have been removed, and bus bars have been installed. Connection bolts have been correctly torqued. Unit is ready for reinstallation of insulation boots.



C: Insulation boots have been reinstalled. Unit is ready for reinstallation of main bus compartment barrier (designated R in **Figure 25**).



D: Taped bus joint configuration, used for joints where a boot is not available. This illustrates a taped connection for multiple cable terminals. After cables have been installed, the cable terminations and the exposed bus must be insulated.

Figure 21. Connection of Bus at Shipping Split

Bus Joint Insulation - Taping
Insulation boots are normally provided for repetitive or standard bus joint conditions. Where boots are not provided, the bus joints must be carefully taped to the required insulation level as described below. See **Figure 21D**, which depicts taped joints associated with a cable lug mounting arrangement for multiple cables. **Note:** When the cables associated with **Figure 21D** have been installed, the cable terminations and the exposed bus must be insulated.

1. Inspect bolted joints to insure they are correctly assembled, bolt heads in proper direction and hardware has been torqued to proper value. All surfaces must be free of dust, dirt or other foreign material.

2. Apply a mastic pad over nuts and a second pad over the bolt heads. Use either small (15-171-988-001: 3.25" x 4.50" (83mm x 114mm) or large (15-171-988-002: 4.50" x 6.50" (114mm x 164mm)) size pad most suitable for joint involved. Remove backing and press adhesive side down and mold in place covering all sharp projections. Cover hardware and sharp edges of bus bar if any will be against the tape.

3. Apply half-lapped layers of 4" (102mm) wide tape (15-171-987-002) or 1" (25mm) wide tape (15-171-987-001) over the joint. Each layer should overlap the bus bar insulation by at least 1-1/2" (38mm). Stretching of tape 10% to 15% in problem areas may help in eliminating voids and wrinkles.

   For 5kV class equipment, use two half-lapped layers of tape over mastic pads. For 8.25kV and 15kV class equipment, use three half-lapped layers of tape over the mastic pads.

   Avoid excessive pressure on the completed bus joint insulation. If bus joints are on standoff insulators, apply tape per the above procedures except the half-lapped tape should overlap the insulator by at least 2" (51mm).

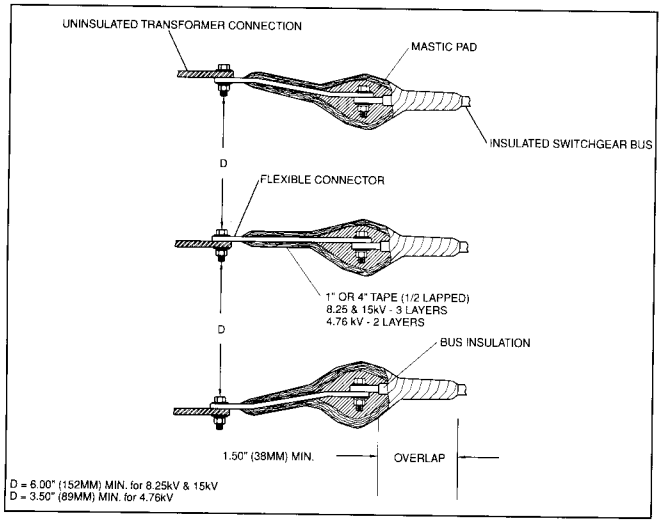


Figure 22. Taped Joint Insulation-Switchgear Bus to Transformer Throat

Transformer Bus Joints - Insulation
The typical transformer to switchgear bus joint shown in **Figure 22** is different from other bus joints in the switchgear main bus. In the transformer bus joints, there is a transition from the fully insulated switchgear system to the transformer, where the spacing between conductors is usually large enough so that the conductors need not be insulated. The use of flexible connectors in this area insures correct alignment of the switchgear conductors to the transformer conductors. If the installed clearance (phase-to-phase or phase-to-ground) is less than 6" (152mm) for 8.25kV and 15kV switchgear (3.5" (89mm) for 5kV switchgear), the joint must be insulated.

Refer to **Figure 22**, and insulate bus joint connections as outlined under "Bus Joint Insulation - Taping".

Primary Cable Connections
All cable connections to metal-clad switchgear must be fully insulated to comply with the ANSI C37.20.2 definition of metal-clad switchgear. Recommendations of the cable supplier should be followed for the installation. Typical termination configuration is shown in **Figure 23**.

Because of considerable variations in installation requirements and available cables, Siemens furnishes a double-bolt, double-clamp, terminal lug as standard. All insulating and terminating materials other than terminal lugs and cable supports are to be furnished by the purchaser.

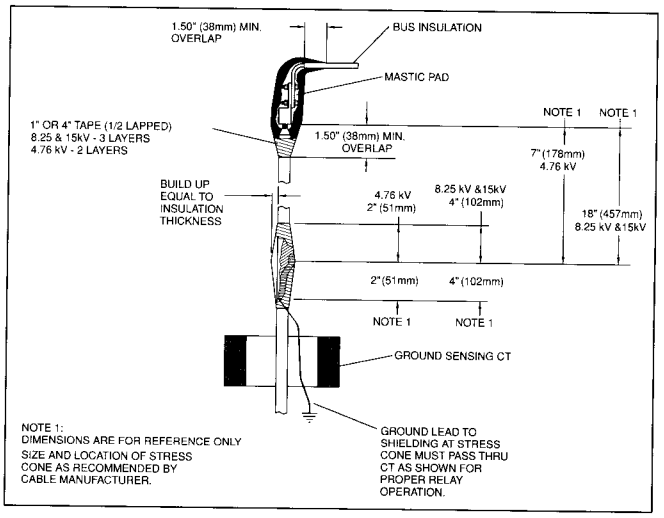


Figure 23. Primary Cable Termination and Insulation

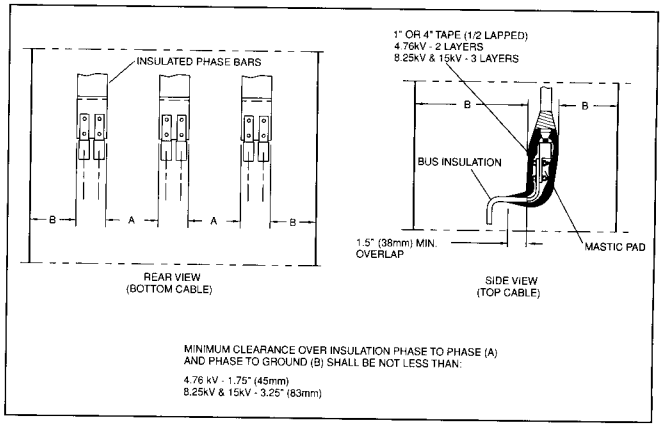


Figure 24. Typical Cable Terminal Mounting and Insulation

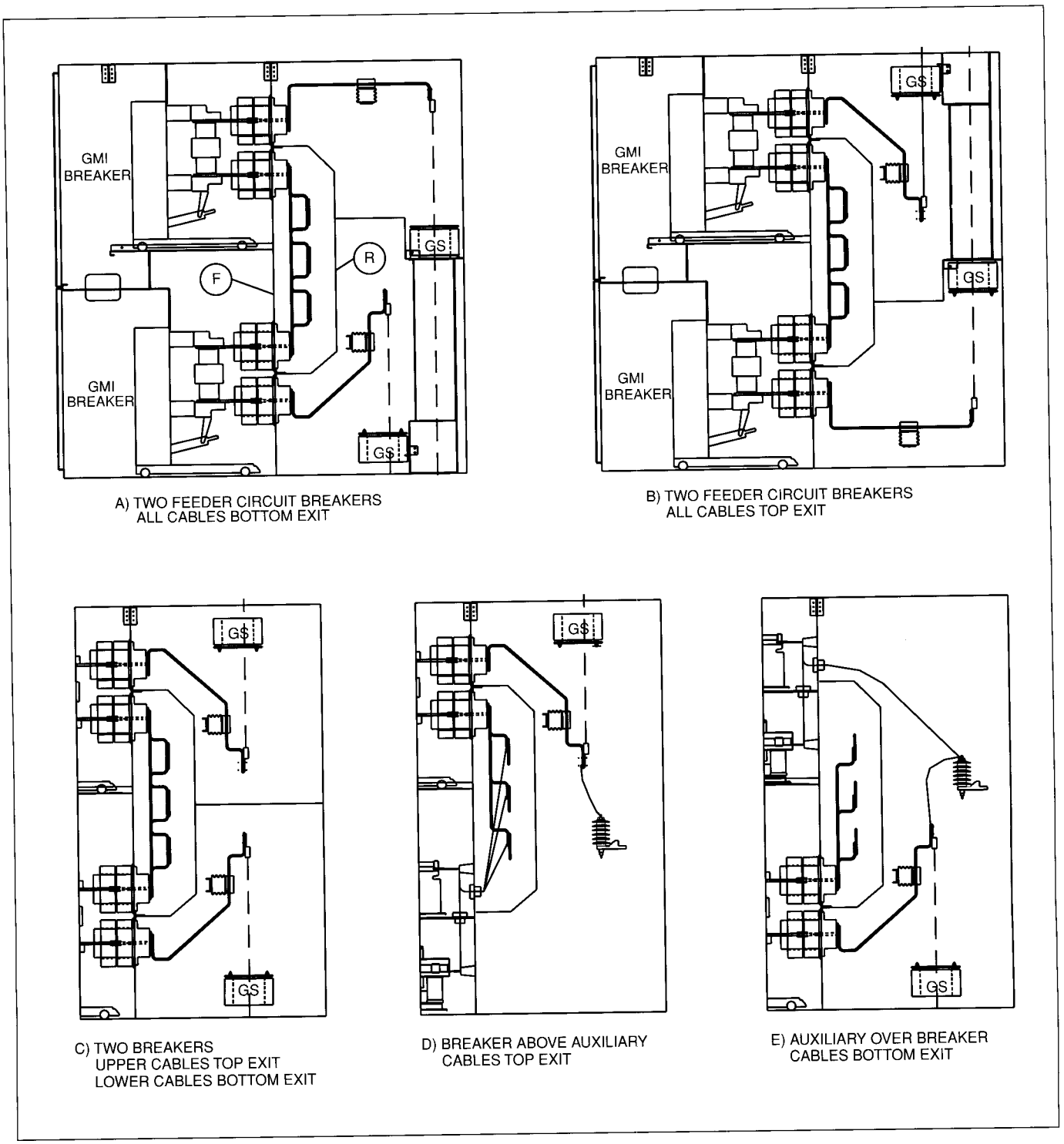


Figure 25. Typical Cable Termination Configurations

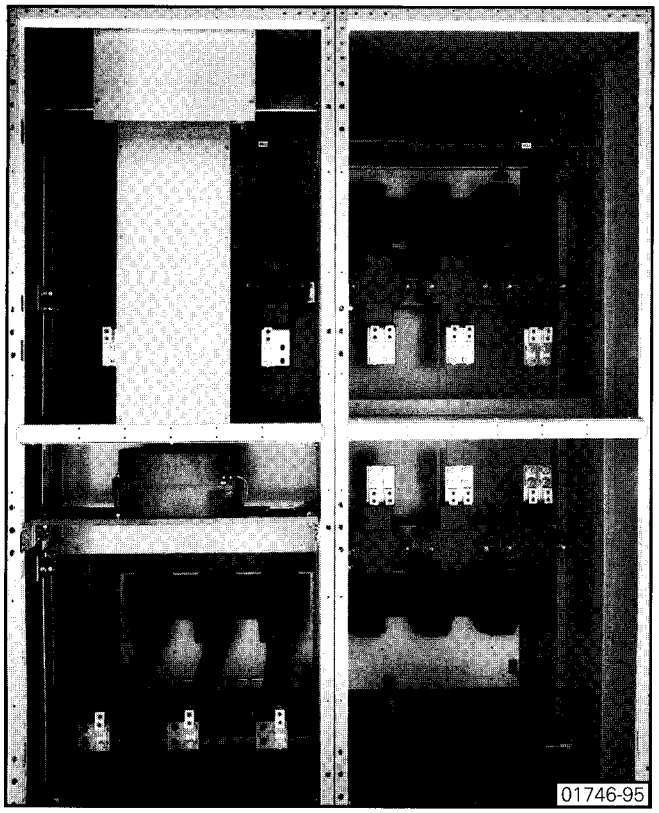


Figure 26. Typical Cable Termination Compartments (Unit on left has top breaker cables exiting top, and bottom breaker cables exiting top through "chimney" or trough. Unit on right has top breaker cables exiting top and bottom breaker cables exiting bottom.)

Secondary Control Wiring

Secondary control wiring is carefully installed and tested at the factory. Inter-group wiring at shipping splits can be readily connected by referring to wire markings. These wires are not terminated and are of sufficient length to be routed to their termination point after cubicles are bolted together. Terminals for these leads are furnished by the purchaser to suit the available crimping tools. Terminal block hardware is furnished with the switchgear. All wiring diagrams needed for installation are furnished in advance.

Wires can be easily traced on wiring diagrams furnished for the switchgear. Each device is illustrated and identified with an alphanumeric code. Each terminal on each device is identified by a number. The wire list adjacent to each device on the diagram indicates the device and terminal number to which each wire is connected at the next connection point.

All secondary control wiring installed by the factory is neatly bundled and cleated to the cubicle side plate. Make all field connections in a similar manner. Check that the circuit breaker, its components, and the hinged front panel clear any additional wiring installed. **Figure 27** shows a typical secondary control cable installation. All purchaser wiring is to be routed behind the cable retainer which is removable for installation purposes. Use plastic or nylon ties to secure all field installed wires to the cubicle structure.

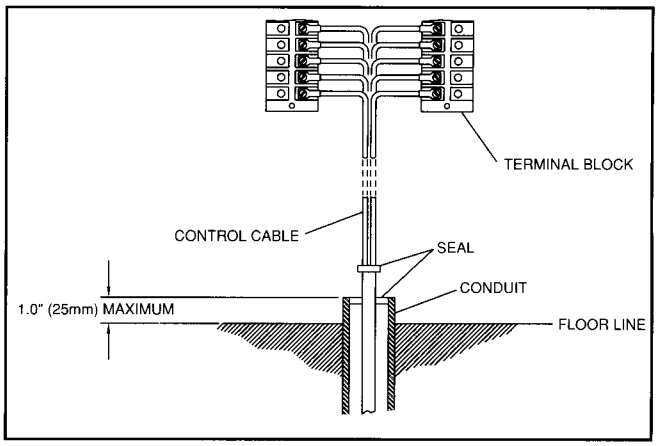


Figure 27. Secondary Control Cable Connections

Ground Connections

A common ground bus is incorporated in all units for properly grounding the equipment after installation.

The ground bus extending through the switchgear is accessible in the primary cable area of each unit. The interunit connector has provisions for two bolts at each end. For ease of assembly, install bottom bolts first. Insure that ground bar to circuit breaker cell is also bolted to interunit bar, as shown in **Figure 28**.

Provision for connecting this ground bus must be made in such a manner that a reliable ground connection is obtained. Consult latest National Electrical Code for ground connection standards.

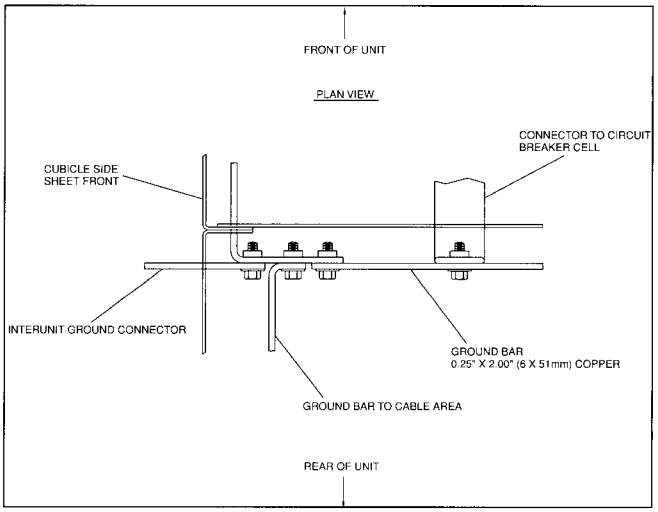


Figure 28. Ground Bus Connection

Temporary Ground Connections

It is recommended that no work be done on current carrying parts until these parts have been disconnected from the system and solidly grounded. One method of solidly grounding the high voltage circuit is by use of a grounding device. This device is placed in a cubicle in the same manner as a breaker and provides a path to ground. It is furnished only when specified in the contract.

Control Power and Voltage Transformers-General Information

When required, voltage transformers (VTs), or a control power transformer (CPT), or fuses for a CPT can be mounted on a withdrawable rollout fuse tray. Each auxiliary cell (A = upper, or B = lower) can contain up to two rollout trays. See **Table 5** for various rollout tray positions. Rollout trays are designed with metal extensions on each end of the primary fuses. These extensions wipe across a flexible copper strap mounted on the cubicle as the rollout tray is withdrawn. This action will ground each side of the primary fuses to remove any residual charge from the fuses or transformers, and grounds the primary fuses when the tray is fully withdrawn.

As the rollout tray is withdrawn, insulating shutters move to cover the cubicle primary disconnect stabs. **Note:** The insulating shutter is only a part of the primary insulation system, and the outer surface of the insulating shutter will not be at ground potential. It should not be assumed, therefore, that personnel can contact the insulating shutter with complete safety.

Voltage Transformers

One, two, or three voltage transformers with primary fuses may be mounted on the rollout tray located in positions C, D, E, and/or F. See the "Operating Sequence" section for disconnecting, connecting or withdrawal instructions.

Typical rollout tray and transformer locations are shown in the side views in **Figure 29**.

Table 5. Rollout Tray and Transformer Positions

Cell	Position	Rollout Tray May Be Used for:
A (Upper)	C	Voltage Transformer (VT)
	D	Voltage Transformer (VT) or Control Power Transformer (CPT) (up to 15kVA single phase) (Fuses for CPT may be installed in position D if position C is empty and the CPT is located in positions E & F)
B (Lower)	E	Voltage Transformer (VT)
	F	Voltage Transformer (VT) or Control Power Transformer (CPT) (up to 15kVA single phase) or Fuses for Control Power Transformer (CPT) with CPT installed in rear of section or remote (over 15kVA single phase, or any three phase)

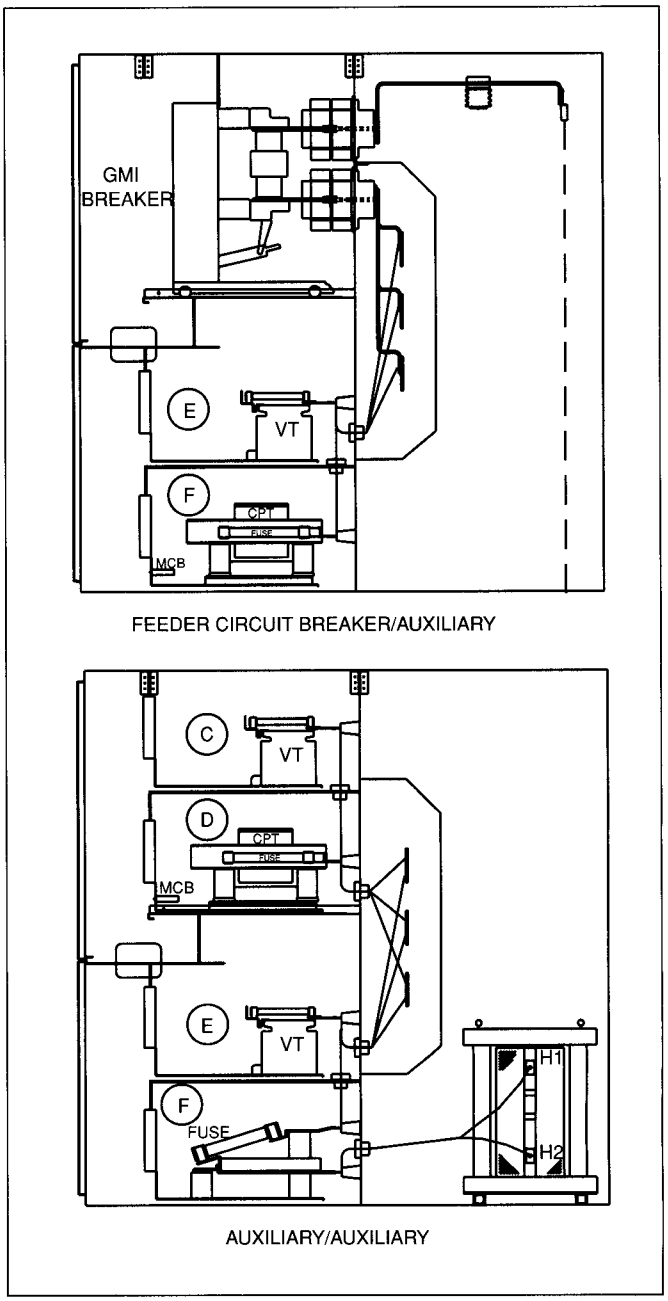


Figure 29. Typical VT, CPT, and CPT Fuse Rollout Locations

Control Power Transformer
Control power transformers, up to 15kVA single phase, with the associated primary fuses, may be mounted on a rollout tray in positions D and F. CPT's larger than 15kVA single phase, and all three phase CPT's, are stationary mounted, either in the rear of the switchgear section, or in the lower front cell, or remote. If the CPT is located in the rear of the section, the primary fuses are mounted on a rollout fuse tray which is located in position F in the lower front cell. If the CPT is located in the lower front cell, the primary fuses are mounted on a rollout fuse tray which is located in the upper cell in position D, and position C must be empty.

The secondary molded case circuit breaker is normally mounted on the front of the CPT rollout tray, interlocked with the tray so that the circuit breaker must be open before the tray can be withdrawn or inserted. For large units, the secondary molded case circuit breaker may be mounted separately, and key interlocked with the rollout fuse tray so that the secondary circuit breaker must be locked open before the rollout fuse tray can be withdrawn.

Operating Sequence

⚠WARNING

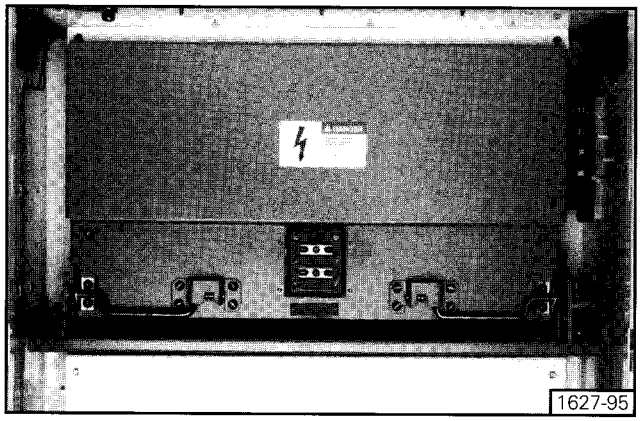
Hazardous voltages.

Can cause death, severe personal injury or property damage.

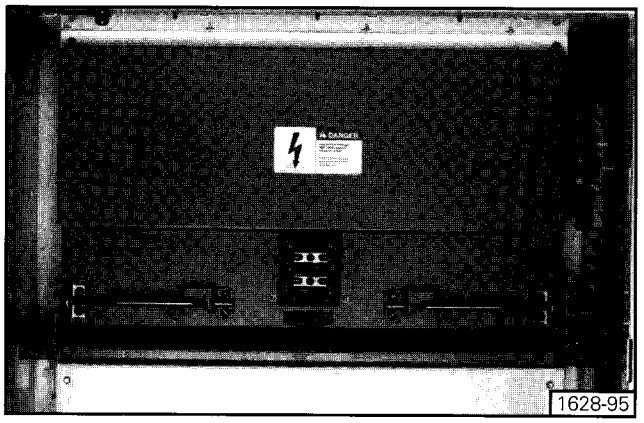
Do not place hands or objects into rollout trays until fully withdrawn from cell.

When inserting or withdrawing a rollout tray, always complete the action in one continuous motion.

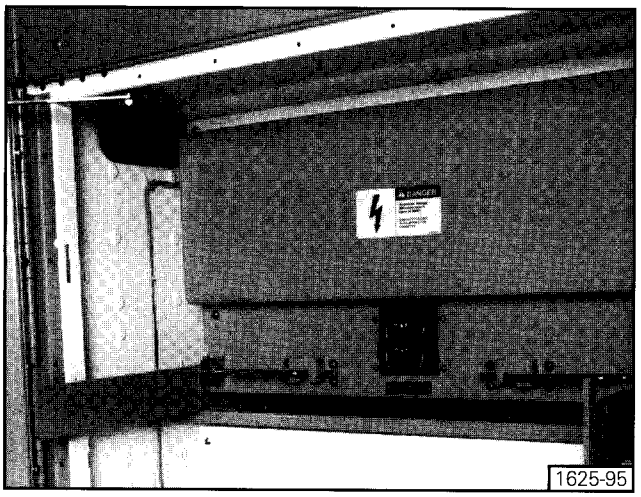
- **To Disconnect VT Rollout** (Refer to **Figure 30**) For disconnecting voltage transformers from the primary circuit, grasp the handle/interlock bar on each side of the rollout tray, and rotate the handle upward while pulling the handle horizontally towards the center of the unit. The handle will lodge in a "notched" area in the mounting bracket, and the interlock portion of the handle will be withdrawn from the guide rails on the side of the cell. When both handles are operated to the raised position, the rollout tray will be free to move. Withdraw the extension rails on each side of the cell to their fully extended position. Then, using the handles on the rollout tray, pull the tray in a smooth motion from the fully inserted (connected) position to the fully withdrawn (disconnected) position.
- **To Connect VT Rollout** Connecting (inserting) the voltage transformer rollout tray is the reverse of the disconnecting operation. The handle/interlock bars must be in their fully raised position, with the interlock bar withdrawn on each side of the rollout. Push the rollout tray in firmly to the fully connected position. Then, push the extension rails in to their fully inserted position. When this is done, holes in the extension rails should align with holes in the cell structure, which will allow the handle/interlock bar to be released, locking the rollout tray into the connected position in the unit.
- **To Disconnect CPT Rollout or CPT Fuses** (Refer to **Figure 31**) Withdrawal of a CPT rollout or a CPT fuse rollout is similar to withdrawal of a VT rollout, except that the secondary circuit breaker must be opened before the rollout tray can be withdrawn. If the secondary molded case circuit breaker is mounted directly on the rollout tray, the circuit breaker will be mechanically interlocked with one of the handle/interlock bars. If the circuit breaker is separately mounted, the circuit breaker will be key interlocked with the handle/interlock bar. Opening of the circuit breaker will allow operation of the key interlock, which will make the key available. This key should then be inserted in the key interlock on the rollout tray, to allow the tray to be withdrawn.
- **To Connect CPT Rollout or CPT Fuses** Connecting (inserting) the control power transformer rollout tray or CPT fuse tray is the reverse of the disconnecting operation. The secondary molded case circuit breaker must be in the open position, and if a key interlock is involved, the key must be inserted in the interlock cylinder on the rollout tray. The handle/interlock bars must be in their fully raised position, with the interlock bar withdrawn on each side of the rollout. Push the rollout tray in firmly to the fully connected position. Then, push the extension rails in to their fully inserted position. When this is done, holes in the extension rails should align with holes in the cell structure, which will allow the handle/interlock bar to be released, locking the rollout tray into the connected position in the unit. Once the rollout tray is fully inserted and the handle/interlock bars fully extended, molded case circuit breaker may be closed, either directly if mounted on the rollout tray, or indirectly if a key interlock is involved.



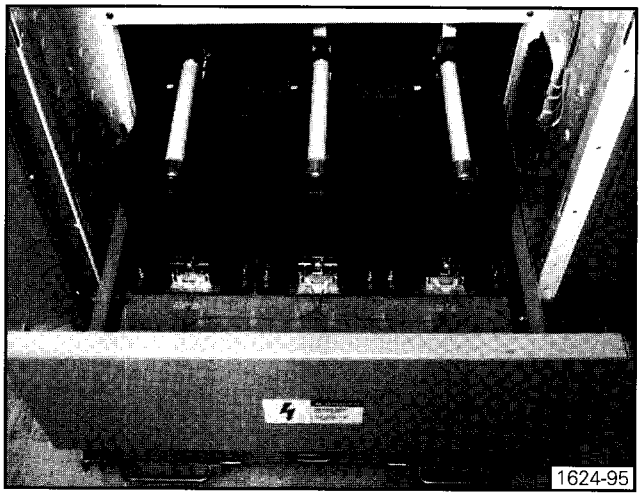
A: VT Rollout Tray in Connected Position. Handle/interlock Bars Fully Extended to Secure Rollout Tray in Cell.



B: Handle/interlock Bars Retracted, to Allow Rollout Tray to be Withdrawn.

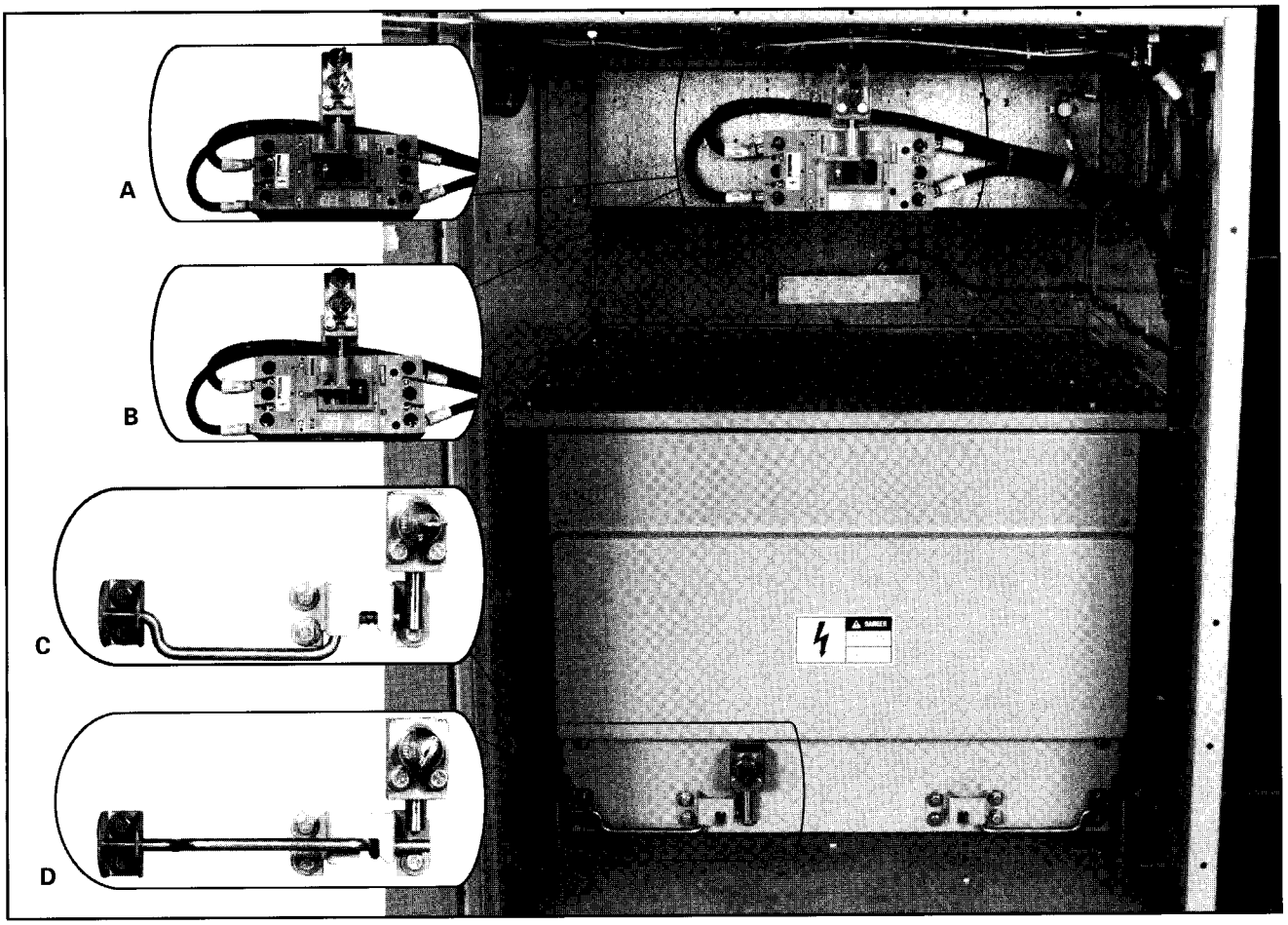


C: Extension Rails Withdrawn to Fully Extended Position.



D: VT Rollout Tray Withdrawn to Allow Inspection of Fuses.

Figure 30. VT Fuse Rollout Tray Operating Sequence



A: Step 1: Secondary breaker is closed. Open secondary breaker. (05092-89)

B: Step 2: Secondary breaker is open. Rotate key interlock, extending interlock to block closing of secondary breaker. Remove key. (05093-89)

C: Step 3: Key interlock on rollout tray is extended, preventing operation of handle/interlock bars. Insert key, rotate key interlock, withdrawing interlock so that handle/interlock bar is free to move. (05091-89)

D: Step 4: Key interlock withdrawn. Operate handle/interlock bar to allow withdrawal of rollout tray. (05090-89)

05102-89

Figure 31. CPT Fuse Rollout Tray with Key Interlocking

Instrument Transformers

Current Transformers

The torroidal current transformers shown installed in a unit in **Figure 32** are the most commonly used type in metal-clad switchgear equipment. The circuit breaker primary studs pass through the transformers when in the CONNECT position. Types MD or MDD current transformers are of the torroidal type mounted in the circuit breaker compartment behind the shutter barrier. Up to two standard or one high accuracy current transformers may be mounted around each primary insulator tube.

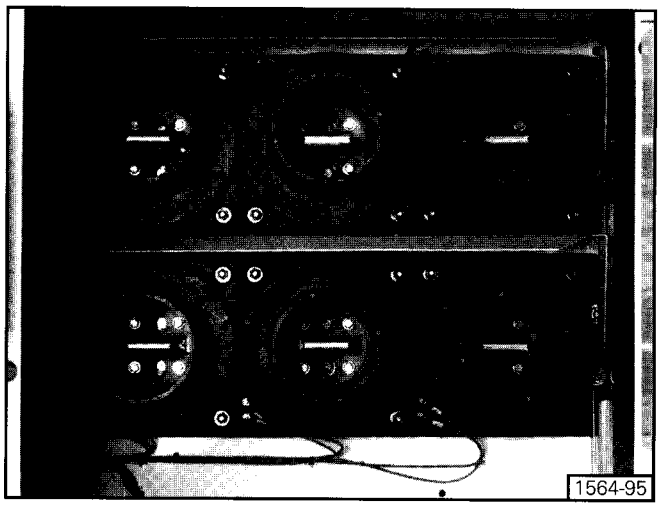


Figure 32. Type MD CT's Installed on Upper and Lower Disconnects (CT Barrier Removed for Photo)

A zero sequence torroidal current transformer can be furnished for ground sensing circuits. This transformer is mounted in the primary cable area at a convenient height for receiving purchaser's cables. Zero sequence current transformers may require that conduits for multiple bottom entrance cables be recessed.

Circuit Breaker Position

Cell Preparation
The cell contains the positioning, interlocking and operating devices described below and shown in **Figures 33** and **35.** These devices must be checked for placement and freedom of operation.

Circuit Breaker Racking Mechanism
The circuit breaker racking mechanism is centered below the circuit breaker. It functions in conjunction with the trip-free interlock on the circuit breaker, to hold the circuit breaker trip-free between positions. Three positions are provided: DISCONNECT, TEST, and CONNECT.

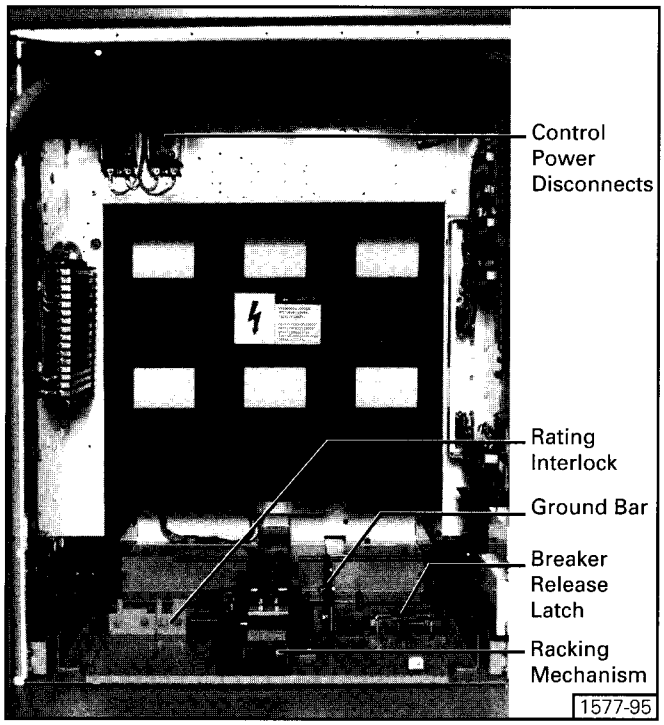


Figure 33. Circuit Breaker Compartment

Interference Blocking Plate
This plate is mounted vertically on the bottom of the cell to allow only the properly rated breaker into the designated cell (e.g., a 1200 ampere circuit breaker to enter a 1200 ampere cell, or a 2000 ampere circuit breaker to enter a 2000 ampere cell), depending on the voltage, interrupting, and close and latch ratings. Normally the cubicle and circuit breaker rating plate combinations will be identical.

⚠WARNING

Hazardous voltages.

Can cause death, severe personal injury or property damage.

Do not insert a circuit breaker into a cell intended for a circuit breaker with ratings above those of the circuit breaker being inserted.

Verify that circuit breakers and cubicles have appropriate ratings and properly located interference blocking plates and angles before attempting to insert a circuit breaker.

The interlock will allow a 2000 ampere circuit breaker to enter a 1200 ampere cell, provided the voltage, interrupting, and close and latch ratings equal or exceed the ratings of the cell.

The coordinating interference plate on the circuit breaker is shown in **Figure 34**.

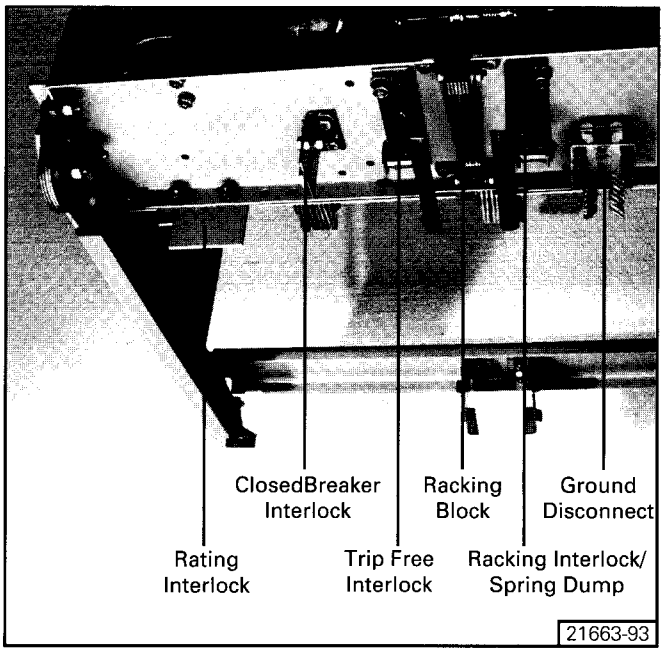


Figure 34. Interlocks on Bottom of Circuit Breaker

Secondary Disconnect
The secondary disconnect contains all the electrical control circuit connections for the circuit breaker. It mates with the secondary disconnect block on the circuit breaker. The circuit breaker contacts slide against the cell contact strips. The secondary contacts are automatically mated in the TEST and CONNECT positions.

Mechanism Operated Cell Switch (MOC)
This switch is operated by a roller on the circuit breaker. The breaker engages the MOC auxiliary switch only in the CONNECT (operating) position unless an optional TEST position pickup is specified in the contract. If a TEST position pickup is included, the breaker will engage the auxiliary switch in both positions. The MOC switch is illustrated in the lower portion of **Figure 35**. Up to 24 stages may be provided.

Truck Operated Cell Switch (TOC)
This switch is operated by an extension of the top plate at the right top corner of the circuit breaker. This switch is operated only as the circuit breaker is moved to or from the CONNECT position. The TOC switch is shown in the upper portion of **Figure 35**. Up to 12 stages may be provided.

Circuit Breaker Position

Circuit Breaker Ground Connection

A sliding contact multiple finger assembly for grounding the circuit breaker frame is mounted underneath the breaker truck frame, as shown in **Figure 34**. This assembly engages the ground bar mounted in the cell and maintains a solid ground contact with a continuous wipe through all positions. The contact is broken when the breaker passes the DISCONNECT position while being removed from the cell.

Shutter Operation

Two shutter operating levers, one on each side of the breaker cell, are driven down by the engagement of the wheels on the circuit breaker frame. This opens the shutters as the circuit breaker is moved into the CONNECT position and allows the shutters to close when the circuit breaker is withdrawn. The shutters are fully closed with the breaker in the TEST position.

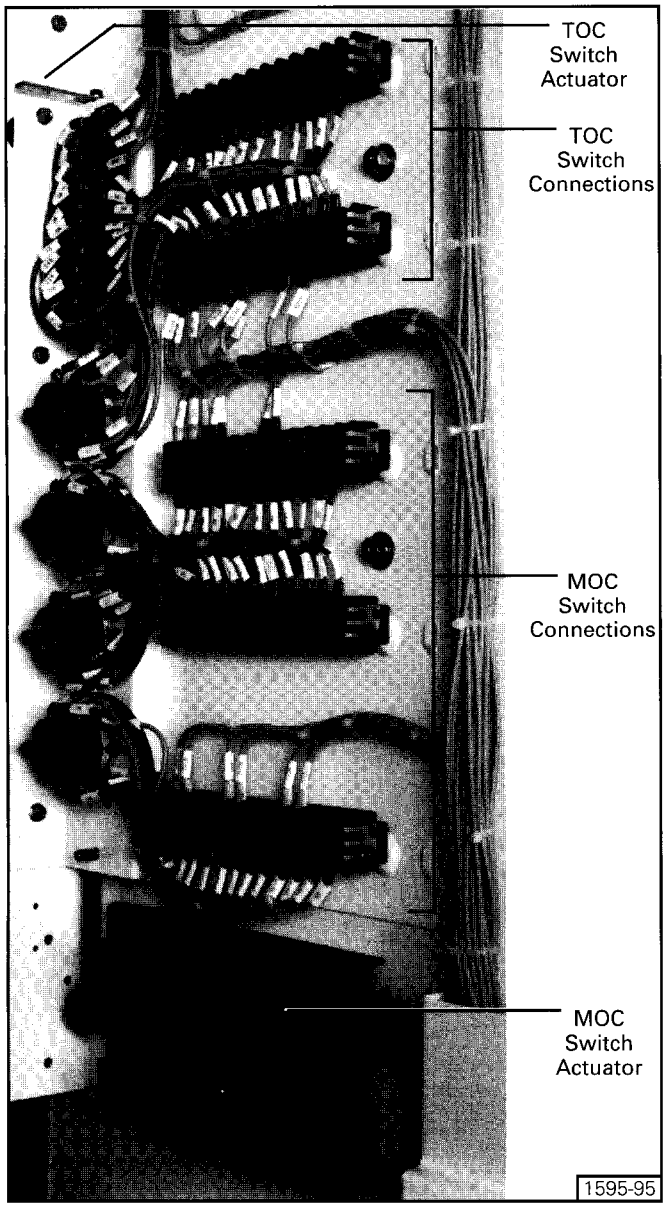


Figure 35. MOC and TOC Switches (cover removed for photo)

Breaker Installation and Removal

Type GMI Vacuum Circuit Breakers are normally shipped installed in the switchgear cells. They are normally shipped with their primary contacts open and the closing springs discharged. However, before racking of a circuit breaker or performing any inspection or maintenance, verify that the circuit breaker is open with closing springs discharged. Refer to instruction manual SG-3268 for information on installation, maintenance, and handling of these circuit breakers.

De-Energizing Control Power to Circuit Breaker

Locate the control power disconnect device associated with the circuit breaker. This disconnect (typically, a pullout type fuse holder) is normally located on the secondary device panel inside the circuit breaker cell. Removal of the fuse holder de-energizes control power to the circuit breaker in the respective switchgear cell. In some switchgear assemblies, a molded case circuit breaker is used in lieu of the pullout type fuse holder. Opening this circuit breaker accomplishes the same result: control power is disconnected.

Spring Discharge Check

Perform the Spring Discharge Check **before** inserting or removing the circuit breaker from the switchgear. Refer to **Figure 36.**

The spring discharge check consists of simply performing the following tasks in the order given. This check assures that both the tripping and closing springs are fully discharged.

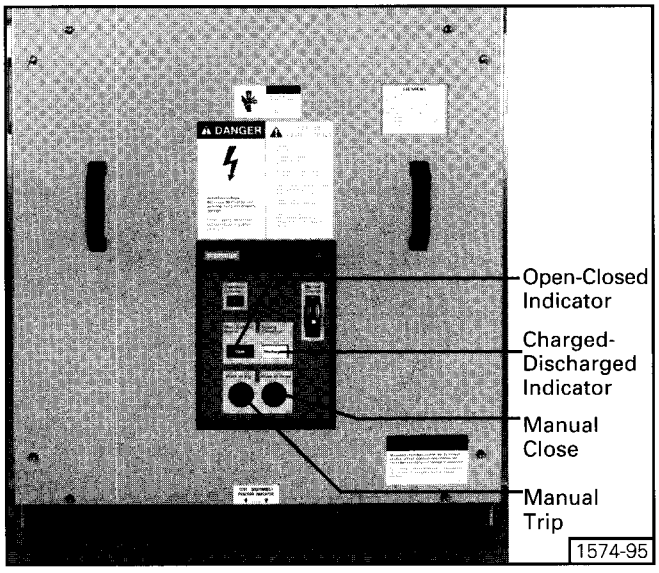


Figure 36. Front Panel Controls of GMI Circuit Breaker

⚠DANGER

Hazardous voltages and high-speed moving parts.

Will cause death, severe personal injury or property damage.

Read instruction manuals, observe safety instructions, and use qualified personnel.

Note: Do not perform Spring Discharge Check if the circuit breaker is in the CONNECT position. Open circuit breaker and rack to the DISCONNECT position, and then perform the Spring Discharge Check.

1. Assure that breaker is not in CONNECT position in cell.
2. Open control power disconnect (e.g., pull fuseholder or open molded case circuit breaker).
3. Press red Trip pushbutton.
4. Press black Close pushbutton.
5. Again press red Trip pushbutton.
6. Verify Spring Condition Indicator shows DISCHARGED.
7. Verify Main Contact Status Indicator shows OPEN.

Removal from Cell in Indoor (if not on raised pad) and Shelter-Clad Outdoor Switchgear

After performing the Spring Discharge Check (with control power de-energized), remove the circuit breaker from its switchgear cubicle.

1. Insert the racking crank on the racking screw on the front of the breaker cell, and push in (see "Racking Crank Engagement Procedure"). This action operates the racking interlock latch. **Figure 37** shows racking of a circuit breaker.
2. Rotate the racking crank **counterclockwise** until the breaker is in the DISCONNECT position.
3. Release the breaker release latch and pull the circuit breaker out from the DISCONNECT position. The breaker can now be removed from cubicle.
4. The circuit breaker is now free to be rolled out on the floor using the handles as shown in **Figure 38.** The wheels of the circuit breaker are virtually at floor level (unless the switchgear is installed on a raised pad), and one person can easily handle the unit.

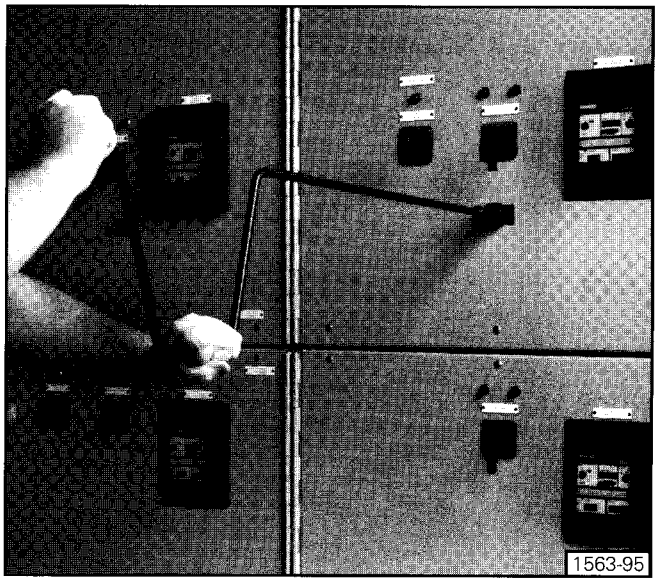


Figure 37. Racking of Circuit Breaker

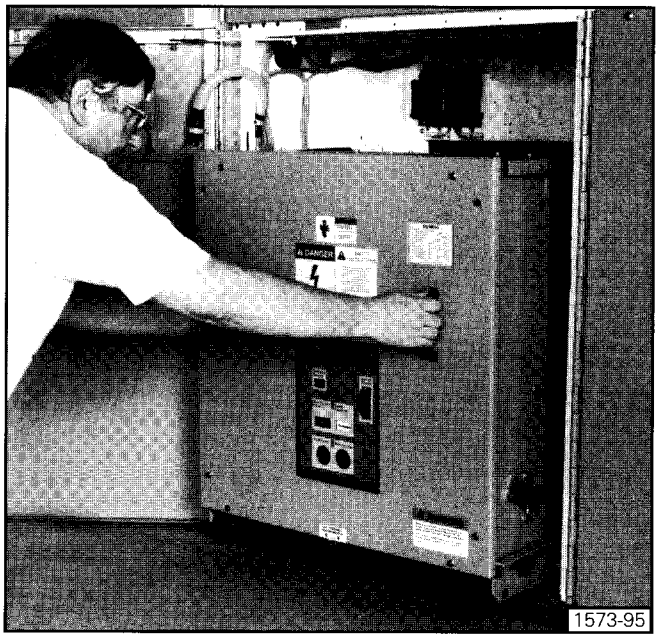


Figure 38. Removal of Circuit Breaker

Removal from Cell in Outdoor Non-Walk-In Enclosures, or for Indoor Switchgear Installed on a Raised Pad
Removal of the breaker from a non-walk-in outdoor switchgear assembly is similar to removal of a breaker at floor level, with several additional steps.

Figure 39 shows one of the two breaker extension rails being inserted into the fixed rails within the breaker cell. The rails engage locking pins in the fixed rails to secure them in position.

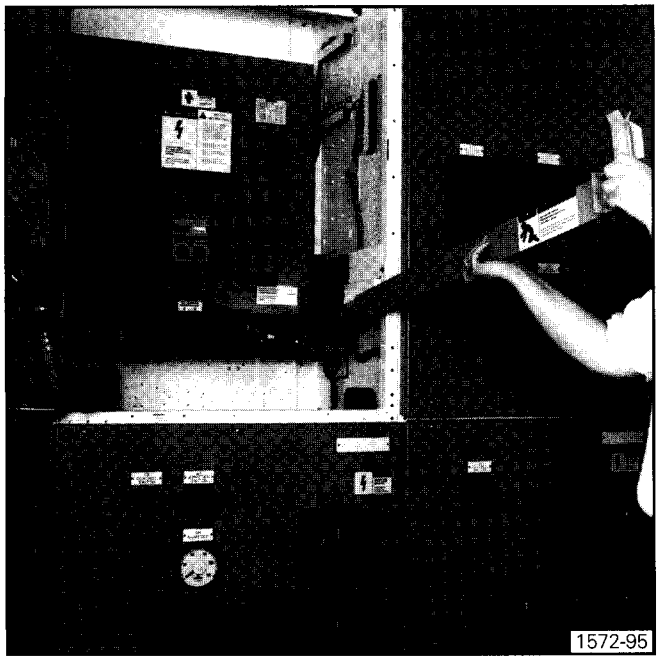


Figure 39. Use of Extension Rails for Removal of Circuit Breaker from Upper Compartment

Figure 40. Lift Truck Engaged

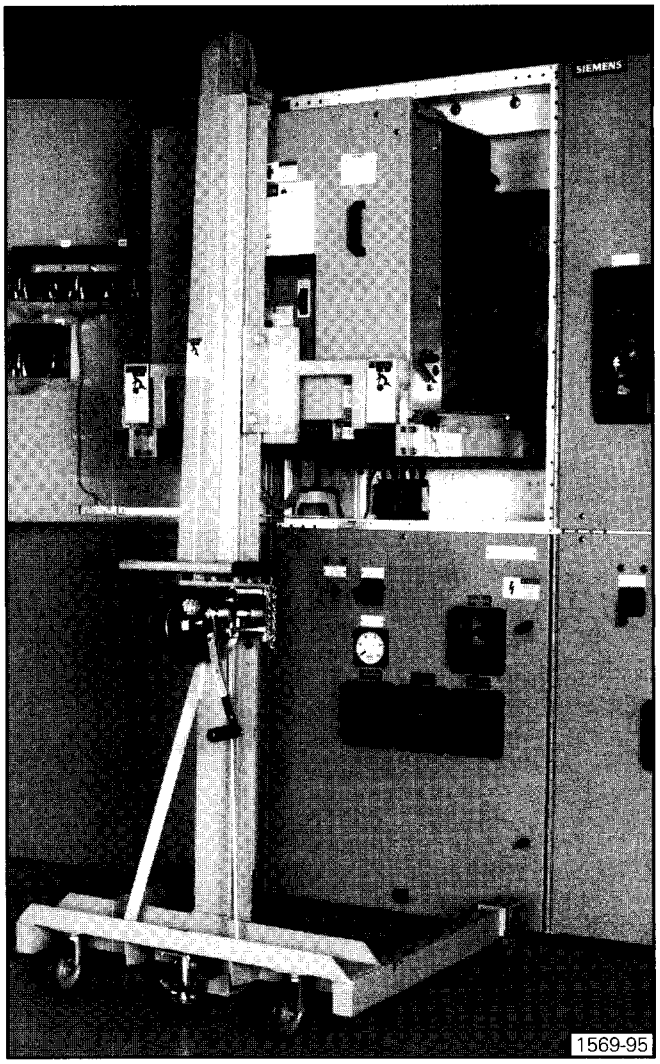
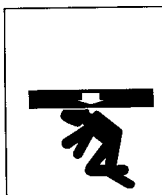


Figure 41. Lift Truck with Circuit Breaker

The procedure for removal of a circuit breaker not located at floor level is:

1. Insert the two extension rails into the fixed rails. Be sure the extension rails are properly secured in place. (This can be done at Step 4 if preferred.)
2. Insert the racking crank on the racking screw on the front of the breaker cell, and push in (see "Racking Crank Engagement Procedure"). This action operates the racking interlock latch.
3. Rotate the racking crank **counterclockwise** until the breaker is in the DISCONNECT position.
4. If you have not yet installed the extension rails, do so now. Note that some difficulty may be experienced installing the extension rails if the circuit breaker is in the DISCONNECT position. If difficulty is encountered, rack the circuit breaker to the TEST position, install the extension rails, and then rack the circuit breaker to the DISCONNECT position.



⚠WARNING

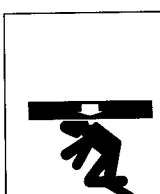
Heavy weight.

Can cause death, serious injury, or property damage.

Always use extension rails to remove or install circuit breaker in cells not installed at floor level.

5. Release the breaker release latch and pull the circuit breaker out from the DISCONNECT position. The breaker is now free to be rolled out on the two extension rails using the handles on the front of the circuit breaker.
6. Remove the breaker from the two extension rails using the approved Siemens breaker lifting device (see **Figures 40** and **41**), or a lifting sling (see **Figure 48**) and a suitable crane.
7. Lift the two extension rails and withdraw them from the switchgear.

Type GMI circuit breakers weigh between 385 and 575 pounds (175-261kg), depending upon their ratings. The breaker can be moved using a properly rated crane and lift sling. A lift sling can be attached to the breaker, and then used to hoist the circuit breaker vertically clear of the extension rails. When clear, remove the rails and lower the circuit breaker to the floor.



⚠WARNING

Heavy weight.

Can cause death, serious injury, or property damage.

Never transport a circuit breaker on a lift truck or other lifting device with the circuit breaker in the raised position.

Racking Crank Engagement Procedure

A crank for racking the drawout circuit breaker is provided as a standard accessory. Racking of a circuit breaker can be accomplished with the drawout compartment front door open or through a small opening (or window) in the front door, with the door closed.

The racking crank consists of an offset handle with a custom socket assembly welded to the opposite end. The socket end of the crank is designed to engage the square shoulder of the racking mechanism shaft and remain engaged during racking by means of two spring plungers located 180 degrees from each other. The spring plungers operate in a manner similar to the retainers on an ordinary mechanic's socket wrench.

The portion of the racking mechanism shaft which is visible is cylindrical, and the square shoulder of the racking mechanism shaft is hidden by a shroud until the engagement procedure starts. The square socket end of the crank will only engage the square portion of the shaft if it is aligned properly.

The suggested procedure to engage the racking mechanism is as follows:

1. The breaker must be open. (The racking shroud cannot be moved if the breaker is closed).
2. Hold the socket end of the crank in one hand and the crank handle in the other hand. Refer to **Figure 42.**
3. Place the socket over the end of the racking mechanism shaft. Align the spring plunger of the socket with the shoulder on the racking mechanism shaft. **Note:** If the socket is not aligned, the socket will not be able to engage. The socket (square) must be aligned with the square shoulder of the racking mechanism shaft.
4. Once alignment is achieved, firmly push the crank and socket assembly toward the racking mechanism.
5. When properly engaged, the crank should remain connected to the racking mechanism, due to the spring plungers. If the crank does not remain in position, adjust the spring plungers clockwise one-half turn. This will increase the contact pressure of the spring plunger.
6. To remove the crank, simply pull the assembly off of the racking mechanism shaft.

Note: If the effort to rack the circuit breaker increases considerably during racking, or if turning of the racking crank requires excessive force, stop racking immediately. Do not try to "force" the racking crank to rotate, or parts of the circuit breaker or racking mechanism could be damaged. Determine the source of the problem and correct it before continuing with the racking.

Circuit Breaker Position

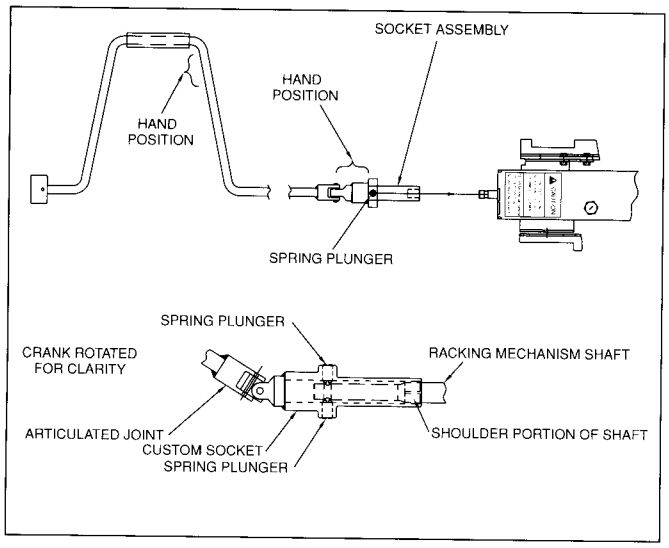


Figure 42. Racking Crank Engagement Procedure

Breaker Racking

When inserting a circuit breaker into a cell, be sure that the racking block is in the lowered position as shown in **Figure 43**. In this position, the racking position indicator should show a green square with the letter "D" for DISCONNECT position. If the racking block is in the raised position, **Figure 44**, use the racking crank to move the racking block to the lowered position.

Important: Failure to follow instructions may result in damage to equipment.

Return racking mechanism to the DISCONNECT position before inserting circuit breaker.

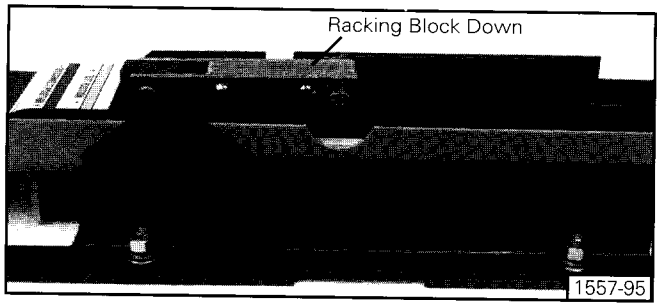


Figure 43. Racking Mechanism with Racking Block Down

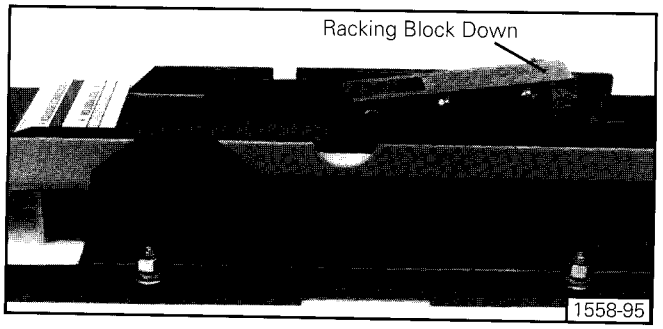


Figure 44. Racking Mechanism with Racking Block Up

The circuit breaker racking method has been designed to be used with the instrument door either open or closed. Moving the breaker between the CONNECT and TEST or DISCONNECT positions with the door closed provides additional protection to the operator and is the recommended procedure.

Racking from DISCONNECT to CONNECT Position

1. Check the position indicator shows "D" for DISCONNECT position.
2. Check that the circuit breaker is fully pushed into the cell to the DISCONNECT position.
3. Check that the circuit breaker is OPEN.
4. Secondary disconnects will automatically connect as the circuit breaker moves to the TEST and CONNECT position.
5. Close instrument door.
6. Insert racking crank through round opening at bottom of door and onto the racking screw (see "Racking Crank Engagement Procedure").
7. Push the racking crank forward to move the closed breaker racking interlock slide back which will allow the socket to engage the hex head on the racking screw. Do not force slide as it is interlocked to prevent sliding forward when the circuit breaker is closed.
8. Rotate the racking crank **clockwise** about 54 turns until a positive stop is felt and the position indicated shows "C" for the CONNECT position. The indicator will show "T" when the circuit breaker is in TEST position.

Racking from CONNECT to TEST or DISCONNECT Position

1. This procedure is essentially the same as racking to connected position procedure except the rotation is counterclockwise.
2. Check that the circuit breaker is open.
3. Close instrument door.
4. Insert racking crank (see "Racking Crank Engagement Procedure") and rotate **counterclockwise** about 54 turns to a positive stop and the position indicator indicates "D" for DISCONNECT position. The intermediate TEST position is indicated by "T".

Contact Penetration

Make certain all electrical connections to both the line/load and bus disconnects are de-energized and locked out. This can be verified by blocking the shutters open and using a hot stick potential device to double-check that all disconnects are de-energized. Rack the breaker completely into the CONNECT position and then withdraw it from the cell. Check that the contact wipe is about 3/8" (10mm) on the cell primary disconnects, for all breaker ratings.

Circuit Breaker Position

Closed Breaker Racking Interlock

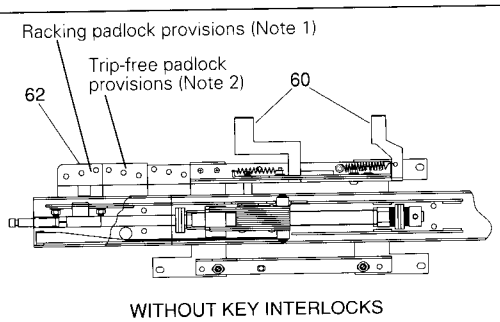
The closed breaker racking interlock is designed to prevent a breaker from being racked from TEST to CONNECT and vice-versa with the primary contacts closed. Only an open circuit breaker is to be moved between these positions. Refer to **Figure 45.**

The trip free interlock slide has angle-shaped members (**Figure 45**, item 60) that project from the left side of the racking mechanism and engage an interlock member from the circuit breaker. The circuit breaker interlock extends down to prevent movement of the trip free interlock slide with the circuit breaker closed. When engaged, the racking screw is not accessible to the racking crank until the breaker has been opened.

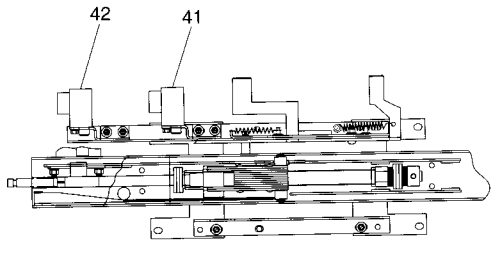
Note: Racking handle must be removed, allowing the interlock slides to return to their initial position. The breaker may now be closed mechanically or electrically.

Racking Access Interlock

The racking interlock slide (**Figure 45**, item 62) has provisions for three padlocks to prevent engagement of the racking crank to the racking screw. This allows locking of the circuit breaker in DISCONNECT, TEST, or CONNECT positions. Key interlocking (**Figure 45**, item 42) can be provided for racking sequence interlocking of dummy breakers, etc. When the key interlock bolt (on key interlock item 42) is extended, the racking interlock slide (item 62) is held in place, preventing access to the racking screw, thus preventing racking. When locked in the DISCONNECT position, the circuit breaker or dummy can be removed for servicing.



WITHOUT KEY INTERLOCKS



WITH KEY INTERLOCKS

Note 1: Racking padlock provisions– when padlocked, prevents racking of circuit breaker, test device, or dummy breaker element. Suitable for up to three padlocks with up to 3/8" diameter shackle.

Note 2: Trip-free padlock provisions– when padlocked, prevents closing of circuit breaker or test device. suitable for up to three padlocks with up to 3/8" diameter shackle.

Figure 45. Racking Mechanism and Interlocks

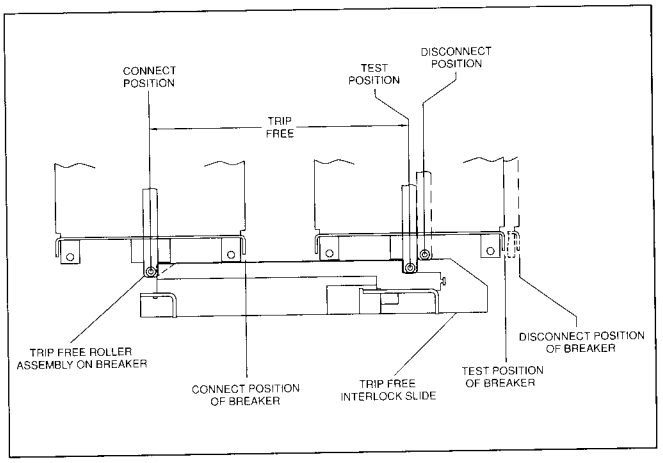


Figure 46. Trip Free Interlock Positions (Viewed from left side of circuit breaker)

Trip-Free Interlock

The trip-free interlock slide prevents a circuit breaker from being closed between the TEST and CONNECT positions by maintaining a mechanical and electrical trip-free condition (**Figure 46**).

As the breaker moves between the TEST and CONNECT positions, the trip-free roller engages the trip-free rail of the racking device. As the roller travels the trip-free rail between positions, the roller activates the trip linkage which holds the circuit breaker in a mechanically trip-free condition.

In order to lock the circuit breaker trip-free in either the TEST or CONNECT positions, the breaker must be opened and the trip-free interlock slide assembly pushed forward to lift the trip-free roller on the breaker. This position permits the use of a key interlock (**Figure 45**, item 41) or padlocks (up to 3) to maintain the mechanism in trip-free position. The circuit breaker can be removed for servicing while interlocked in the trip-free position.

The interlock can be tested by racking the circuit breaker to a position between the TEST and CONNECT position with the closing springs charged. Activating the "close" function manually will cause the springs to discharge and the interlock should prevent the circuit breaker from closing. Activating the "close" function electrically (such as by using the control switch) should cause no operation. This is also true when the breaker is in either the TEST or CONNECT positions and the trip-free interlock slide is pushed forward and key interlocked or padlocked. The breaker will operated trip-free when closing is attempted.

Spring Discharge Interlock

The closing spring discharge interlock prevents the insertion or removal of a circuit breaker with a charged mechanism. The spring dump roller rides up a rail releasing the closing springs while held trip-free. This discharges the closing springs without closing the breaker primary contacts. (**Figure 33**).

Inspection and Testing

Inspection and Testing
Before the equipment is energized, it must be thoroughly inspected and tested. Correct any deviations before energization.

Inspection
Check the following points:
1. High voltage connections properly insulated.
2. Electrical disconnecting contacts, machined parts, shutter, etc., checked for lubrication and operation.
3. Blocking, supports and other temporary ties removed from breakers, instruments, relays, etc.
4. Proper fuses correctly placed.
5. Temporary wiring jumpers (used on the secondaries of current transformers wired to external devices, as shown on wiring diagrams) removed.
6. Ground connections properly made.
7. Incoming primary and secondary connections properly made and checked for shorts or undesired grounds.
8. All equipment which has been removed during assembly has been replaced.
9. Relays coordinated with other relays and protection devices on the system. Refer to relay instructions before making any adjustments. Consult the local utility before making any connections to the power supply.
10. Storage battery fully charged and provided with recharging facilities.
11. Interlocks performing properly.
12. Circuit breakers checked and prepared per instruction books.
13. All filters in vent areas are clean and free of shipping or construction material.

Testing
1. An insulation resistance test is made on the high voltage circuit to be sure that all connections made in the field are properly insulated. An insulation resistance test is also advisable on the control circuit.

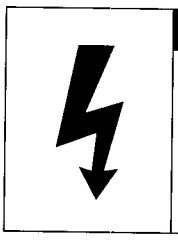
2. A dielectric test, if possible, should be made on the high voltage circuit for one minute at one of the following voltages corresponding to the rated voltage of the equipment. (**Note:** Voltage transformers, control power transformers, surge arresters, and surge capacitors must be disconnected during this test).

Rated Maximum Voltage kV (rms)	Power Frequency Withstand kV (rms)	Field Test Voltage	
		kV (rms)	kV (dc)
4.76	19	14.25	20.2
8.25	36	27	38.2
15	36	27	38.2

Note: The DC test voltage is given as a reference only for those using DC tests to verify the integrity of connected cable installations without disconnecting the cables from the switchgear. It represents values believed to be appropriate and approximately equivalent to the corresponding power frequency withstand test values specified for each voltage rating of switchgear. The presence of this column in no way implies any requirement for a DC withstand test on AC equipment or that a DC withstand test represents an acceptable alternative to AC withstand tests. When making DC tests, the voltage should be raised to the test value in discrete steps and held for a period of one minute.

In accordance with ANSI C37.20.2 Clause 5.5, Field Dielectric Tests are also recommended when new units are added to an existing installation, or after major field modifications. The equipment should be put in good condition prior to 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, moisture, or other contaminants without being first restored to good condition.

A dielectric test on secondary and control circuits should be made for one minute at 1125 volts AC or 1590 volts DC. The above voltages are in accordance with NEMA Standards. (**Note:** Certain control devices, such as motors and motor circuits, should be tested at 675 volts AC. Electronic devices should be tested at the voltages specified in the instruction manual for the electronic device).



⚠CAUTION

Excessive test voltages.

May result in damage to equipment.

Do not perform dielectric tests at test voltages exceeding the ratings of the tested equipment.

3. With breaker in the TEST position make the following tests on each unit:
   A. Trip and close the circuit breaker with the control switch.
   B. Trip the breaker by passing sufficient current (or voltage, if applicable) through the coils of protective relays.
   C. Trip and close the breaker from any remote control locations.
   D. Operate auxiliary devices.
   E. Test the phase sequence of polyphase high voltage circuits, particularly those used for motor starting.

Placing Equipment into Service
To place equipment in service for the first time proceed as follows:
1. Check that all circuit breakers are open and all control circuits energized.
2. Connect primary incoming power source to equipment.
3. Check all instruments, relays, meters, etc., during this time.
4. Connect as small a load as possible and observe instruments. **Note:** Allow several minutes before connecting additional load.
5. Gradually connect more load to the equipment while observing instruments until the full load is connected.
6. Check for signs of overheating of primary and secondary circuits and satisfactory operation of all instruments during the first week of operation.

Maintenance

Introduction and Maintenance Intervals
Periodic inspections and maintenance are essential to obtain safe and reliable operation of the switchgear. When Type GM switchgear is operated under "Usual Service Conditions", maintenance and lubrication is recommended at five year intervals. "Usual" and "Unusual" service conditions for Medium Voltage Metal-Clad Switchgear are defined in ANSI C37.20.2, clauses 3 and 7.1. Generally, "usual service conditions" are defined as an environment in which the equipment is not exposed to excessive dust, acid fumes, damaging chemicals, salt air, rapid or frequent changes in temperature, vibration, high humidity, and extremes of temperature.

The definition of "usual service conditions" is subject to a variety of interpretations. Because of this, you are best served by adjusting maintenance and lubrication intervals based on your experience with the equipment in the actual service environment.

Regardless of the length of the maintenance and lubrication interval, Siemens recommends that circuit breakers should be inspected and exercised annually.

⚠DANGER

Hazardous voltages and high-speed moving parts.

Will cause death, personal injury, and property damage.

Do not work on energized equipment. Always de-energize and ground the equipment before working on the equipment.

For the safety of maintenance personnel as well as others who might be exposed to hazards associated with maintenance activities, the safety related work practices of NFPA 70E, parts II and III, should always be followed when working on electrical equipment. Maintenance personnel should be trained in the safety practices, procedures and requirements that pertain to their respective job assignments. This manual should be reviewed and retained in a location readily accessible for reference during maintenance of this equipment.

The user must establish a periodic maintenance program to ensure trouble-free and safe operation. The frequency of inspection, periodic cleaning, and preventive maintenance schedule will depend upon the operation conditions. NFPA Publication 70B, "Electrical Equipment Maintenance" may be used as a guide to establish such a program. **A preventive maintenance program is not intended to cover reconditioning or major repair, but should be designed to reveal, if possible, the need for such actions in time to prevent malfunctions during operation.**

Switchgear assemblies are enclosed on all sides and top with sheet metal. Access into the enclosure is provided by doors or removable covers. Although the bus and connections are insulated in metal-clad switchgear assemblies, it is a coordinated insulation system; insulation plus air or creep distance equals a given insulation level.

⚠DANGER

Hazardous voltages.

Will cause death, severe personal injury, and property damage.

Do not contact energized conductors. Before working on or near high voltage conductors within switchgear, be sure they are de-energized and properly grounded.

See ANSI C37.20.2, clause 6.2.3, which reads as follows:

> This insulating covering is a requirement of metal-clad switchgear and is provided to minimize the possibility of communicating faults and to prevent development of bus faults that would result if foreign objects momentarily contacted bare bus. This insulating covering is usually only a part of the primary insulation system and in such cases the outer surface of this insulating covering will not be at ground potential. It should not be assumed, therefore, that personnel can contact this insulating covering with complete safety.

Recommended Hand Tools
Type GM switchgear and type GMI circuit breakers use both standard American and metric fasteners. American fasteners are used in most locations in the switchgear cubicles.

Recommended Maintenance and Lubrication
Periodic maintenance and lubrication should include all the tasks shown in **Table 6**.

⚠WARNING

Failure to maintain the equipment could result in death, serious injury or product failure, and can prevent successful functioning of connected apparatus.

The instructions contained herein should be carefully reviewed, understood, and followed.

The maintenance tasks in **Table 6** must be performed regularly.

Table 6. Maintenance Tasks

1. Before any maintenance work is performed within primary compartments, make certain that the equipment is completely de-energized, tested, grounded, tagged or properly identified and released for work in an authorized manner.
2. Before starting work on the switchgear, the following should be completed on any equipment that will affect the area of the work:
   - A. Disable remote control and automatic transfer schemes.
   - B. De-energize all direct and back feed power and control sources, test and ground.
   - C. Disconnect all voltage and control power transformers.
   - D. Open all disconnects.
3. Include the following items in your inspection procedure:
   - A. Check general condition of switchgear installation.
   - B. Inspect switchgear interior for accumulation of dust, dirt or any foreign matter.
   - C. Clean air filters by washing in any mild household detergent.
   - D. Examine indicating lamps and replace as required.
   - E. Check terminal block contacts for loose connections.
   - F. Check instrument and control switches and inspect their contacts.
   - G. Check for proper condition of instrument transformers. Replace burned out fuses, if any. Check primary and secondary connections.
   - H. Remove dust from all insulators and insulation.
   - I. Inspect bus bars and connections for proper condition. If bus bars are overheating check for poor or loose connections or for overload.
   - J. Examine automatic shutters for proper operation.
   - K. Examine all safety interlocks.
   - L. Perform maintenance of circuit breakers as outlined on circuit breaker instruction manual.
   - M. Check space heaters and thermostat (if equipped) for proper operation.
   - N. Maintain other equipment per their respective instruction book requirements.
   - O. Lubricate mechanisms, contacts, and other moving components.
   - P. Replace, reassemble, re-insulate, return all items to proper operating conditions and remove grounds prior to energization.

The list of tasks in **Table 6** does not represent an exhaustive survey of maintenance steps necessary to ensure safe operation of the equipment. Particular applications may require further procedures. Should further information be desired or should particular problems arise which are not covered sufficiently for the Purchaser's purposes, the matter should be referred to the local Siemens sales office.

The use of unauthorized parts in the repair of the equipment, or tampering by unqualified personnel will result in dangerous conditions which can cause death, serious injury or equipment damage. Follow all safety instructions contained herein.

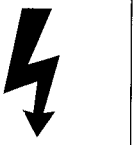
Lubrication

It is essential that switchgear be lubricated carefully and properly to guard against corrosion and to insure that all operating parts work freely.

Old grease should be removed annually and parts relubricated. Relubricate at more frequent intervals if required with Siemens lubricant Part No. 15-337-131-001.

Moving Parts

Lubricate shutter guide, bearings, rollout fuse truck moving parts, etc., with dry spray lubricant Siemens Part No. 15-171-270-001. Note: Use of lubricant not suitable for the application will make the mechanism very difficult to operate.



⚠DANGER

Hazardous voltages.

Will cause death, personal injury, and property damage.

Do not open shutters unless both line/load and bus are first de-energized.

Electrical Contacts

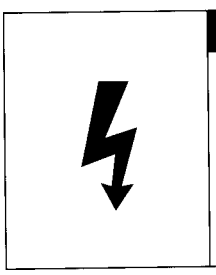
Lubricate stationary silver-surfaced contacts with electrical contact lubricant Part No. 15-171-370-002 prior to use, as follows:

1. Wipe contacts clean.
2. Apply lubricant to contact surfaces.
3. Wipe off excess lubricant, leaving a film. Avoid getting lubricant on insulation.

Cleaning Insulation

Most of the plastics and synthetics used in insulation systems are attacked by solvents containing aromatics or halogenated hydrocarbons. The use of these may cause crazing and deformation of the material reducing the dielectric strength. ISOPROPYL ALCOHOL IS THE ONLY RECOMMENDED SOLVENT CLEANER.

Maintenance



⚠DANGER

Hazardous voltages.

Can cause death, personal injury, and property damage.

Use only recommended solvents for cleaning insulation materials.

Corrosive Atmospheres

This switchgear is designed to give top performance when installed in normal indoor or outdoor locations. Where abnormal conditions, such as corrosive atmospheres, are encountered, special precautions must be taken to minimize their effect. Exposed metallic surfaces, non-insulated bus bars, disconnect switches, primary and secondary disconnecting contacts, wire ends, instrument terminals, etc., must all be protected. At each maintenance inspection, all of the old grease should be wiped off of the contacts and new lubricant applied to all sliding surfaces. Apply the contact lubricant in a layer .03-.06" (1-2mm) thick. Use only Siemens Electrical Contact Lubricant, Part No. 15-171-370-002, available in 8 oz. (.23kg) tubes. Other exposed components can be protected with a coat of glyptol or other corrosion-resistant coating.

When old grease becomes dirty, wipe the part clean and apply new grease immediately.

Relays and Instruments

To insure satisfactory operation of relays and instruments do not leave device covers off longer than necessary. When a cover has been broken, cover the device temporarily and replace broken glass as soon as possible.

Equipment Surfaces

Inspect the painted surfaces and touch up scratches as necessary. Touchup paint is available from Siemens. This paint matches the unit and is thinned and ready for use in one pint (473mm^3) spray cans.

Split Plug Jumper Test Device
When specified, a split plug jumper test device is supplied. This device allows a circuit breaker to be operated from the control switch on the instrument panel while the circuit breaker is outside of and adjacent to its cell.

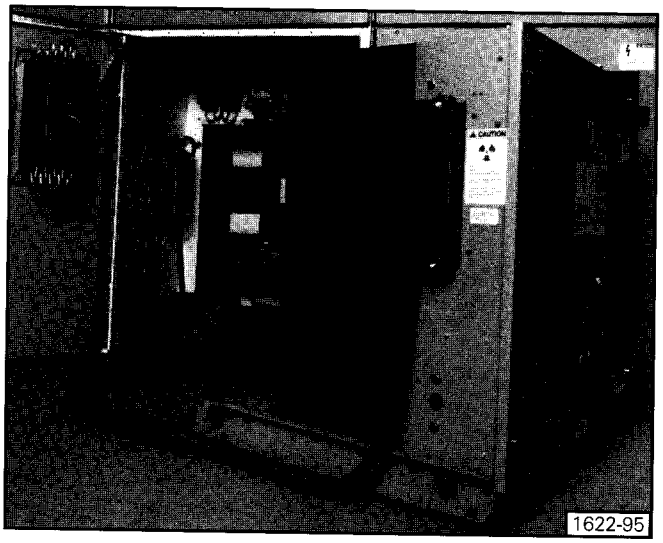


Figure 47. Split Plug Jumper

The split plug jumper consists of a length of flexible cable with terminal plugs on each end. These terminals can be connected to the secondary disconnects on the circuit breaker and in the cell. When connected the circuit breaker can be opened or closed electrically from the instrument panel control switch.

Test Cabinet
When specified, a test cabinet is supplied. This device allows a circuit breaker to be operated from a control switch in a cabinet, which is wall mounted by the purchaser. A length of flexible cable is connected to the cabinet and has a terminal plug on the other end which may be connected to the secondary disconnects on the circuit breaker. When connected, the circuit breaker can be opened or closed electrically from the control switch on the test cabinet, which is connected to a suitable power supply by purchaser.

Lift Truck
When specified, a lift truck is supplied (see **Figure 41**) for handling circuit breakers. The lift truck is useful whenever circuit breakers are installed above floor level. For Shelter-Clad installations, the lift truck is normally stored in the aisle area, as it does not conveniently pass through the aisle doorway.

Lift Sling
If a lift truck is not provided, a lift sling is supplied as standard when circuit breakers are installed above floor level. The lift sling is suitable for use with any crane which has an adequate capacity (750 lbs. or 340kg minimum). **Figure 48** shows a lift sling being used to lift a circuit breaker.

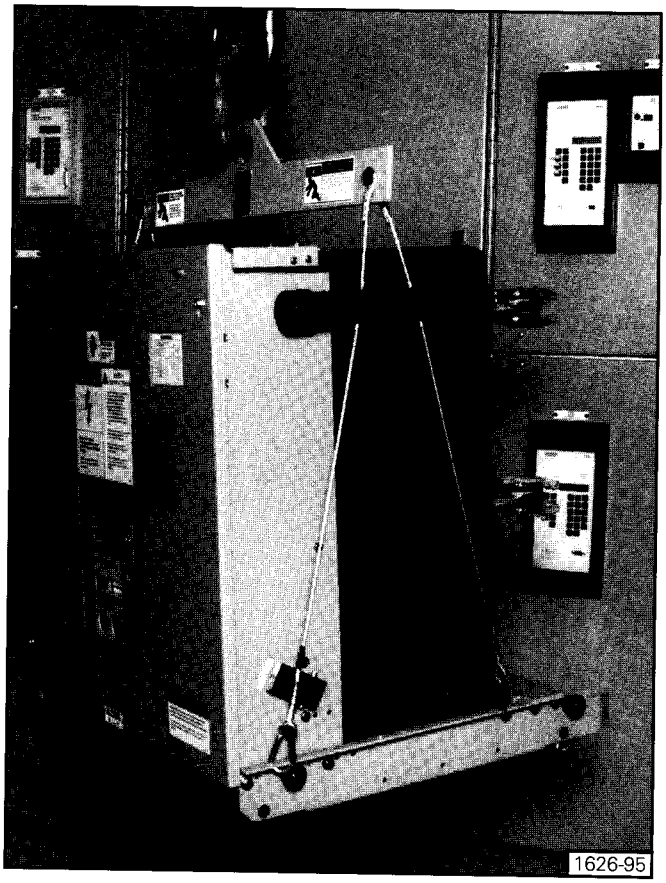


Figure 48. Lift Sling in Use to Handle Circuit Breaker

Electric Racking Accessory
An optional electric racking accessory is available. The accessory consists of a motor drive enclosure which installs on mounting brackets on the switchgear front panel of a circuit breaker compartment. The unit includes a power cord, which can be connected to a convenient power source in the vicinity of the switchgear. Instructions for mounting the racking accessory and for racking of circuit breakers are provided on a label on the racking accessory.

Type 3EF Surge Limiters

The type 3EF Surge Limiter is used with vacuum circuit breakers and contactors to prevent the development of excessive overvoltages due to multiple reignitions or virtual current chopping. This is primarily of concern during the starting of motors and the switching of reactive loads. Surge limiters are recommended in the applications shown in **Table 7**. If surge limiters are provided, and an overvoltage does occur, the magnitude of the voltages will be limited to the values indicated in **Table 8**. Recommended service voltages for each limiter are also shown in this table.

Surge limiters are intended to be used in cable network systems to protect motors, transformers, and reactors from the effects of voltage surges associated with vacuum breaker operations. If lightning or switching surges may be present, the equipment must be properly protected by means of surge arrestors.

The surge limiters must be disconnected from the equipment before any high potential testing is performed. The one-minute test period for the application of these test voltages to switchgear may damage the surge limiters.

Table 7. Type 3EF Surge Limiter Application Recommendations

Protected (Load) Equipment	Surge Limiter Recommended
Liquid transformers	No
Dry type transformers, Standard BIL	Yes [1]
Dry type transformers 5kV with 60kV BIL	No
Dry type transformers 7kV or 15kV with 95kV BIL	No
Motors Locked Rotor Current < 600A	Yes [2]
Motors Locked Rotor Current > 600A	No
Reactors	Yes
Capacitors	No

1 Surge limiter not necessary if surge capacitors or surge arrestors are located at transformer terminals.

2 Surge limiter not necessary if surge capacitors or surge arrestors are located at machine terminals.

Table 8. Type 3EF Surge Limiter Data

Rated Voltage	kV	3.6	6	7.5	11	15
MCOV of ZnO element	kV	2.6	3.9	5.2	9.1	10.4
Series Gap Sparkover Voltage 1.2 x 50 wave	kV	8	10	15	25	31
0.5kA Switching Surge Discharge Voltage 8 x 20 wave	kV	8	10	15	25	31
1.5kA Switching Surge Discharge Voltage 8 x 20 wave	kV	8.3	12.4	16.5	28.9	33.0
Grounded Wye System Applications	kV	2.4 4.16	6.9 7.2	8.32	12.0 12.47 13.2 13.8	—
Delta System Applications	kV	2.4	4.16 4.8	4.8 6.9	6.9 7.2 8.3	12.0 12.47 13.2 13.8
High Resistance Grounded Wye System Applications	kV	2.4	4.16	6.9	6.9 7.2 8.32	12.0 12.47 13.2 13.8

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