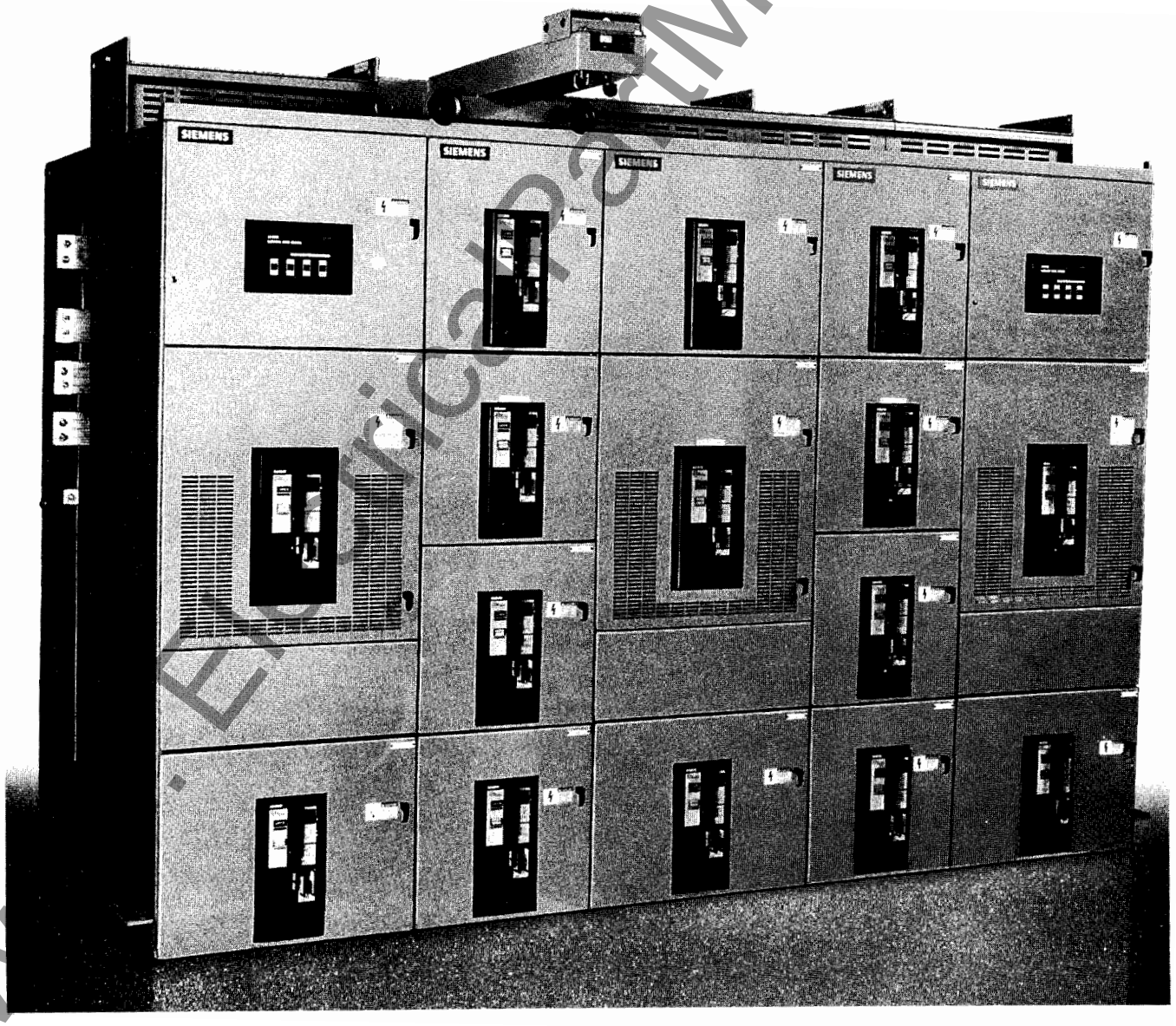
SIEMENS

Low Voltage Metal-Enclosed Switchgear

Type "R" (Indoor) and "SR" (Outdoor) 600 Volt

Instructions
Installation
Operation
Maintenance

SGIM-3088B



⚠ DANGER

Hazardous voltages and high-speed moving parts.

Will cause death, serious personal injury or equipment or property damage.

Always de-energize and ground the equipment before maintenance. Read and understand this instruction manual before installing, operating, or maintaining the 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 death or serious personal injury or equipment or property 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 and product labels a qualified person is one who is familiar with the installation, construction, operation, or maintenance of the equipment and the hazards involved. In addition, this person has the following qualifications:

(a) **is trained and authorized** to energize, 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 Siemens 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.

Table of Contents

Introduction
Types R and SR low voltage switchgear are designed to meet all 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, serious 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 the equipment.

Qualified Person
For the purpose of this manual and product labels, 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 discharge energy from closing and opening (tripping) springs before performing maintenance on circuit breakers.**
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

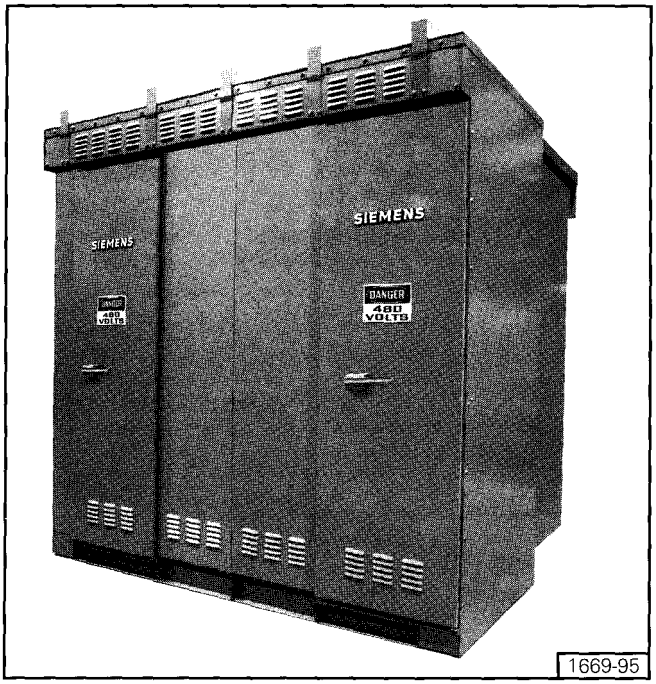


Figure 1. Typical Outdoor Type SR Switchgear

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

Siemens Type R and SR Metal-Enclosed 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-Enclosed Low Voltage Switchgear. Performance requirements of these standards have been met or exceeded by these designs. The principal standard which applies is:

C37.20.1 Metal-Enclosed Low Voltage 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.

Scope
These instructions cover the installation, operation and maintenance of Siemens types R and SR metal-enclosed low voltage switchgear assemblies, using type RL low voltage power circuit breakers. The equipment described in this manual consists of indoor or outdoor designs for application up to 600 Volts. A typical outdoor type SR switchgear assembly is shown in **Figure 1**.

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. Ratings described in this manual are in accordance with NEMA, IEEE and ANSI standard requirements.

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 bus bracing (momentary) and short time ratings 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-enclosed type. The switchgear sections described are comprised of full depth side sheets and components providing separate compartments for drawout breakers, buses, and auxiliary equipment. In addition, the section main bus and intersection bus work may be isolated (optional) from the primary entrance cable area with segregating barriers. Interlocks are provided, where necessary, to insure proper sequence and safe operation.

Indoor switchgear, type R, consists of one or more vertical sections secured together as a single group. It is completely operational when installed and connected to purchaser's power supply. When connected directly to a power transformer, a 14.9" (381.4mm) wide transition section may be provided to adjust connections to the proper elevation or provide space for incoming metering current transformers. Circuit breaker compartments are provided with hinged access doors for installing or removing circuit breakers. Auxiliary compartments are designed with hinged panels for mounting of instruments, relays and switches.

Outdoor switchgear, type SR, is similar to indoor switchgear, except that it is enclosed in a weather resistant (NEMA 3R) steel housing. The equipment is designed so that weather conditions will not affect operation of the switchgear. An illuminated service aisle is provided at the front of the switchgear allowing inspection and maintenance without exposure to the elements. An access door is provided at each end of the aisle wall with panic bar latch release inside the aisle. The rear of each vertical section is equipped with a door for access to the primary cable entrance area and secondary terminal blocks.

Receiving

Each shipping section of switchgear is securely blocked and braced for shipment. It is crated, boxed or covered as required by shipping conditions. Whatever method of shipment is employed, every precaution is taken to insure its safe arrival. If special handling is required, it is so indicated on the shipment. All moving parts are secured; however, relatively delicate instruments are included which requires that each section be handled carefully until installed in its final location.

Note: When circuit breakers are shipped installed in their respective compartments, they are secured in the fully connected position.

Identification

In the case of load center substations, the low voltage circuit breakers may be key interlocked with the transformer primary switches. Check substation numbers on packaging of switchgear and primary switches with those noted on applicable general arrangement and floor plan drawings. These numbers insure that all components applying to a particular substation are correctly located before uncrating.

When there are multiple shipping sections, each may be identified by a tag giving a drawing number which also appears on the purchaser's copy of the shipping list. The shipping list also describes the content of the crate or package as section or unit No. 1-2-3 etc. Refer to the general arrangement drawing for location of each shipping section within a group lineup. Use this information to simplify the assembly operation and avoid unnecessary handling.

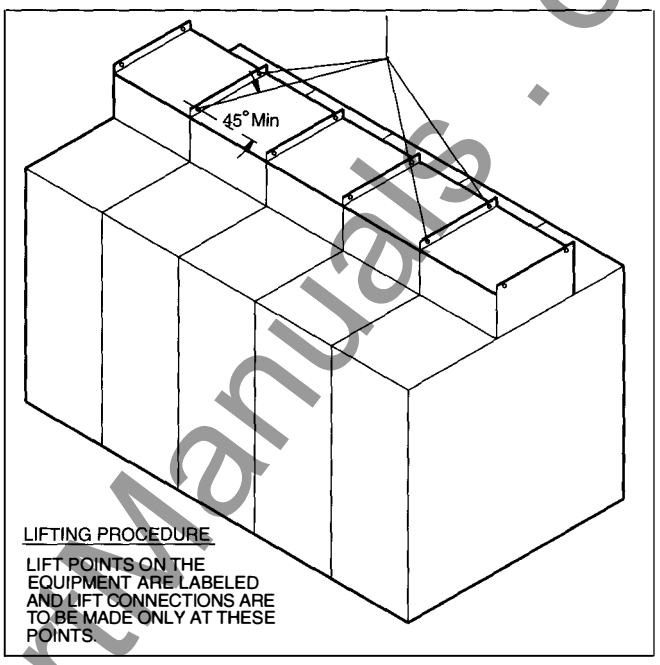


Figure 2. Lifting Indoor Switchgear

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 the equipment for any possible damage.

Check the shipping manifest to be certain that all items have been received. Do not destroy any packing material until all items listed on shipping manifest have been accounted for. Small packages of parts can be lost in packing material. Do not remove identification tags from apparatus until the switchgear is completely installed.

If there are any shortages, or damage not previously noted, make certain it is noted on the delivery receipt 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 the vehicle prior to unloading, close inspection during unloading must be maintained 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 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 carrier inspector is on site. If inspection for concealed damage is not practical at the time the carrier 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 the 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.

Lifting Switchgear

⚠WARNING

Heavy weight.

Can cause death, serious personal injury or property damage.

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

Both indoor and outdoor switchgear are lifted in the same manner. Both types have holes in the top of the equipment for attaching lift cables. These lift holes are located at the division between vertical sections within a shipping group. The maximum shipping group is five vertical sections, excluding the transition box to liquid transformers if involved (this is not considered a vertical section). Lift points on the equipment are labeled and lift connections are to be made only at these points. (See **Figure 3**).

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. A copy of this instruction manual is included. The drawing pocket is normally located on the left end of the lineup. Review this information carefully before moving equipment.

On outdoor switchgear the outdoor roof channels (See **Figures 3** and **10**) are not installed at the factory, to allow access to the lift holes. Be sure to install the roof channels immediately after lifting to make the equipment weather resistant. See **Figure 11**.

The angle of the lift cable relative to a horizontal plane must not be less than 45 degrees. (See **Figures 2** and **3**). Also note the tension on each cable of a four cable lift at 45 degrees is 70.7% efficient, that is, 1/4 of the total load divided by .707 will equal the force in pounds on each cable. Lesser angles and could damage the switchgear.

Make certain the crane used is of adequate height and capacity. A safe estimate of required crane capacity would be 4000 lbs. (1820 kg) per vertical section for indoor equipment, and 5000 lbs. (2275 kg) per vertical section for outdoor equipment.

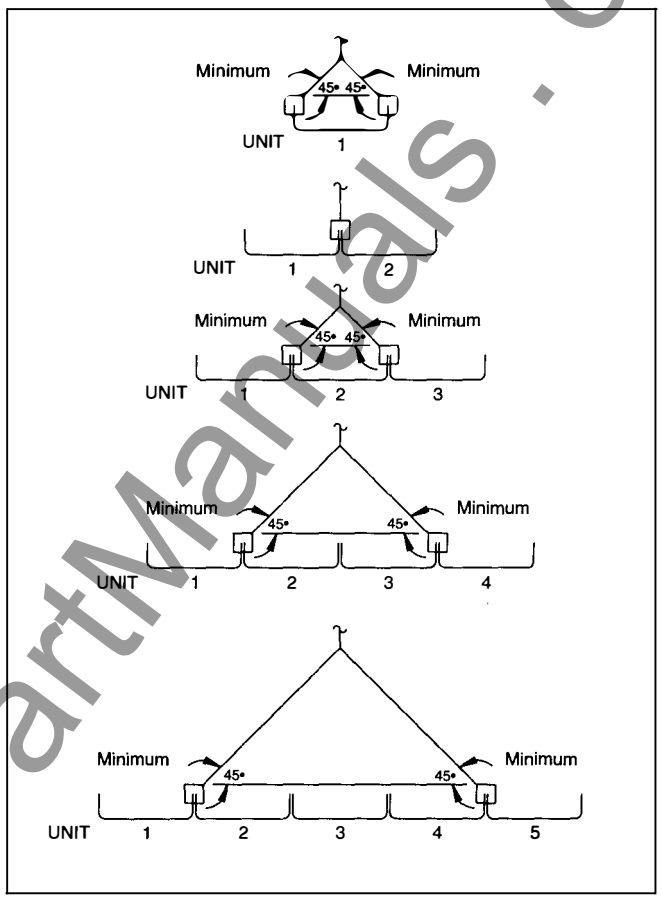


Figure 3. Lifting Points (Indoor or Outdoor)

Moving Switchgear with Rollers & Jacks

Moving switchgear in an obstructed area where a crane cannot be employed can be accomplished by the use of rollers; however, this must be done before the wooden shipping skid is removed. If pipes are used as rollers they should be of sufficient diameter that they will roll with ease without digging into the skid. In placing rollers under the skid, or removing them, it will be necessary to lift the switchgear shipping group by either jacks or a fork lift truck.

If a fork lift truck is used to lift indoor switchgear, it must be used with utmost caution to avoid possible damage to switchgear, and under no circumstances are the points of lift contact to be other than the following:

- Indoor switchgear: Lift only on the jacking angle provided near bottom at each end of the shipping group.

Outdoor switchgear: Use of a fork lift truck to handle or move outdoor switchgear is NOT recommended. Outdoor switchgear should be lifted only from above, using the attachment points shown in **Figures 3** and **10**.

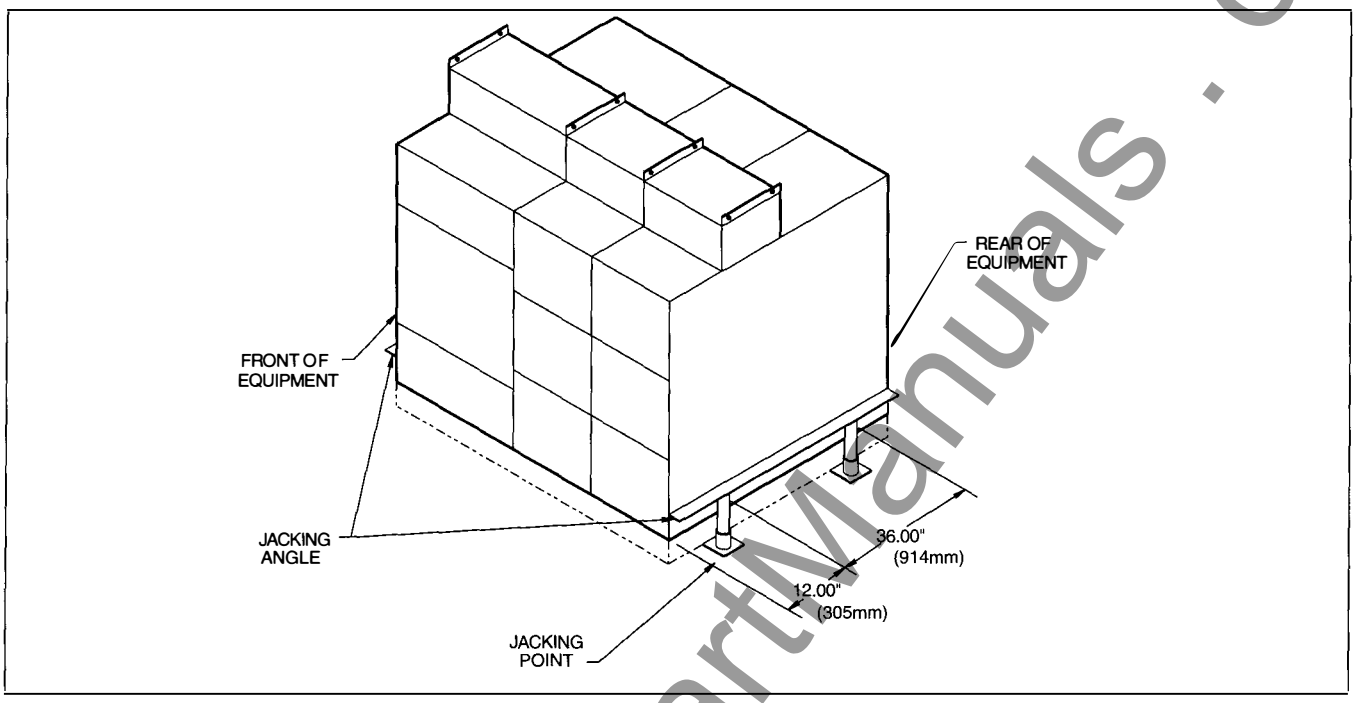


Figure 4. Use of Jacks for Lifting

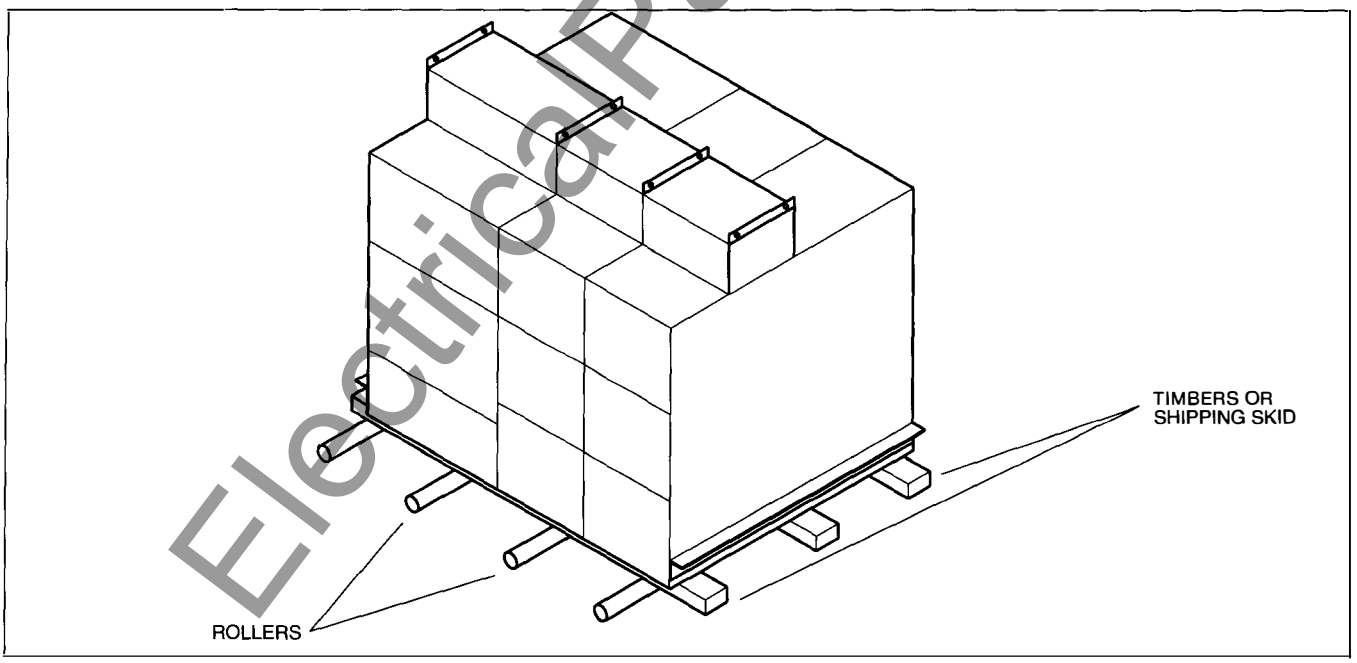


Figure 5. Use of Rollers to Move Switchgear

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 in either direction.
3. Protect equipment and external items from damage during movements. 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. Note the mounting position and orientation of any items removed during installation, 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, the shipping skid 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 skid, 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 6**.
8. Be sure to instll roof channels on outdoor switchgear to make the equipment weather resistant. See **Figure 11**.
9. See "Installation" section for additional important information.

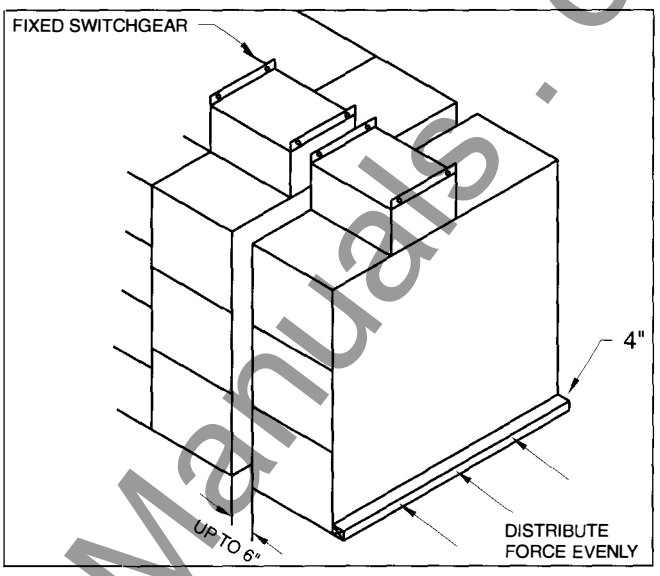


Figure 6. Final Positioning of Switchgear in Obstructed Areas without a Crane

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 indcors. If it is to be stored outdoors, or in a humid, 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. DO NOT LUBRICATE slide rails or aluminum hinge gear on metal shutter (if provided).

⚠DANGER

Hazardous voltages.

Will cause death, serious personal injury or property damage.

Before using external source to energize space heaters, disconnect space heater circuit from normal supply to prevent back-energization of control power transformer.

Storage-Outdoor Switchgear
When storing outdoor switchgear in an area exposed to the weather or to humid conditions, energize the space heaters provided within the sections and make certain that louvers and vents are uncovered to allow air to circulate. The heater circuit is accessible by opening the rear door of the switchgear. Refer to the switchgear wiring diagram to determine where space heater connections can be made. Lubricate any moving parts such as hinges, shutters, etc., if storage is for an extensive period of time. DO NOT LUBRICATE slide rails or aluminum hinge gear on metal shutter (if provided). Be sure to install roof channels during storage to make the equipment weather resistant. See **Figure 11**.

If the outdoor switchgear lineup consists of multiple shipping groups, provide an adequate covering to protect the equipment from the weather.

Preparation for Installation
Prior to installation of switchgear, study this instruction manual and the switchgear drawings, such as general arrangement, one line diagram, schematic diagrams, wiring diagrams, installation instruction drawing, panel arrangement, electrical 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, that is capable of supporting the weight of the switchgear and other related equipment.

If the switchgear cannot be lowered over conduits because of head room 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.

Indoor Foundations
As it is difficult to obtain a true and level floor on a concrete slab, it is highly recommended that 3" (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.

Outdoor Foundations
Concrete slab, sill channels, piers or pilings, whichever type of foundation is used, must have smooth and level surfaces and 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 or third vertical section, so that the span between supports does not exceed 66" (1676mm). 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" (191mm) above mounting surface. This will allow the conduit to enter the vertical section and exclude entry of water and rodents.

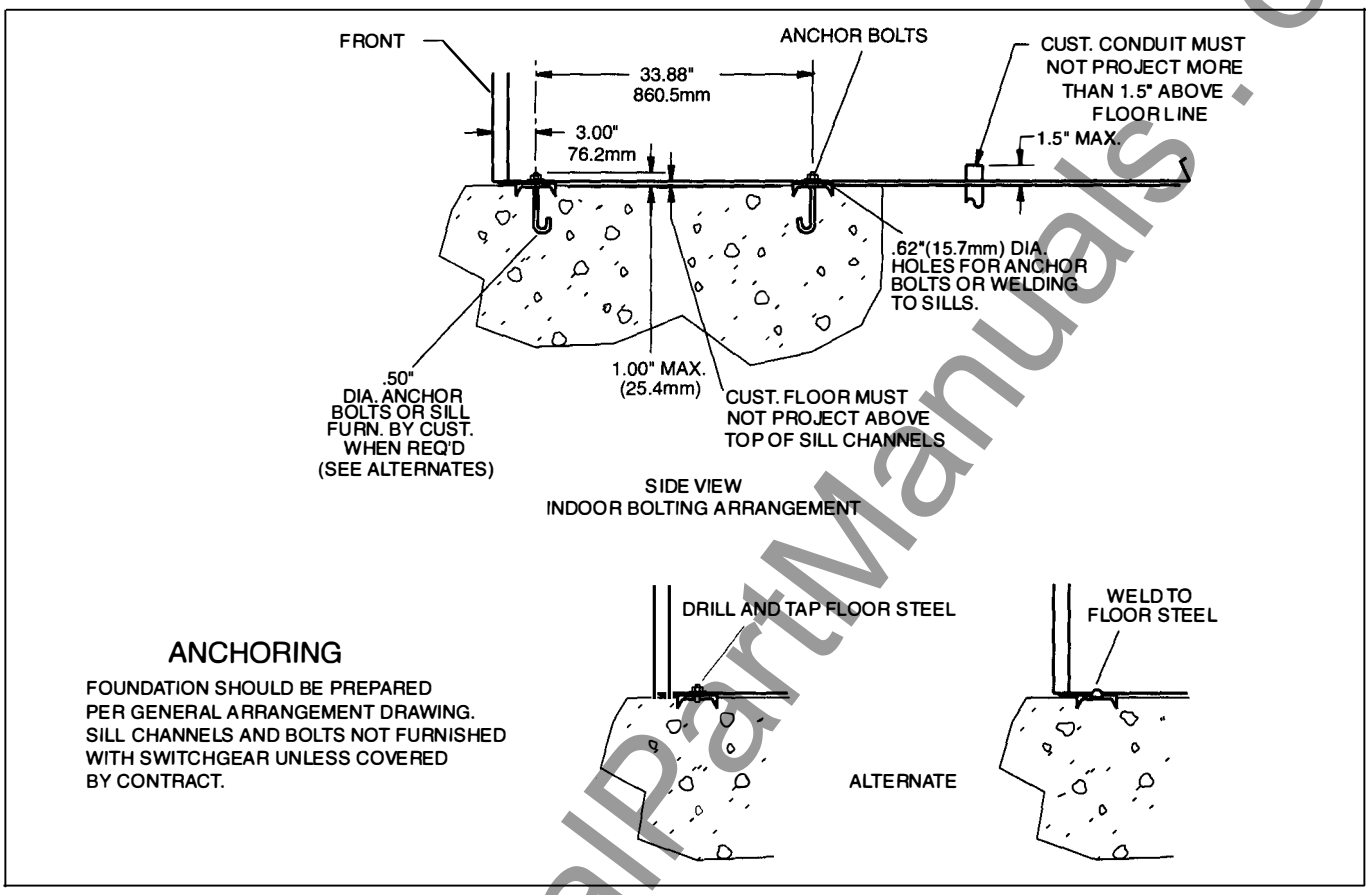


Figure 7. Anchoring Indoor Switchgear

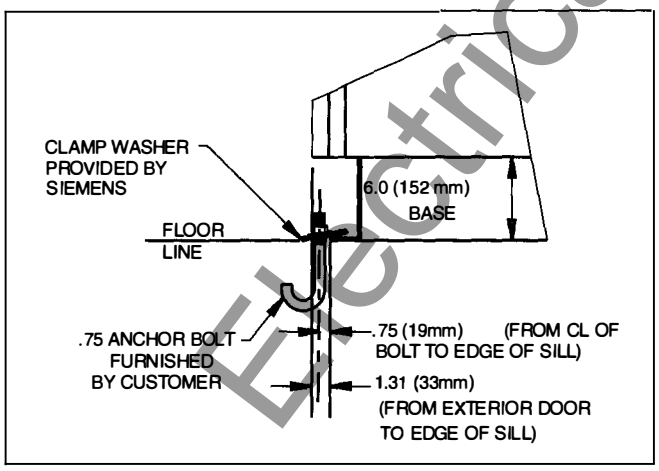


Figure 8. Anchoring Outdoor Switchgear

Weights of Vertical Sections

The following estimates may be used in foundation loading calculations. These estimated weights are for each vertical section within a shipping group. The estimates are based on maximum conditions; actual equipment weights will probably be lower.

Indoor	
22" wide with 4 breakers	2850 lbs. (1300kg)
30" wide with 2 breakers	3050 lbs. (1385kg)
30" wide with 1 breaker and fuse carriage	3150 lbs. (1430kg)
Transition Box	680 lbs. (310kg)
Outdoor	
22" wide with 4 breakers	4200 lbs. (1910kg)
30" wide with 2 breakers	4550 lbs. (2070kg)
30" wide with 1 breaker and fuse carriage	4650 lbs. (2110kg)
Transition box	680 lbs. (310kg)

These estimates should be increased for unusual secondary or auxiliary equipment, impact loading, or for seismic conditions, if required.

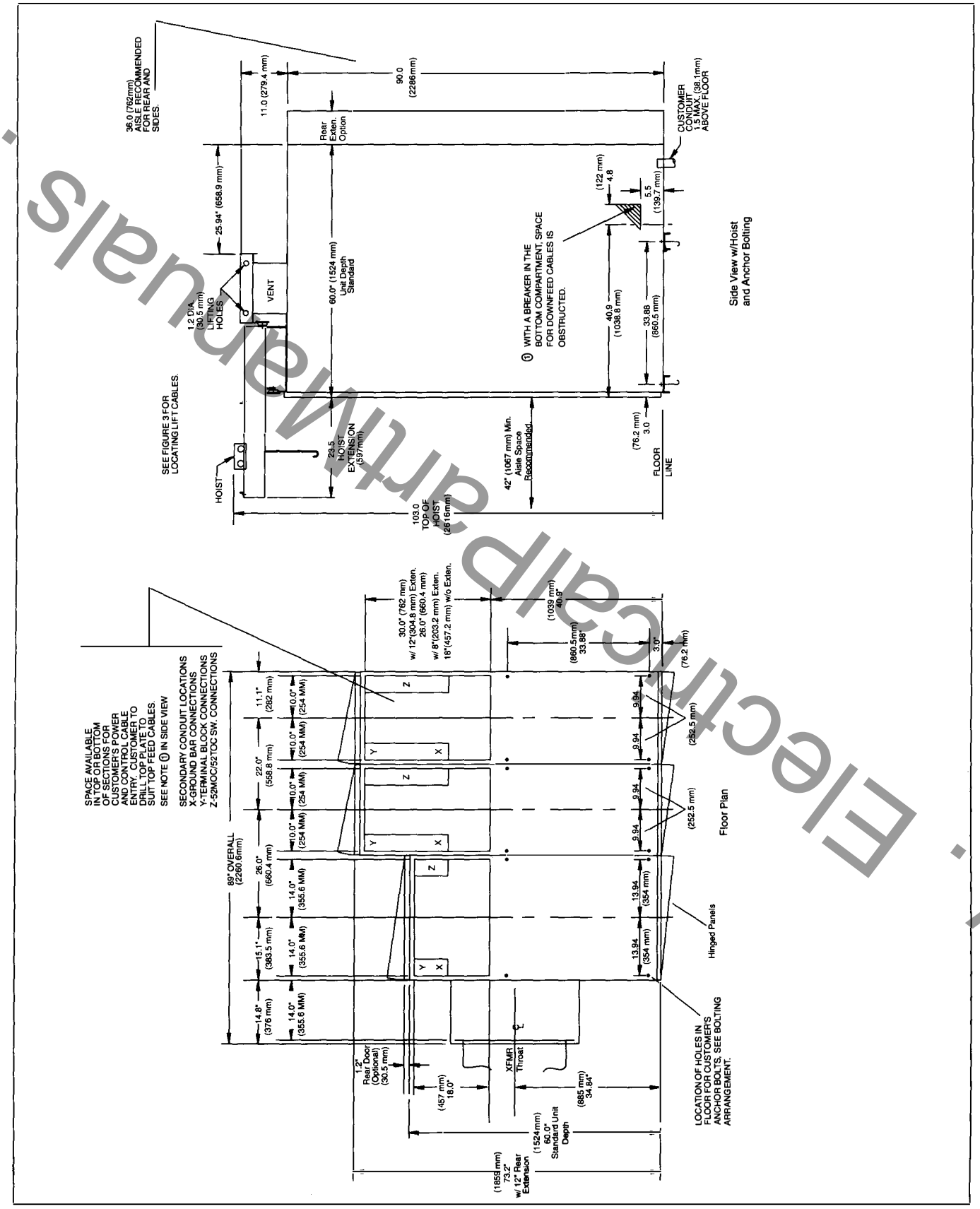


Figure 9. Typical Indoor Floor Plan and Side View

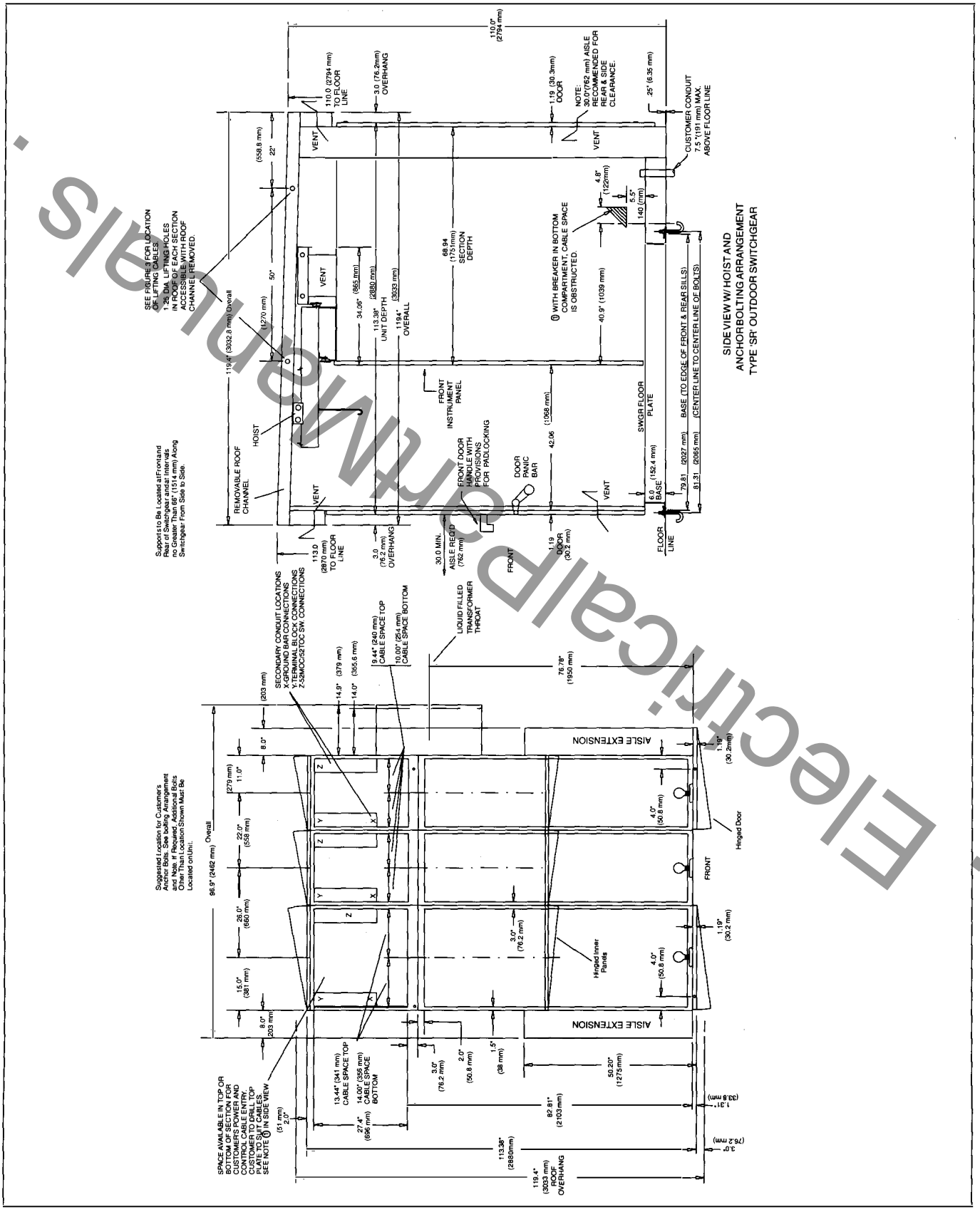


Figure 10. Typical Outdoor Floor Plan and Side View

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, vertical section numbers and their location within the switchgear lineup. Sections are assembled and wired in accordance with the arrangement as in the final installation.

Mounting surfaces (sills, slab, piers or pilings) must be level and in the same plane. Conduits must be properly located and installed so that they will clear the floor plate cutouts. Mounting surfaces must be swept free of stones, chips and other debris.

Setting Shipping Sections
After checking each shipping section for its proper location sequence, as shown on the general arrangement drawing, move the first section of the switchgear to its location. When a throat-connected transformer is part of the installation and in its correct location, the switchgear is positioned next to the transformer as shown in **Figures 16** and **17**. The switchgear shipping section should be kept high enough to just clear any conduits, and then moved toward the transformer throat to conform to the dimensions shown on the general arrangement drawing.

Align the switchgear with the anchor bolt locations and (simultaneously) with the conduit locations. With all points aligned and with conduit caps and floor plate covers removed, carefully lower the section to its permanent location.

It is important that the first section be accurately positioned and leveled as each successive section will depend on the first.

Leveling of the Switchgear
The floor, sills, piers, or pilings must be true and in a level plane. Within the area of the switchgear, there should be no projections (such as pebbles, concrete, or debris) protruding above this plane.

To make certain that there has been no distortion of the switchgear in shipping or handling, each shipping section should be checked with a plumb line after it is resting on the permanent (level) foundation. A plumb line dropped from the top front corner at each end of the shipping section should verify that the section is vertical within 1/8" (3.2mm). Out-of-plumb conditions greater than 1/8" (3.2mm) usually indicates an uneven base, and shimming may be required.

Leveling Indoor Switchgear
Each section is provided with four anchor bolt locations, as shown in **Figure 9**. Examine these anchor bolt locations to make certain that the section is in firm contact with the mounting surface in the area of the anchor bolt. In the absence of firm contact, shims must be added adjacent to the anchor bolt holes. These shims will prevent distortion of the section when anchor bolts are drawn tight. Shims should be approximately three inches square, and sufficient shims should be installed to provide firm contact between the section and the shimmed foundation. Tighten anchoring hardware, and check for plumb. The act of tightening of the anchoring hardware should not cause any distortion of the section. If the section does distort, add additional shims as required.

If the lineup consists of more than one shipping section, each successive shipping section should be installed in a similar manner. Move the second section into place, being certain that the front panels are aligned with those of the first section. Check for plumb as was done for the first section. Insert hardware for bolting the two sections together, but do not tighten. Repeat the leveling, shimming and tightening of anchoring hardware as on the first section. After this is complete, tighten the hardware holding the two shipping sections together. Repeat this procedure for each shipping section in the line-up.

Leveling Outdoor Switchgear
Plumbing and leveling outdoor equipment is basically the same as for indoor. When resting on its permanent foundation, the sections should be plumb within 1/8" (3.2mm). Unlike indoor switchgear, outdoor equipment is anchored using studs or J-bolts grouted into the foundation, and with clamp washers gripping the switchgear base. Examine the area adjacent to each anchor bolt to make certain that the base is in firm contact with the mounting surface. If there are areas adjacent to these studs which are not in firm contact with the mounting surface, shims must be added as described for indoor units. These shims must prevent distortion of the base when anchor hardware is tightened. With all points of contact checked, and shipping section properly located, tighten anchor hardware.

If the lineup consists of more than one shipping section, each successive shipping section should be installed in the similar manner. Move the second section into place, being certain that the front panels are aligned with those of the first section. Check for plumb as was done for the first section. Insert hardware for bolting the two sections together, but do not tighten. Repeat the leveling, shimming and tightening of anchoring hardware as on the first section. After this is complete, tighten the hardware holding the two shipping sections together. Repeat this procedure for each shipping section in the lineup.

Check the supports to be sure that no shipping split (junction between two shipping sections) is unsupported. If proper support is not present, correct as needed.

Install roof channels as shown in **Figure 11**.

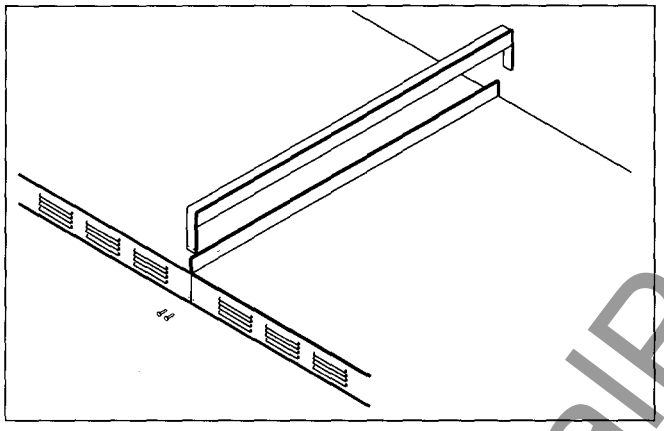


Figure 11. Installing Outdoor Roof Channels

Installation of Traveling Crane

⚠ WARNING

Heavy weight.

Can cause death, serious personal injury or property damage.

Install traveling crane per the following instructions and tighten all hardware.

The traveling crane is furnished as standard equipment on outdoor switchgear, and is shipped installed.

For indoor switchgear installations, the traveling crane is an optional accessory. When this option has been ordered, the crane is shipped loose with the accessories. To mount the crane, it is necessary to remove the stop angles from one end of the track, roll the crane onto the track, and reinstall the stop angles. See **Figure 12**.

Important: Be sure that the crane is properly lubricated before use, as outlined in the "Maintenance" section of this manual.

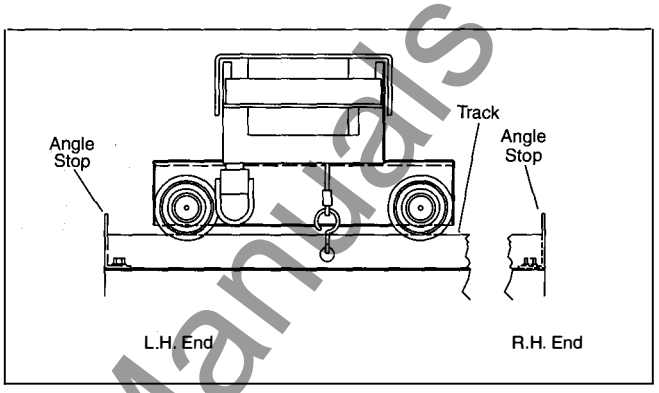
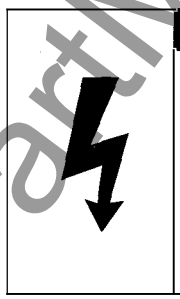


Figure 12. Traveling Crane



⚠ DANGER

Hazardous voltages.

Will cause death, serious personal injury or property damage.

Do not contact energized conductors.

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

Extension of Existing Switchgear

Provisions have been made for future extension of switchgear lineups. The main bus has been terminated with tin plated aluminum or silver plated copper pads with the necessary holes to splice to the new installation.

Extending Indoor Switchgear

To extend indoor switchgear, remove the end plate, line up and anchor the new equipment, as covered in the first part of this instruction book, make up the primary and secondary connections, and mount the end plate at its new location.

Extending Outdoor Switchgear

Before extending the length of outdoor switchgear a new section of foundation should be installed and ready, with anchoring studs and the required conduits in place.

To expand outdoor switchgear, remove the existing end roof channel and the end plate from both aisle and vertical section. It also will be necessary to relocate the aisle door panel (mounted in the aisle wall) and replace it with a new aisle wall panel which will be shipped with the new equipment. Align the new switchgear with the existing lineup, using the same procedure as discussed earlier in this section.

Tighten the anchoring hardware. Make up primary and secondary connections. Relocate the aisle wall door panel to the end of aisle and install the new aisle panel. Install the roof channel at the split between the existing and new sections. Remount the end plates and reinstall the end channel.

Primary Connections

Bus Bars and Connectors
Bus bars, risers and various connectors may be aluminum or copper, depending on the specifications for the project. Typical bus arrangement is as illustrated in **Figure 13**.

When aluminum bus is provided, all bus and connector joints with exception of shipping splits, neutral bus, primary contacts and termination points joining other equipment are of welded construction. Each weldment has been carefully designed to meet the temperature rise limitations in ANSI Standard C37.20.1. At shipping splits and termination points, the connecting surfaces of the aluminum bars are tin plated, and 1/2" hardware is provided for bolting joints together.

When copper bus is provided, all joints are of bolted construction, and completely assembled at factory except for shipping split splices and termination points to other equipment. Contact areas are silver plated and may be coupled to tin plated aluminum bars or to other silver plated copper bars.

Figure 13. Typical Bus Bar Arrangement

⚠DANGER

Hazardous voltages.

Will cause death, serious personal injury or property damage.

Do not contact energized conductors.

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

Bolted Bus Joints
When bus joints are field assembled, the following procedure shall be used. This procedure applies to aluminum to aluminum joints, aluminum to copper joints, and copper to copper joints:

1. All surfaces must be free of dust, dirt, and other foreign material.

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

3. Assemble all joints with parts dry. Do not use any grease or oxide inhibiting compounds even where aluminum bus is used. Aluminum buses and connectors requiring bolted connections are tin plated and can be applied directly to other tin plated aluminum parts or silver plated copper bars without the use of an oxide inhibiting compound.

4. Refer to **Figure 14** for method of bolting joints, and follow hardware tightening instructions which follow.

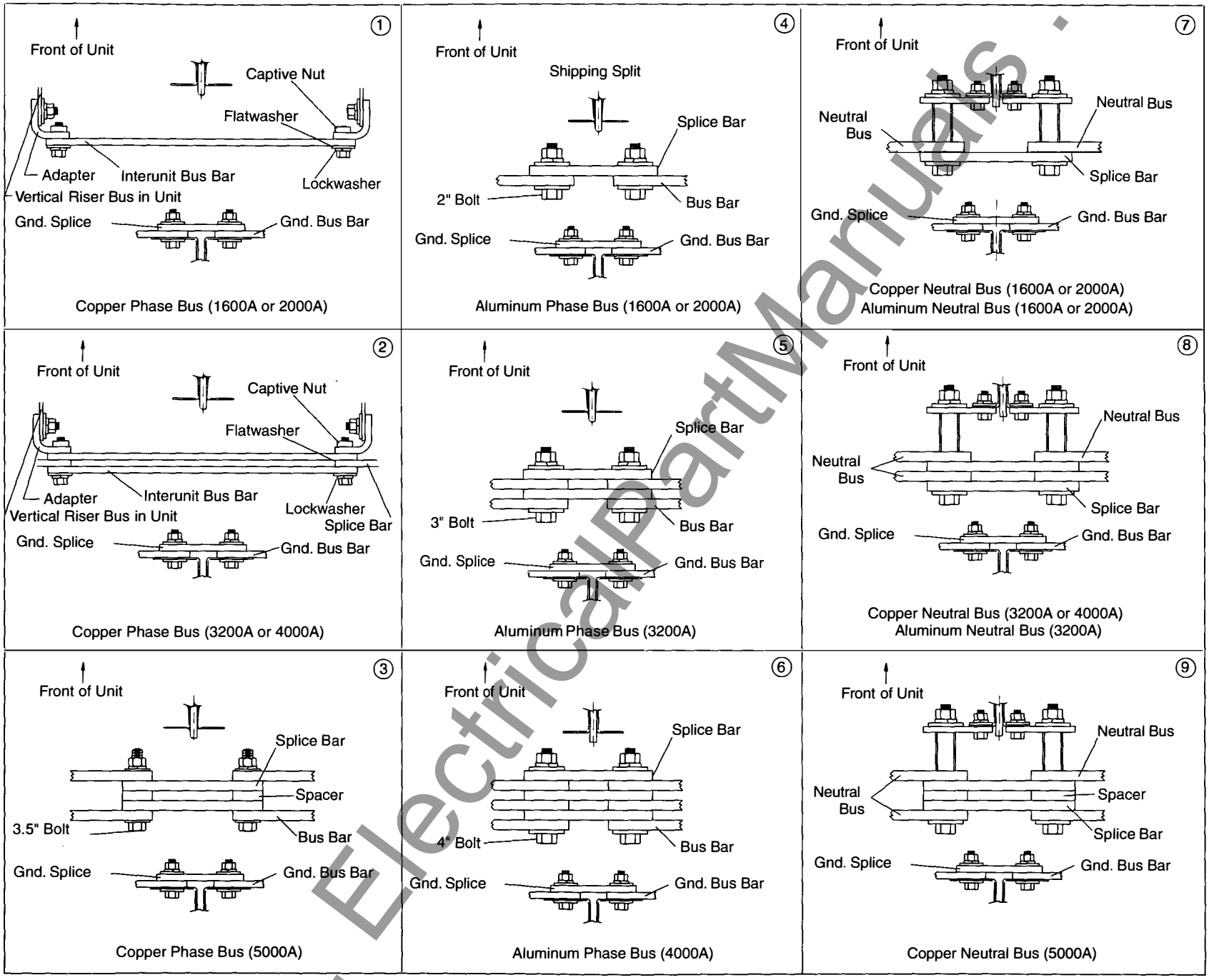


Figure 14. Bolted Bus Joint Arrangement

Hardware Tightening Instructions
All bus joint hardware furnished is zinc plated, dichromate treated, high strength steel. Cap screws are 1/2-13 SAE Grade 5, while nuts are SAE Grade 2 hexagon heavy. Sizes and grades other than these are not to be used. Tighten 1/2-13 hardware to 50-75 ft. lbs. (68-102 Nm) torque.

When purchaser's specifications require, special hardware (e.g., silicon bronze or stainless steel) may be provided. For such applications, consult the factory for proper torque range.

For all-copper bus joints, arrange hardware as shown in **Figure 15**, with a flat washer on each side of the joint, and a lockwasher between the flat washer and the nut. When aluminum bus or a mixture of aluminum and copper bars is involved, the lockwasher and flat washer under the nut are replaced by a single "Belleville" spring washer. The concave side of this spring washer is placed against the bus or splice plate.

Torque hardware as described above. Do not exceed the maximum torque value given. Forces within the torque range will produce a low resistance joint, without cold flow of material.

Note: All hardware furnished is plated, high strength steel. Capscrews are 1/2-13 SAE Grade 5. Hex nuts are Grade 2. **Do not use metric hardware.**

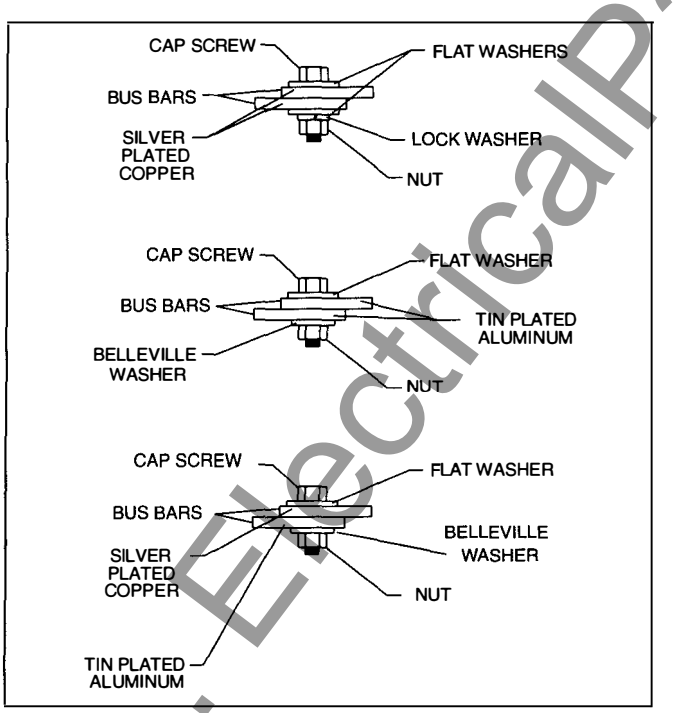


Figure 15. Bus Joint Hardware Installation

Connection to Power Transformer
Before making the primary connections to a liquid transformer, it will be necessary to remove the transition box cover for access. See **Figure 17**. The joints connecting power transformers to the switchgear are the same as joints previously described, except that braided flexible connectors are used to make certain that strain transmitted to the transformer bushings is minimal and as an aid to alignment. See **Figure 16**. Connections to dry type transformers are normally made within the transformer enclosure.

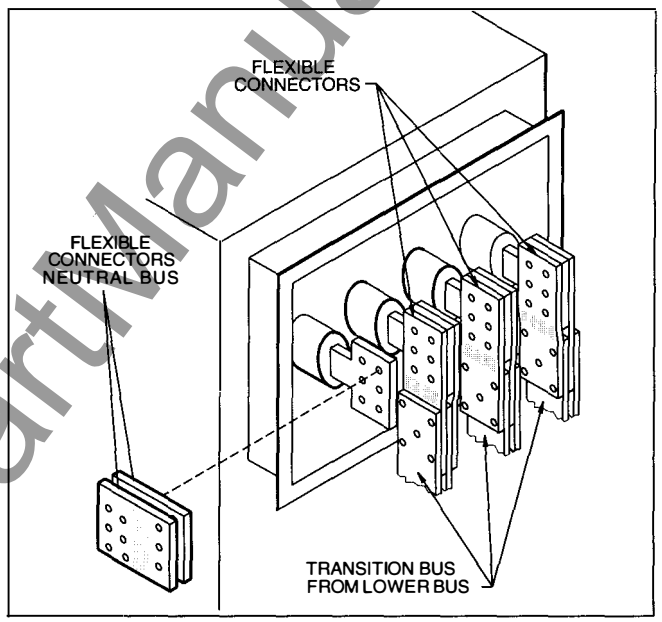


Figure 16. Transformer Throat Connection (Lower Bus Shown, Upper Bus Similar)

Transformer connector arrangements are shipped with flexible connectors attached to the switchgear assembly. The flexible connectors contain the required hardware to make the connections to the transformer terminals. Carefully observe how the flexible connectors are mounted to the switchgear (placement of bolts, nuts, washers and spacers), then remove the flexible connectors or carefully spread them to prevent damage to the transformer terminals or connectors while the switchgear is brought into final position. Carefully connect the flexible connectors to the transformer and switchgear terminals, and torque all connections.

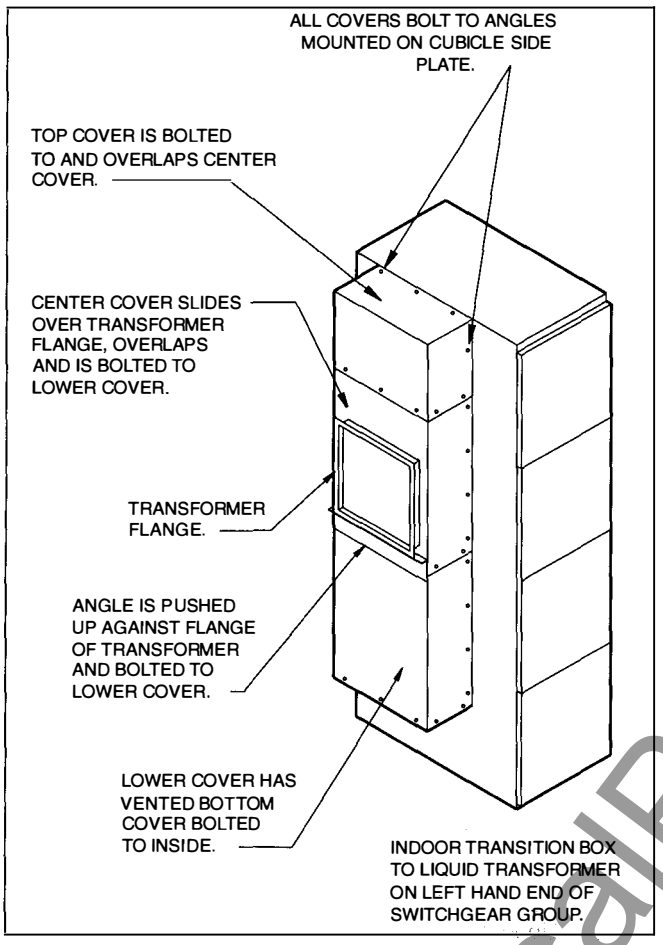


Figure 17. Transformer Hood

Primary Power Cable Connections
Because of considerable variations in purchaser requirements and available cables, Siemens furnishes a single bolt and clamp terminal lug only, unless specified otherwise by the purchaser.

Power cable terminal lugs should be installed as shown in **Figure 18.**

> **Important:** Clearance between bare phase conductors and to ground should be at least one inch. If this requirement is not met, the connections should be insulated with electrical insulating tape to achieve the required dielectric levels.

Primary and secondary cables should enter the switchgear through the space shown on the General Arrangement drawing. Always arrange cables in smooth curves and anchor securely to cable supports to relieve strain on terminations, and to control cable movement under short-circuit conditions. If cable entry is from above, drill the top plate or roof plate to suit. For outdoor installations, drill the cable area cover to suit the conduits. If cable entry for outdoor or drip resistant applications is through the roof, install Code-approved hubs or weather seal means.

Before the cable connections are made, phase rotation should be checked.

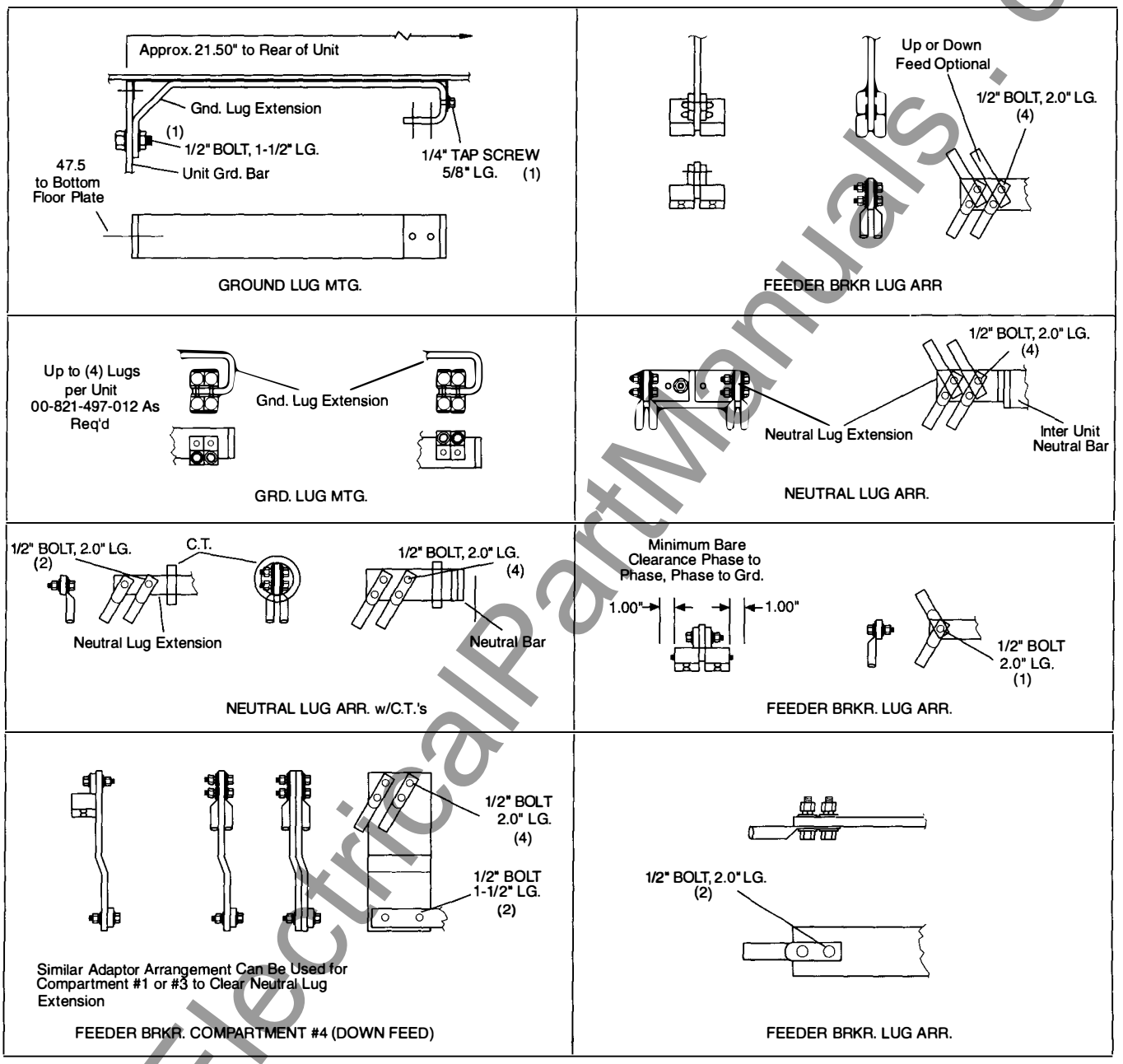


Figure 18. Power Cable Lug Arrangements

Control Wiring

Terminal blocks are provided in the rear of the switchgear for purchaser's control wiring connections. Refer to the master wiring diagram for wire designations. Wiring between sections at shipping splits is connected and tagged as shown on the master wiring diagram for purchaser's ease in field connection. Shipping split wiring connections are made in an area on top of the switchgear near the front of the section. A removable cover allows access to these connections.

For ventilated dry transformer installations, a conduit is furnished for wiring between switchgear and the temperature control system box on the transformer. This conduit is installed and wired by the purchaser in the field.

For liquid filled transformer installations, the conduit is furnished with the transformer for connecting to the switchgear in the field.

All secondary wiring installed by factory is bundled and cleated to the side plate. Make all field connections in a similar manner as shown in **Figure 19.**

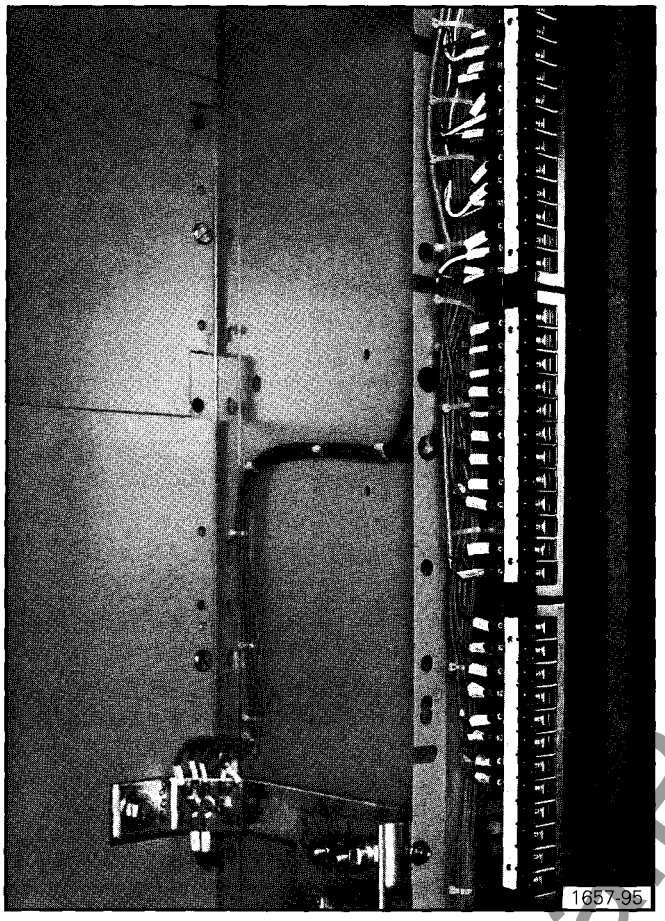


Figure 19. Typical Control Wiring

Current Transformers

⚠WARNING

Hazardous Voltages.

Can cause death, serious personal injury or property damage.

Do not open-circuit the secondary of a an energized current transformer. Always short-circuit the secondary of any current transformer before performing maintenance on current transformer wiring.

Current transformers for metering are generally mounted on the stationary primary disconnect studs in the circuit breaker compartment and are readily accessible for inspection and replacement.

Current sensors for static trip device use are called "tripping transformers". They have a 0.5A secondary and are not suitable for metering. They are mounted on the circuit breaker except when a ground fault trip element or neutral metering element is furnished for a four wire application. In this case, a fourth tripping transformer is mounted in the cable compartment on the neutral bus or in the link between the neutral bus and the ground bus. This will be shown on the one line diagram.

Ground Connections

A common ground bus is incorporated in all sections for properly grounding the switchgear after installation. Each section has a tap from the ground bus to the primary entrance cable compartment. Provisions for connecting this ground bus to the station ground must be made by purchaser in a reliable manner.

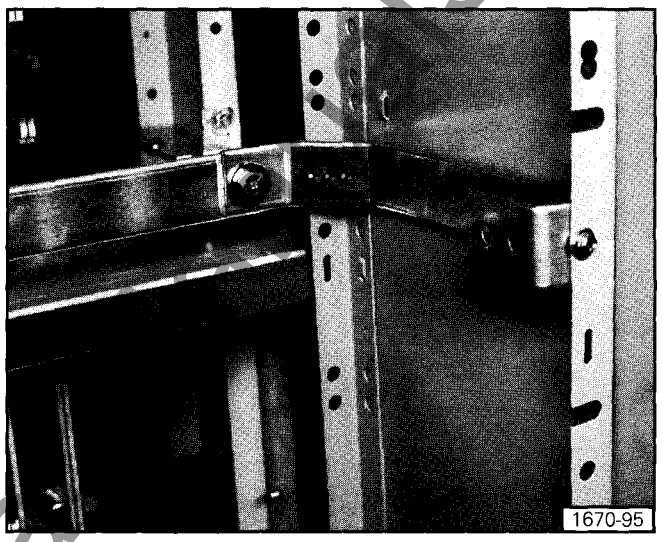


Figure 20. Typical Ground Connection Pad

Cleaning

⚠DANGER

Hazardous Voltages.

Will cause death, serious personal injury or property damage.

Do not contact energized conductors.

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

When switchgear installation is complete and all electrical connections have been made, but prior to energizing or installing circuit breakers, all equipment must be thoroughly cleaned using a vacuum cleaner to make certain they are free of construction dust, chips or other debris. Do not use pressurized air (i.e., an air hose) to blow dirt and debris out of the switchgear, as this can cause foreign items to lodge in areas from which removal will be difficult. Do not use solvents without reading "Cleaning of Insulation" in the "Maintenance" section.

Shutters
Shutters are available as an option when specified. Two shutter designs are available, depending on the options provided. For most applications, an insulated shutter mechanism is installed at the rear of the circuit breaker compartment. For other applications, a metal shutter is used, which is installed on the floor of the circuit breaker compartment floor plate. In either case, the shutter automatically closes when the breaker is removed from the compartment and opens when the breaker is inserted.

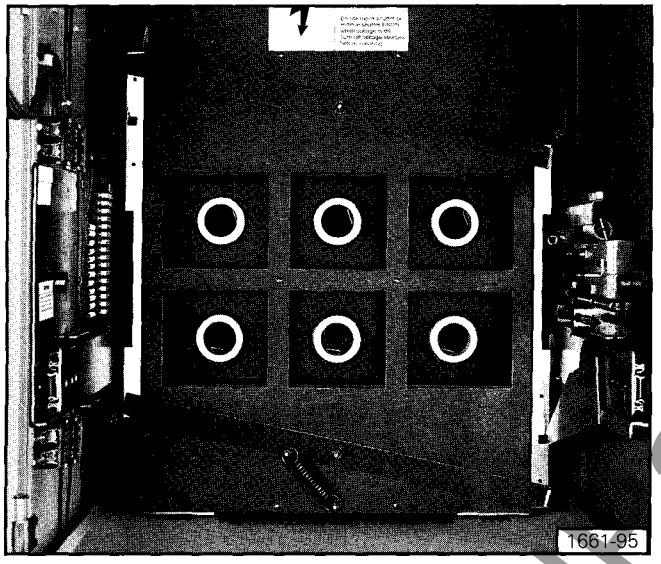


Figure 21. Insulating Shutter (Shown Blocked Open)

⚠DANGER

Hazardous Voltages.

Will cause death, serious personal injury or property damage.

Do not place hands or tools beyond the edge of the shutter, or open the shutter, without determining that all circuits are de-energized and grounded.

Insulating Shutter
When the breaker is installed on the sliding rails, and is pushed into the compartment, the rear of the breaker frame makes contact with the shutter operating disc. Refer to **Figures 21 and 22**. Further movement causes the operating disc to roll under the breaker frame, rotating the arm to which it is mounted. This fully opens the shutter. In the process of withdrawing the breaker from the compartment, a tension spring closes the shutter.

Note: If inspection or work must be performed behind the shutter, the primary circuits must be de-energized. Never place hands or tools beyond the edge of the shutter to move it downward.

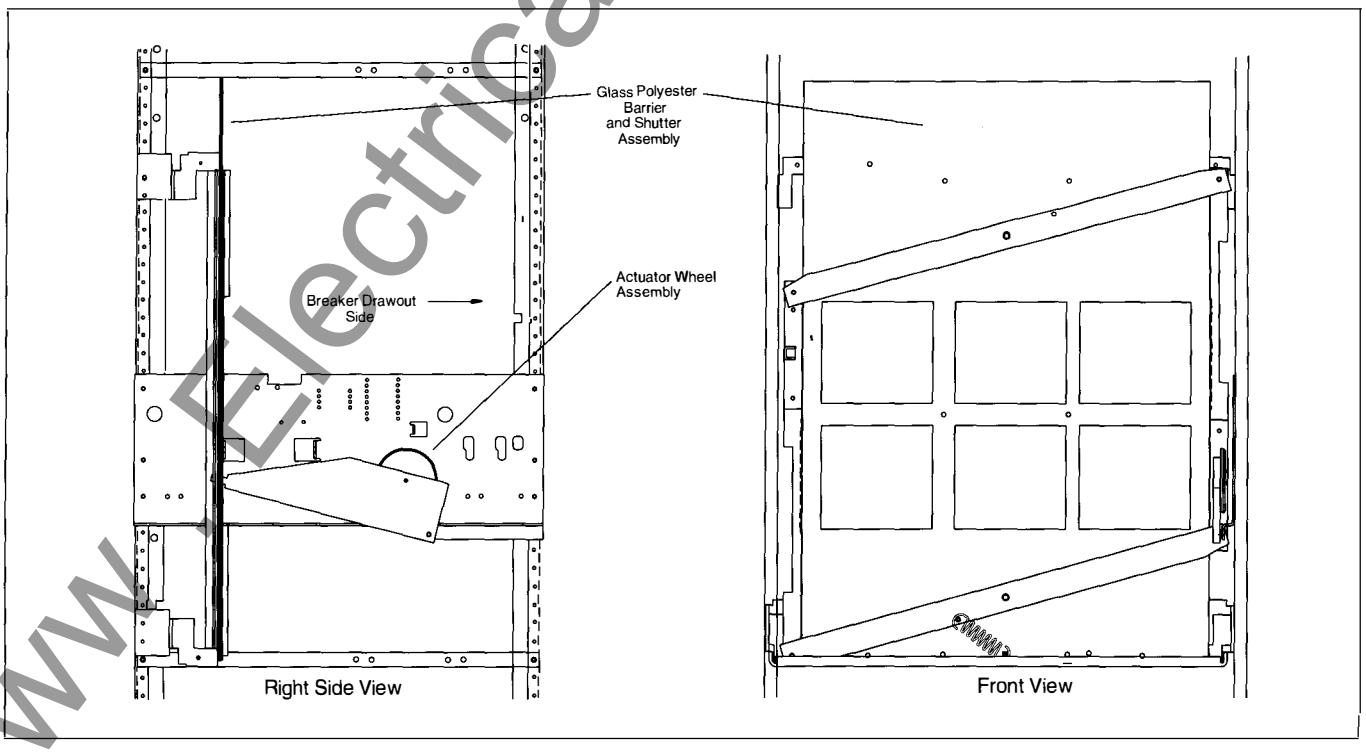


Figure 22. Insulating Shutter Mechanism

Metal Shutter

When the breaker is installed on the sliding rails, and is pushed into the compartment, the rear of the breaker frame makes contact with the shutter operating disc. Further movement causes the operating disc to roll under the breaker frame, rotating the arm to which it is mounted. This partially opens the shutter. Further inward movement of the breaker causes the lower portion of the breaker frame to contact the upper leaf of the shutter, and completes the opening operation of the shutter.

In the process of withdrawing the breaker from the compartment, torsion springs plus a positive shutter return (a projecting boss on the slide rail which engages the operating disc) force complete closure of the shutter. Protruding glass polyester angles prevent shutter contact with primary disconnect studs.

> **Note:** If inspection or work must be performed behind the shutter, the primary circuits must be de-energized. Never place hands or tools beyond the edge of the shutter to move it downward.

Always pull on the handle provided near the center of the shutter, as shown in **Figure 23**. To manually lower the shutter by any other method may damage the shutter operating mechanism.

Like any mechanical device, the shutter mechanism should be lubricated as part of a maintenance program; however, do not lubricate the aluminum gear hinge. See **Figure 24.**

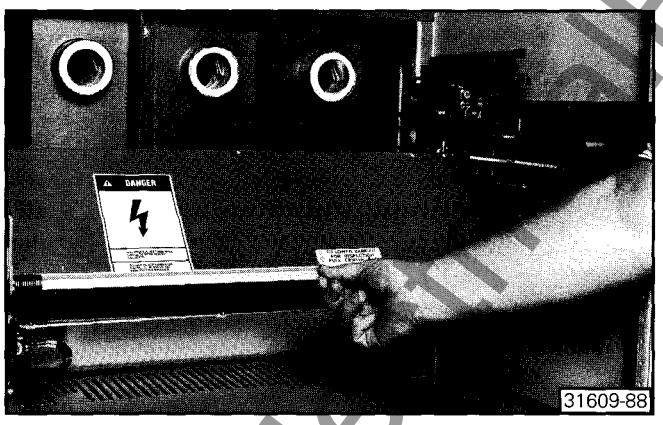


Figure 23. Opening Metal Shutter for Maintenance Inspection

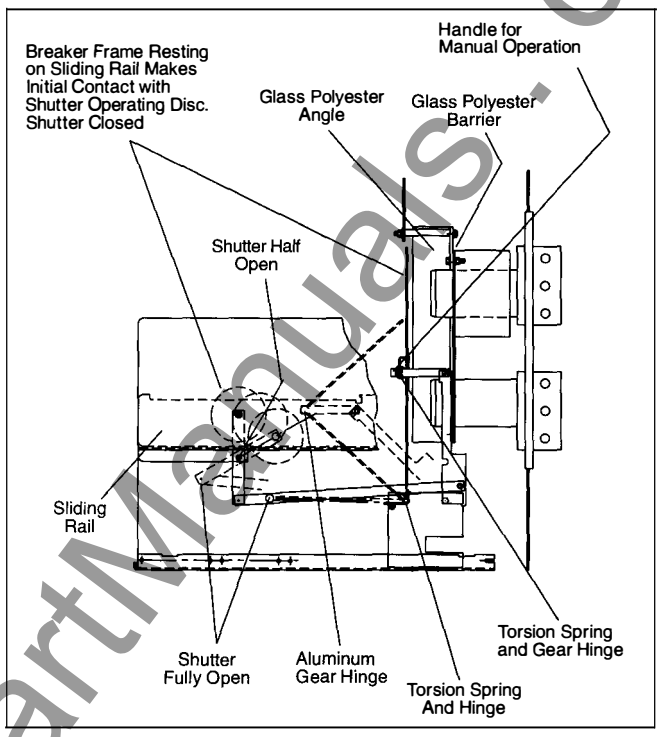


Figure 24. Metal Shutter

MOC (Mechanism Operated Cell) Switches
When optional mechanism operated cell (MOC) switches are provided, they are mounted on the left hand side plate (as veiwed from the rear) in the secondary equipment area for easy access. They are operated by a push-pull cable from a mechanism in the breaker drawout compartment which is activated by the circuit breaker.

The MOC switch operator (See **Figure 26**) in the breaker drawout compartment is coupled to the circuit breaker when the breaker is pushed into the compartment. Alignment is gained by a block with a large countersunk end which is mounted on the breaker. This block serves as a funnel to guide the operator coupling into alignment with a piloted square shaft within the block. This shaft on the breaker transmits a rotary motion to the MOC switch operator, which in turn converts the rotary action into a linear motion for operation of the push-pull cable. Closing the circuit breaker pushes the cable toward the MOC switch, whereas opening the breaker pulls it back.

Each of the contacts within the MOC switch may be individually set to be either open or closed as required (as an "a" or "b" switch). Contacts may be adjusted by removing the cover plate. Contact segments are set 60 degrees apart between open and closed stages. Contact segments are notched every 15 degrees and may be adjusted in 15 degree increments on a hexagonal band on the switch shaft. When the MOC switch cover plate is in place the contact segments are secured in their location and cannot be inadvertently dislodged. See **Figures 25** and **26**.

Lubrication of the operating mechanism and MOC switch contacts should be part of a periodic maintenance program.

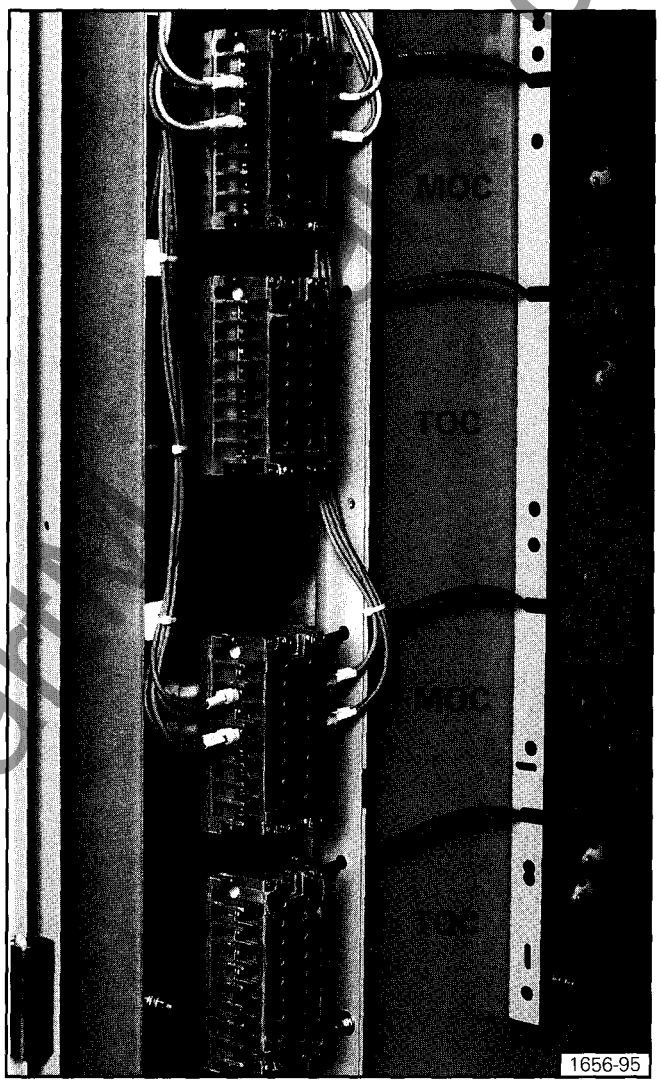


Figure 25. MOC and TOC Switches

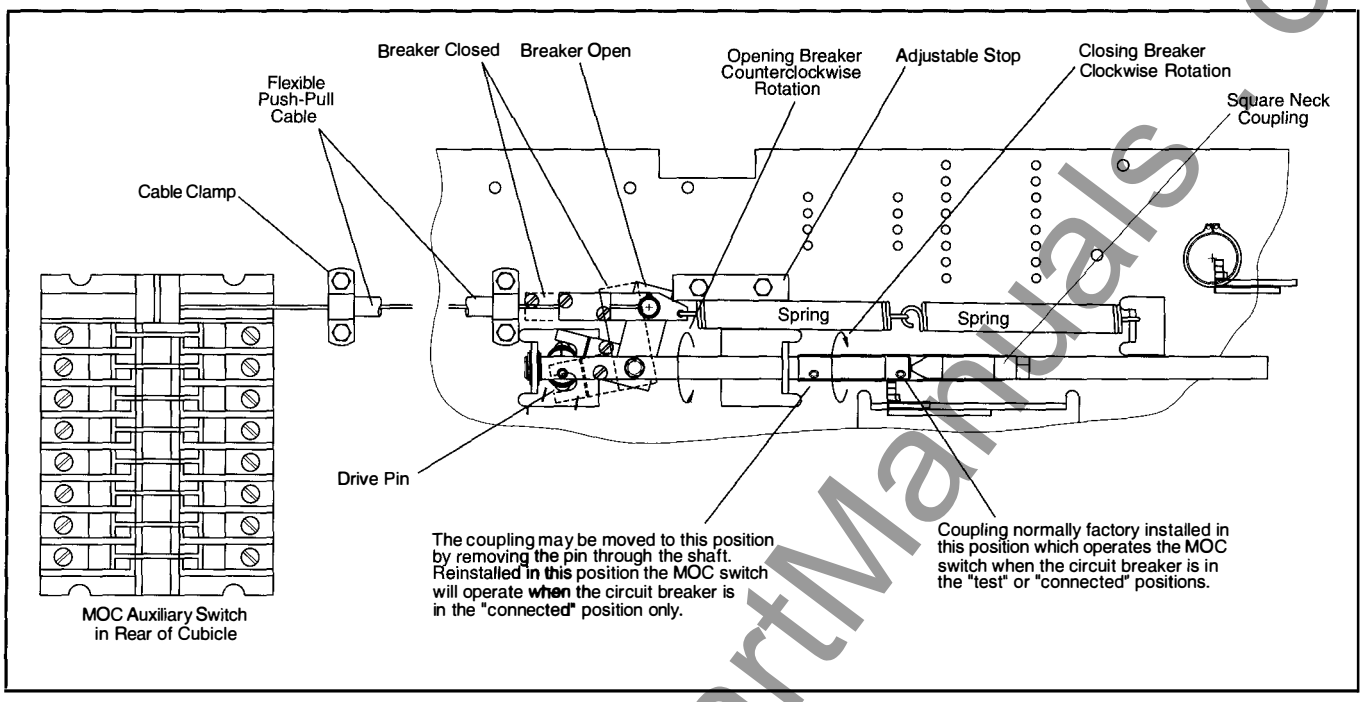


Figure 26. MOC (Mechanism Operated Cell) Switch Operator in Circuit Breaker Compartment

TOC (Truck Operated Cell) Switches
Truck operated cell (TOC) switches are similar to MOC switches except they reflect only the position of the breaker in the compartment, that is, connected position or "not in connected" position. Opening and closing of the circuit breaker has no effect on this switch. This option is mounted on the left hand side plate (as viewed from the rear) in the secondary area, and like the MOC switch, is operated by a push-pull cable. Both MOC and TOC switches are mounted in close proximity and are operated by the same breaker from the same drawout compartment.

The TOC switch is operated by the use of a push-pull cable which is activated by a snap-action operator, producing a quick make and quick break contact action within the switch. **Figure 27** show the TOC switch operator, while **Figure 25** shows the location of the TOC switch, in the same area as the MOC switch.

The operator is an assembly of 3 small plates on which springs and linkages are mounted each performing their necessary function. The three plates on which the various components are assembled are: a fixed plate which is attached to the vertical section, a horizontal floating plate on which a cam and bumper screw are mounted, and a sliding plate to which the push-pull cable wire is attached. In addition, there are two toggle latch systems, one releases the energy of a charged spring when the circuit breaker approaches the connected position, and the other releases the energy of another charged spring when the circuit breaker leaves the connected position. Both toggle latches are linked between the fixed and sliding plates.

When the circuit breaker is racked from test position to connected position, the circuit breaker frame will make contact with the bumper screw which is attached to the floating plate. Further racking will cause the floating plate to move toward the rear of the drawout compartment compressing spring "A" between the pin which is attached to the floating plate and the edge of the sliding plate. The sliding plate is restrained from moving by the inline toggle linkage. The movement of the floating plate has also charged the extension spring "B".

The cam mounted on the floating plate is positioned in such a manner that when spring "A" is at proper charge it will lift the restraining toggle linkage, driving the sliding plate toward the rear of the compartment and in turn it will push the cable wire to operate the switch. In the same motion the force of spring "A" has charged compression spring "C" and set the front toggle latch in a restraining condition against the force of spring "C".

In the process of racking the circuit breaker from the connected position the extension spring "B" moves the floating plate along with the breaker as the breaker is withdrawn. The cam mounted on the floating plate will lift the front restraining toggle latch, allowing the sliding plate to drive forward which, in turn, will pull the push-pull cable wire operating the switch. During this motion the rear toggle latch has reset for the next racking operation.

Lubrication of the operating mechanism and the TOC switch contacts should be part of a periodic maintenance program.

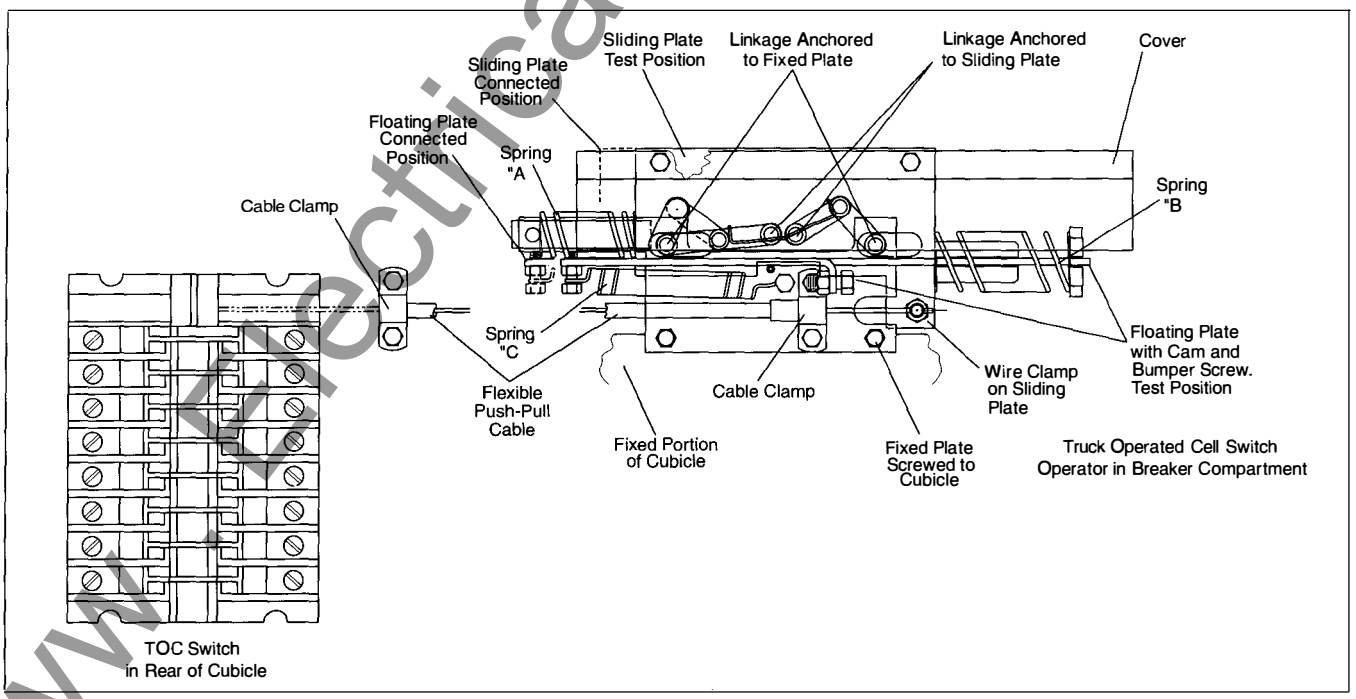


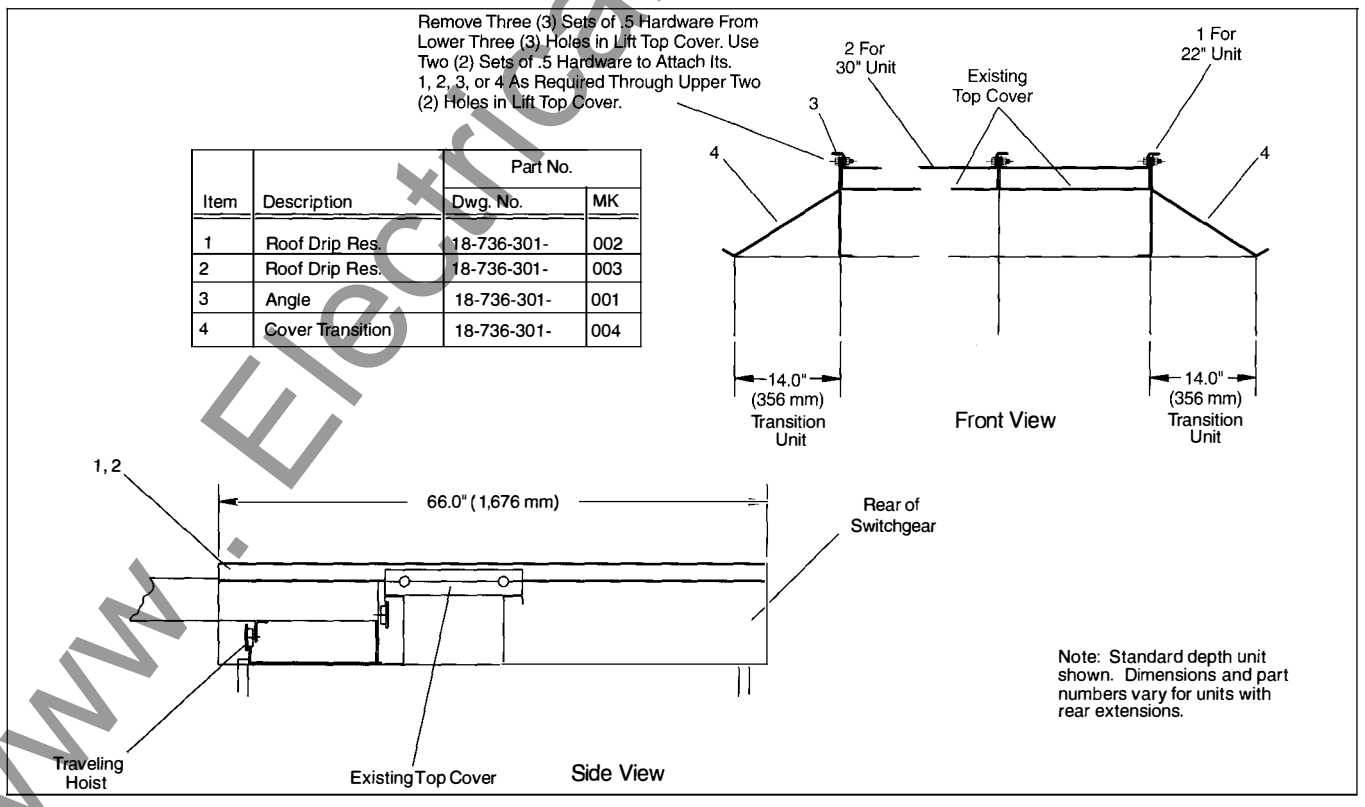
Figure 27. TOC (Truck Operated Cell) Switch Operator in Circuit Breaker Compartment

Key Interlock Systems
Key interlock systems are available as an option, and may include one or two key interlock cylinders. With the lock bolt extended, the breaker is held in a trip-free condition, and the key may be removed. The linkage should be examined as a periodic maintenance check to make sure the device is working freely.

Key interlocks are standard between RFC-3200, RFC-4000 and RFC-5000 fuse carriages and their related breakers, to prevent racking of the fuse carriage until the associated circuit breaker is open.

Drip Resistant (Indoor Option)
The purpose of the optional drip resistant shield is to prevent vertically falling liquid or dust from entering the switchgear. To avoid interference with lifting provisions for the switchgear, the drip shield is shipped loose for installation after the equipment is installed in its permanent location. The drip shield is an arrangement of interlocking roof decks with an overhang beyond the switchgear, which is sloped downward toward the rear of the switchgear to shed any liquid. See **Figure 29**.

Figure 28. Key Interlock Option (Circle shows that interlock has blocked closing of circuit breaker)



Item	Description	Part No. Dwg. No.	MK
1	Roof Drip Res.	18-736-301-	002
2	Roof Drip Res.	18-736-301-	003
3	Angle	18-736-301-	001
4	Cover Transition	18-736-301-	004

Figure 29. Drip Resistant Shield Option

Breaker Preparation and Insertion

Circuit Breaker Preparation
Circuit breakers are normally shipped in the open position. Remove any blocking and tags. Verify that the circuit breaker is open before installing or operating the circuit breaker.

Refer to the circuit breaker instruction manual for complete operating instructions and lubrication information. Check to be sure that the primary disconnects are properly lubricated.

Use the traveling crane or other suitable means for lifting the circuit breaker for insertion or removal.

Important: Be sure that the crane is properly lubricated before use, as outlined in the "Maintenance" section of this manual.

Compartment Identification
Before installing a circuit breaker in its compartment, check the following items to be sure the circuit breaker is in the correct compartment. The one line diagram will show the following:

⚠DANGER

Hazardous Voltage.

Will cause death, serious personal injury or property damage.

Check that the circuit breaker data listed below agrees with the compartment data (all 6 items).

Do not attempt to insert a fused circuit breaker into a compartment which was built for a non-fused power circuit breaker.

1. Circuit breaker type (for example RL-800 (unfused), RLF-800 (fused), RL-1600 (unfused), etc.)
2. Trip transformer or sensor rating
3. Static trip type (RMS-TS-TZ, RMS-TIG-TZ, etc.)
4. Type of operator (MO=manual operator, or EO=electrical operator)
5. Wiring diagram information
6. Special accessories (undervoltage trip, etc.)

Placing Circuit Breaker into Compartment
Refer to **Figure 30**. Place circuit breaker in front of the vertical section in which it is to be installed and attach lifting bar (furnished with accessories). Attach crane cable (or other lifting means) to lifting bar, and with crank inserted in crane eye, turn crank to raise breaker. Raise breaker to a point slightly above compartment rails. Extend right-hand and left-hand rails to their limit.

Lower the breaker onto the rails taking the following precautions: The disconnect (rear) end of the circuit breaker must be tilted downward to engage the notch on the right-hand rail first making certain that it engages the tabs on both rails. With breaker securely seated on rails, remove the lifting bar and push the breaker into the compartment.

Racking of Circuit Breaker
Use the following sequence to rack breakers:

1. On electrically operated breakers, be certain that the control toggle switch on the lower front portion of the breaker is in the OFF position.
2. Depress red trip bar on front of the breaker and hold in depressed position. Open racking window (see **Figure 31**) by pushing the interlock slide to the left, exposing the end of the racking screw. The breaker is trip-free (i.e., it cannot be closed) when the interlock slide is open.
3. Using the racking crank (furnished with accessories), rotate the racking screw to move racking arms into alignment with the pins just above the slide rails.
4. Push the breaker to the disconnect position. Check to be sure that the racking arms have engaged the pins. Clockwise rotation of the racking crank will move the circuit breaker through the test position to connected position. During racking, check to see that the ground shoe (left-hand side of the breaker) has made firm contact with edge of fixed portion grounding strip. If secondary disconnect block is provided, check for alignment with fingers on breaker and for firm contact.

   Counter-clockwise rotation of crank will move breaker from connected position toward test and disconnect position. A position indicator is located on the front of the breaker mechanism cover, just to the right of the racking screw/interlock slide opening. This position indicator is shown in **Figure 31**. The breaker movement relative to the connect, test and disconnect positions may be observed while turning the racking crank. In addition a detent has been provided to properly align the breaker in the test position. When the breaker is in the connected or test position and the interlock slide is closed, the breaker is in its operating mode and can be closed.

⚠DANGER

Heavy weight.

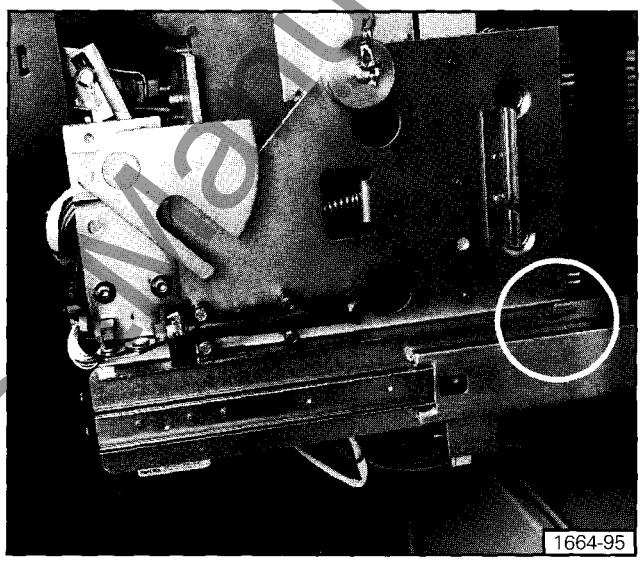
Can cause death, serious personal injury or property damage.

Use of a lifting device or crane will place heavy weights overhead. Avoid excessive speeds and sudden starts or stops.

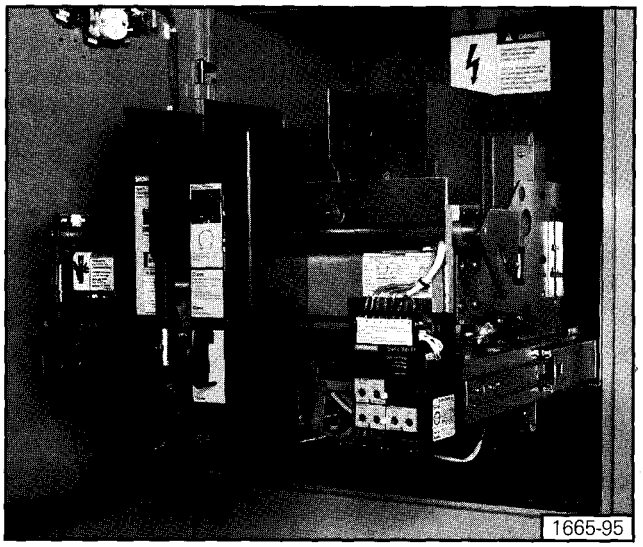
Never lift a circuit breaker over an area where personnel are located.

A) Attach lifting bar assembly to circuit breaker as shown above. Fasten locking screws through circuit breaker side plates and lifting plates.

B) Attach crane hook and insert crank into hoist mechanism eye. Raise breaker above compartment, and fully extend rails.



C) Lower breaker onto rails. **Important!** The rear of the breaker must be tilted downward so that the breaker engages the notch at the rear of the right hand rail (shown in circle).



D) Continue lowering until circuit breaker rests securely on the rails. Remove the lifting yoke. The circuit breaker is now ready for inserting into the cell.

Figure 30. Use of Lifting Bar Assembly to Handle Circuit Breakers or Fuse Carriages

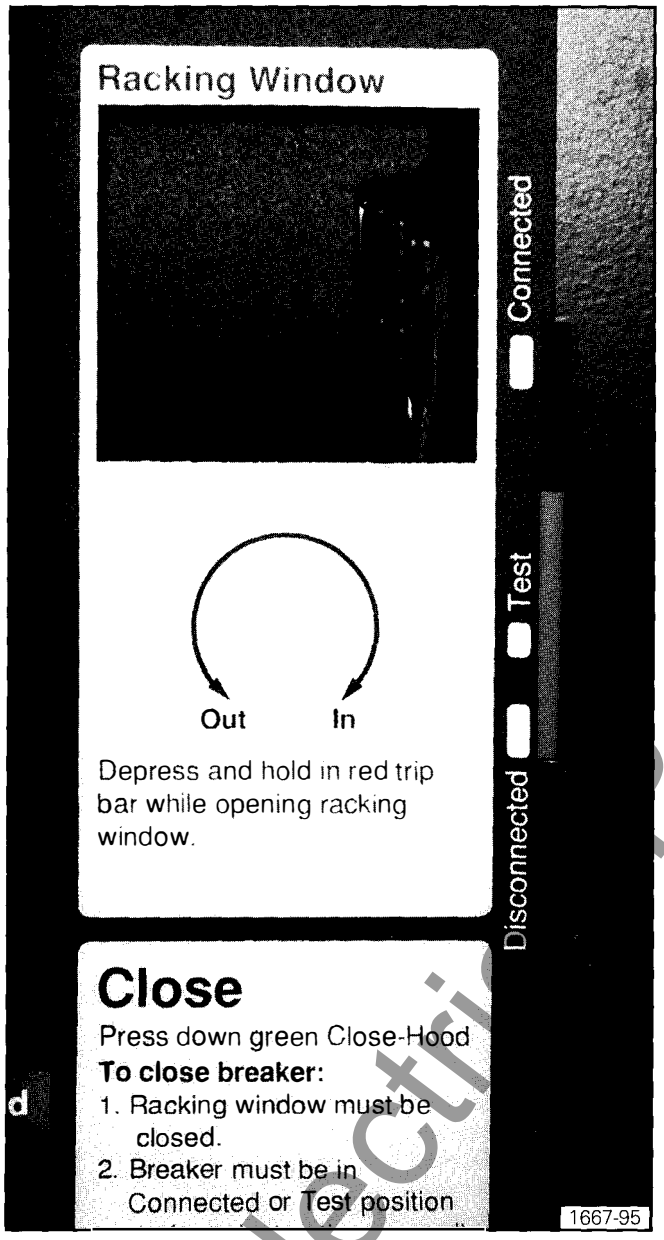


Figure 31. Circuit Breaker Position Indicator (Breaker shown about halfway between Test and Connected positions)

Drawout Fuse Carriages (RFC-3200, RFC-4000, and RFC-5000)
Types RFC-3200, RFC-4000, and RFC-5000 drawout fuse carriages are used (and interlocked) with RLF-3200, RLF-4000, and RLF-5000 circuit breakers. Because of the interlocking, each fuse carriage is allocated to a specific compartment. (See one line diagram for location.) Racking and lifting is accomplished in the same manner as for a circuit breaker.

Future Breaker Compartments
These compartments have the primary contacts and bus bars installed for future installation of a circuit breaker. To prevent accidental contact with live parts, primary contacts are shielded by an insulating barrier.

⚠DANGER

Hazardous Voltages.

Will cause death, serious personal injury or property damage.

Do not place hands or tools beyond the edge of the barrier without determining that all circuits are de-energized and grounded.

Do not remove insulating barrier from a compartment until a circuit breaker is to be installed.

De-energize and ground all conductors before working on or near them.

⚠DANGER

Hazardous Voltages.

Will cause death, serious personal injury or property damage.

Do not work on energized equipment.

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

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. Power connections and secondary control connections properly made and checked for shorts and undesired grounds.
2. Electrical disconnecting contacts, machined parts, shutters, 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. After external connections have been made, check that temporary wiring jumpers (used on the secondaries of current transformers tied to external devices, as shown on wiring diagrams) have been removed.
6. Ground connections properly made.
7. All equipment which has been removed during assembly has been replaced.
8. Static trip devices and/or relays coordinated with other protective devices on the system. Refer to protective device instructions before making any adjustments. Consult the local utility before making any connections to the power supply system.
9. Storage battery fully charged and battery charger operating correctly (For DC control source only).
10. Interlocks performing properly.
11. Circuit breakers checked and prepared per instruction manuals.
12. All filters in vent areas are clean and free of shipping or construction material.
13. All tools removed from equipment, and equipment clean.

Testing

1. A megger test is made on the high voltage circuit to be sure that all connections made in the field are free of undesired grounds. A megger test is also advisable on the control circuit.
2. A dielectric test, if possible, should be made on the high voltage (power) circuit for one minute at the appropriate test voltage. (Voltage transformers, control power transformers, surge arresters, and surge capacitors must be disconnected during this test).

Rated voltage of circuit	Test voltage
480 or 600 volts	75% of 2200 = 1650 VAC
208 or 240 volts	75% of 1500 = 1125 VAC
Secondary & control circuits	75% of 1500 = 1125 VAC

Note: Certain control devices, such as motors and motor circuits, should be tested at 675V AC. Electronic devices should be tested at the voltages specified in the instruction manual for the electronic device).

In accordance with ANSI C37.20.1, 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.

⚠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 circuit breaker in the TEST position make the following tests on each unit:
   - A. Trip and close the circuit breaker manually, and electrically if breaker is electrically operated.
   - B. Use a static trip test set or other suitable source of current to trip the circuit breaker through the static trip device.
   - C. If protective relays are provided, trip electrically operated circuit breaker by passing sufficient current (or voltage, if applicable) through the coils of protective relays.
   - D. Trip and close electrically operated circuit breakers from any remote control locations.
   - E. Operate auxiliary devices (e.g., MOC or TOC switches) to confirm correct operation.
   - F. Test the phase sequence of polyphase high voltage circuits, particularly those used for motor starting.
   - G. Perform other tests and checks in accordance with the circuit breaker and trip device instruction manuals.
   - H. Test for correct phasing across the bus tie circuit.
4. Current transformer circuits are tested for continuity. As shown in **Figure 32**, with the switchgear installed but not energized, disconnect the "grounded" lead at the current transformer secondary terminal block connection, and pass a measurable amount of current not to exceed five amperes through the lead to ground. Pass sufficient current to observe operation of relays and instruments.

   Manipulate the instrument switches and observe the phasing. Repeat with each transformer. Do this for metering and relaying current transformers only - not tripping transformers.

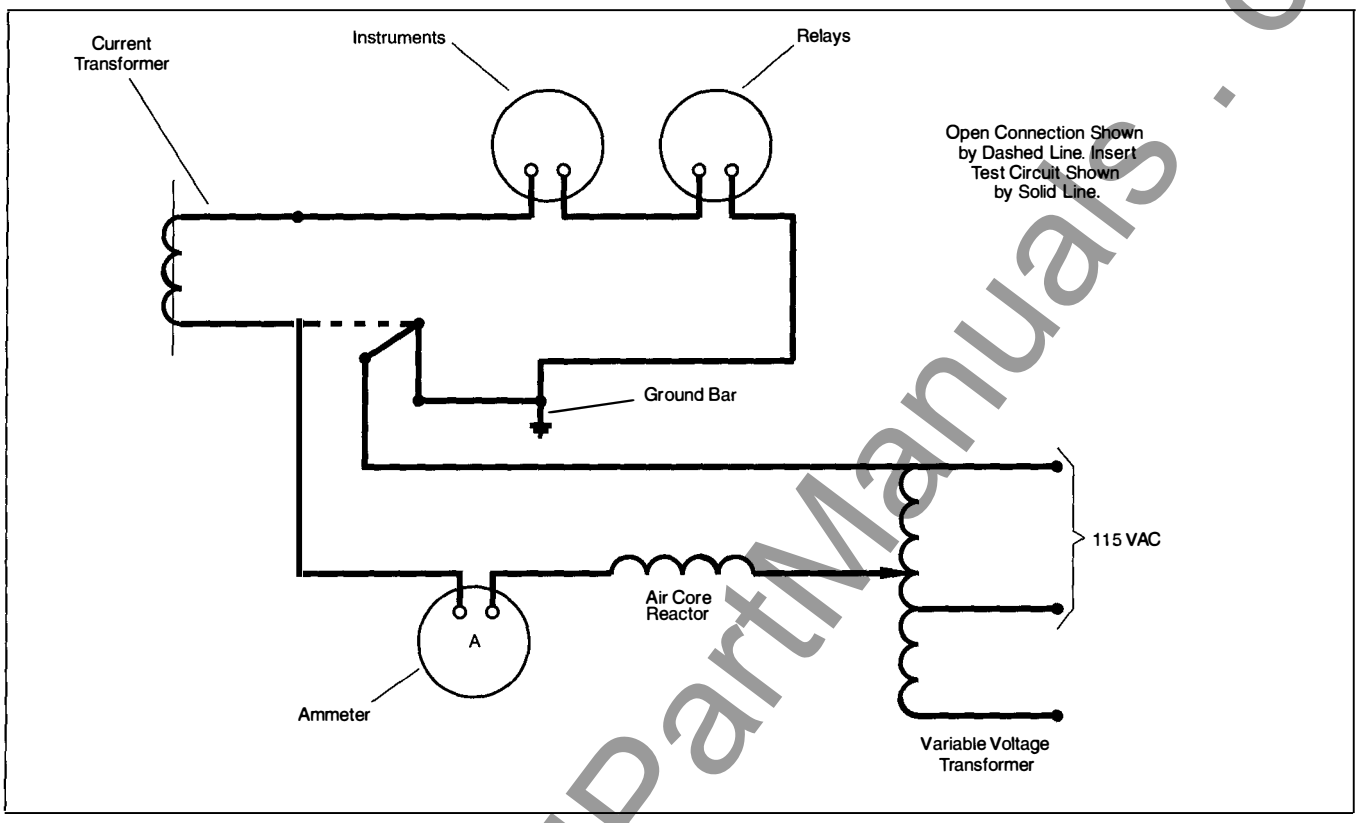


Figure 32. Current Transformer Testing

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 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 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 Types R or SR switchgear are operated under "Usual Service Conditions", maintenance and lubrication is recommended at five year intervals. "Usual" and "Unusual" service conditions for Low Voltage Metal-Enclosed Switchgear are defined in ANSI C37.20.1. 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, serious personal injury, and property damage.

Do not work on energized equipment.

Always de-energize and ground the equipment before working on the equipment.

Maintenance should be performed only by qualified personnel.

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.**

Recommended Hand Tools
The switchgear uses standard SAE fasteners, although some devices (particularly instruments), may have metric fasteners.

Recommended Maintenance and Lubrication
Periodic maintenance and lubrication should include all the tasks shown in **Table 1**.

⚠WARNING

Failure to properly maintain the equipment can 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 1** must be performed regularly.

Table 1. Maintenance Tasks

1. **Before any maintenance work is performed within primary compartments, make certain that the equipment is completely de-energized, tested, grounded, tagged and 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 backfeed 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, and clean as needed.
   - 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. Check wiring for loose connections.
   - K. Examine automatic shutters (if any) for proper operation.
   - L. Check MOC and TOC switches (if provided) and their operating mechanisms for proper operation, and check their contacts.
   - M. Examine all safety interlocks for correct function.
   - N. Perform maintenance of circuit breakers as outlined in circuit breaker instruction manual.
   - O. Check space heaters and thermostat (if equipped) for proper operation.
   - P. Maintain other equipment per the relevant instruction manual requirements.
   - Q. Lubricate mechanisms, contacts, and other moving components.
   - R. Replace, reassemble, re-insulate, return all items to proper operating conditions and remove grounds prior to energization

The list of tasks in **Table 1** 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
Lubrication is most essential in maintaining the performance of switchgear and should not be treated indifferently. It will aid in protecting the switchgear from corrosion and wear, and will help assure that all operating mechanisms work freely. Lubrication intervals should be adjusted to suit the operating conditions. Lubrication is required at more frequent intervals under severe operating conditions or when exposed to contaminated atmospheres.

Siemens electrical contact lubricant, part no. 15-171-370-002, is not only an excellent contact lubricant, but also a fine general purpose grease for mechanical parts. This grease has very good thermal stability to cover the wide range of conditions to which switchgear may be exposed, and aids in protecting silver plated contact surfaces from tarnish. The following areas or parts must be lubricated:
1. Wiping electrical contacts
2. Mechanical devices
3. Circuit breakers

Wiping Electrical Contacts
The silver plated contact surfaces of primary disconnects and secondary disconnects, when properly lubricated, will greatly outwear contacts without grease, and will be protected from severe tarnishing. After wiping off old grease, apply a thin film of electrical contact lubricant 15-171-370-002 periodically. Avoid getting contact lubricant on insulating materials.

Important: If optional shutters are included with the equipment, refer to the section of this manual, and study the operation of the shutter before attempting to open the shutter. The shutter must be open in order to allow lubrication of the primary disconnects in the switchgear.

⚠DANGER

Hazardous voltages.

Will cause death, personal injury, and property damage.

Do not place hands or tools beyond the edge of the shutter, or open the shutter, without determining that all circuits are de-energized and grounded.

Electrical contact lubricant should be applied to:
1. Primary disconnects
2. Secondary disconnects
3. MOC switch contacts
4. TOC switch contacts

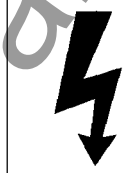
In extremely corrosive atmospheres, it is recommended that a heavier coating be applied (0.03-0.06 inches thick). With this heavier coat, grease will migrate more readily to areas wiped clean by contact finger movement.

Mechanical Devices
After wiping off old grease, moving parts should be lubricated with Anderol 732 fluid grease, available from Siemens in a spray can, Part No. 15-172-816-058. Siemens electrical contact lubricant is also suitable. The following parts or assemblies should receive a light coating of lubricant:
1. Hinges
2. Shutters (if present), except do not lubricate the aluminum gear hinge of the metal shutter
3. MOC switch operator
4. TOC switch operator
5. Traveling crane (hoist) — apply a heavy coat of lubricant to the gears

DO NOT LUBRICATE slide rails on left side and right side of circuit breaker or fuse carriage compartments. The rails do not require lubrication, as dirt and grit could become embedded in grease and drawn into inaccessible areas.

Circuit Breakers
Circuit breakers should be lubricated as described in the instruction manual for the circuit breakers.

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.**



⚠DANGER

Hazardous voltages.

Can cause death, personal injury, and property damage.

Reduced dielectric strength of insulation caused by use of improper solvents can cause insulation failure. 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, 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 material in a layer .03-.06" (1-2mm) thick. On electrical contacts, use only Siemens Electrical Contact Lubricant, Part No. 15-171-370-002. Other mechanisms should be lubricated with Anderol 732, Part No. 15-172-816-058. 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 or plastic as soon as possible.

Equipment Surfaces
Inspect the painted surfaces and touch up scratches as necessary. Touchup paint is available from Siemens.

SIEMENS

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