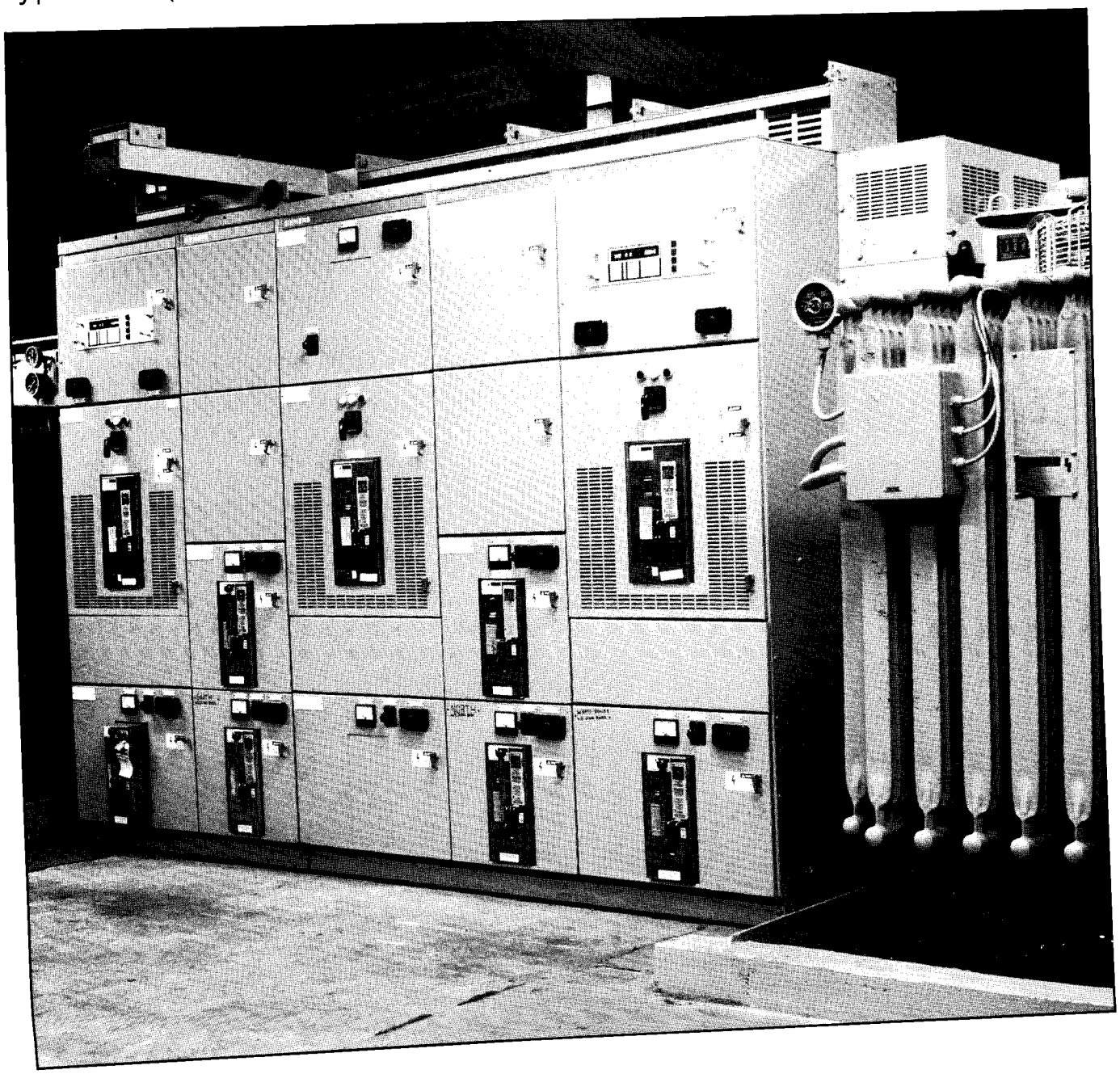
SIEMENS

Low Voltage Metal-Enclosed Switchgear

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

Instructions
Installation
Operation
Maintenance
SG-3088



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 of each cubicle within a shipping group. The maximum shipping group is five cubicles excluding the transition box to liquid transformers if involved (this is not considered a cubicle). Lift points on the equipment are labeled and lift connections are to be made only at these points. (See Figure 6). On outdoor switchgear it will be necessary to temporarily remove the outdoor roof channels (Figure 10 and 11) for access to the lift holes. Be sure to replace the roof channels immediately after lifting to make the equipment weather resistant. The angle of the lift cable relative to a horizontal plane must not be less than 45°. (See Figure 6.) Also note the tension on each cable of a four cable lift at 45° 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 become more severe and could damage the switchgear.

Make certain the crane used is of adequate height and capacity. If equipment is shipped without breakers being installed in their compartments a safe estimate of required crane capacity would be 3000 lbs. multiplied by the number of cubicles to be lifted. If breakers are installed for shipment, use 4000 lbs. multiplied by the number of cubicles to be lifted.

Use of 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 skids are removed. If pipes are used as rollers they should be of sufficient diameter that they will roll with ease without digging into skids. In placing rollers under skids or removing them it will be necessary to lift switchgear shipping group by either jacks or fork lift truck. If fork lift truck is used 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. On outdoor switchgear, lift only at points indicated in Figure 7. At these points on outdoor equipment there is a rigid support base suitable for jacking.

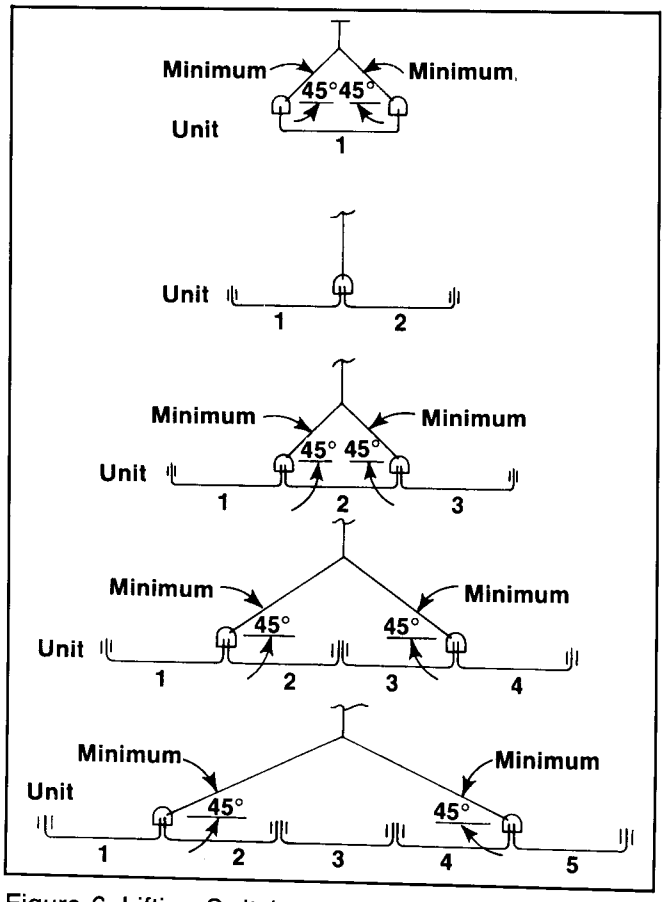


Figure 6. Lifting Switchgear Indoor and Outdoor

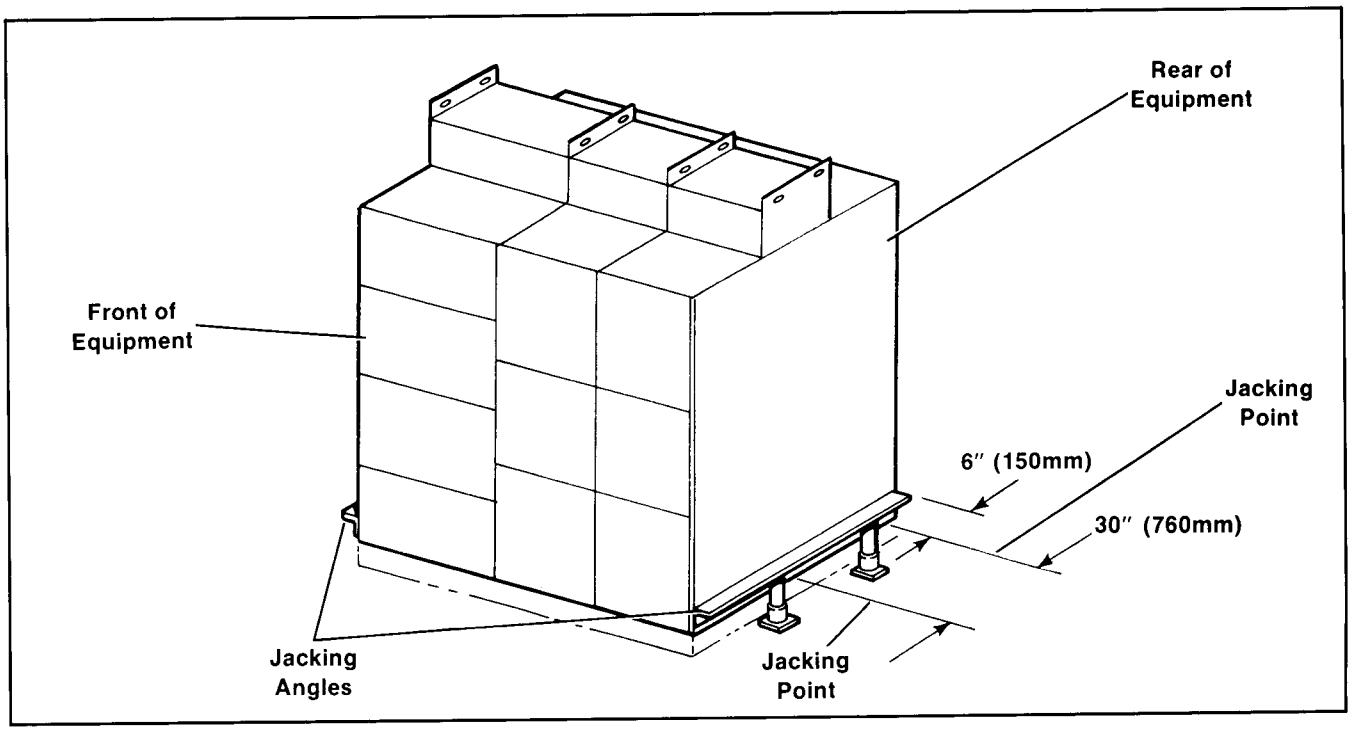


Figure 7. Jacking

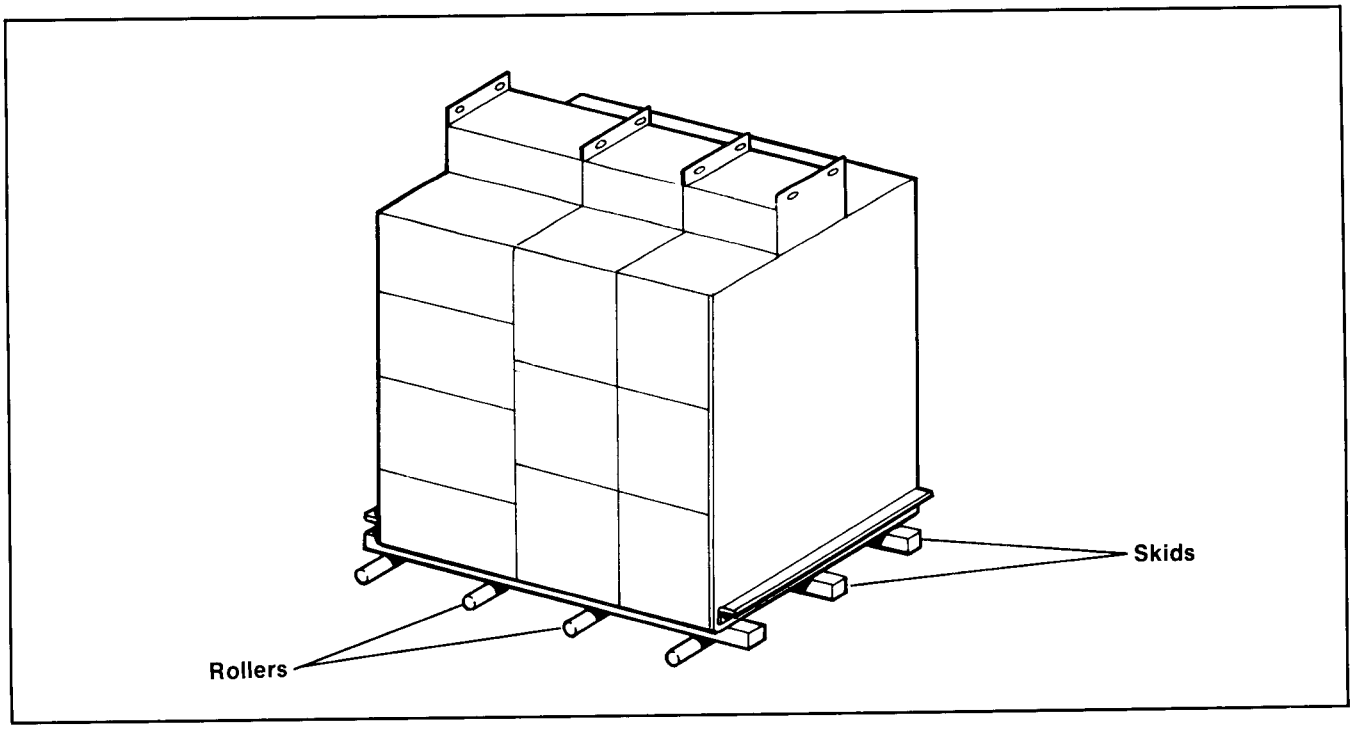


Figure 8. Use of Rollers

Indoor Switchgear

When switchgear is not to be erected immediately, it should be uncrated and inspected for damage within fifteen days of receipt and stored in a clean, dry location. Indoor cubicles are neither weather resistant nor dip resistant; therefore, they should be stored indoors. If they must be stored outdoors, or if they are to be kept in a humid , unheated area, provide adequate covering and place a heat source of approximately 500 watts output within each cubicle to prevent condensation. Space heaters are not standard equipment on indoor switchgear. If storage is for an extensive period of time lubricate moving parts such as hinges, shutters, etc. to protect from possible oxidation. Do not lubricate slide rails, or aluminum hinge gear on shutter!

Outdoor Switchgear

When storing outdoor switchgear in an area exposed to weather or humid conditions, the space heaters provided must be energized. Access to heater circuit is gained through rear doors. See wiring diagram for terminal identification. If storage is for an extensive period of time lubricate moving parts such as hinges, shutters (but not the shutter hinge gears) and other moving parts. Do not lubricate slide rails, or aluminum hinge gear on shutters!

Introduction

Prior to installation of switchgear read this instruction book and drawings mailed at an earlier date, such as general arrangement, three line diagram, schematic diagram, master wiring diagram, cubicle wiring diagram, installation instruction drawing, panel arrangement and panel arrangement bill of material, nameplate engraving list and accessories drawing. In reading this instruction book special attention should be given to "Foundation" already covered on Pages 3 and 4. Check the foundation which at this time should be complete. It must conform to the requirements described in this book and the general arrangement drawing.

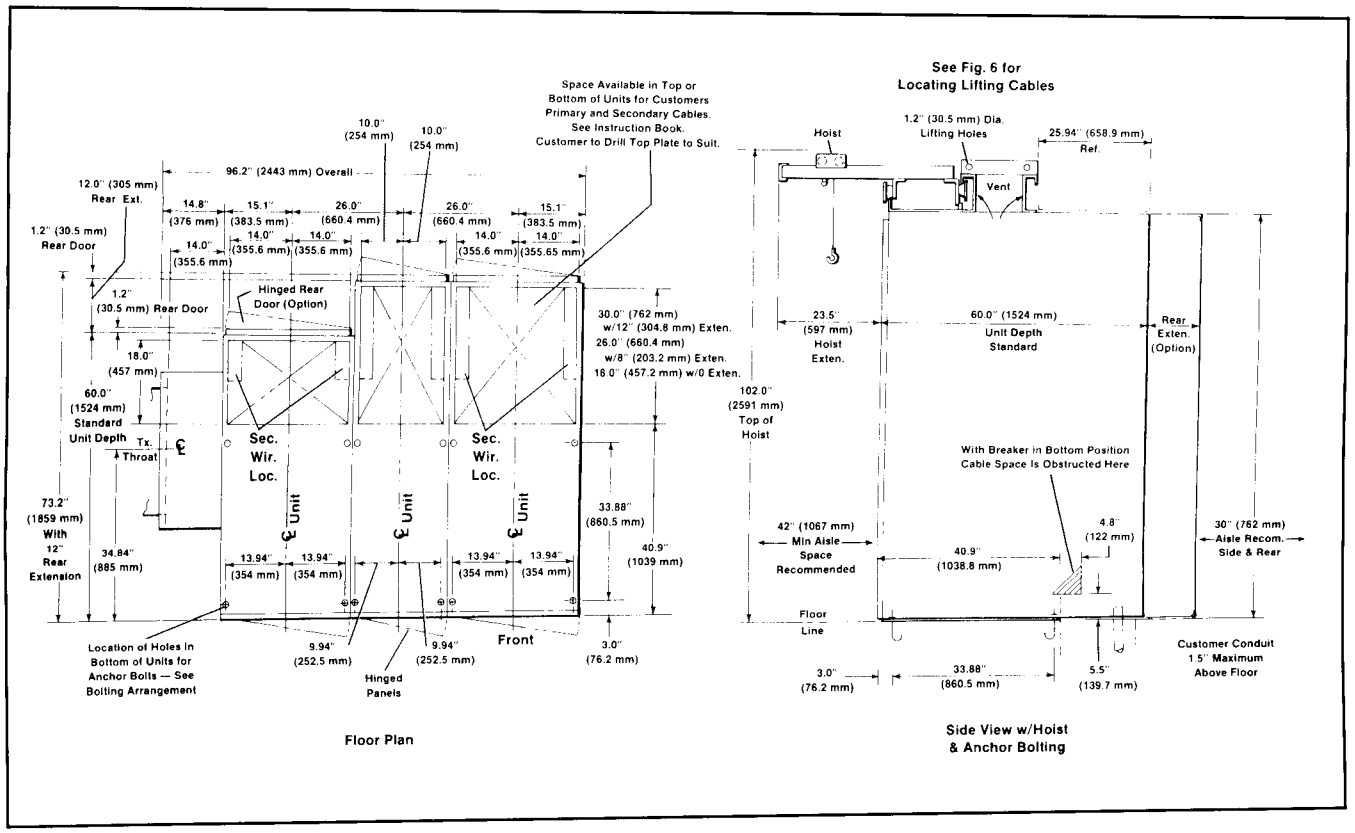


Figure 9. Typical Indoor Floor Plan and Side View

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, cubicle numbers and their location within the switchgear line-up. Sections are assembled and wired in accordance with the arrangement as in final installation.

As previously covered under "Foundation," mounting surfaces, sills, slab, piers or pilings must be level and in the same plane. Also, conduits must be properly located and perpendicular to such a degree that they will clear the floor plate cutouts. Mounting surfaces must be swept free of stones, chips and other debris which might impede rollers or leveling of switchgear.

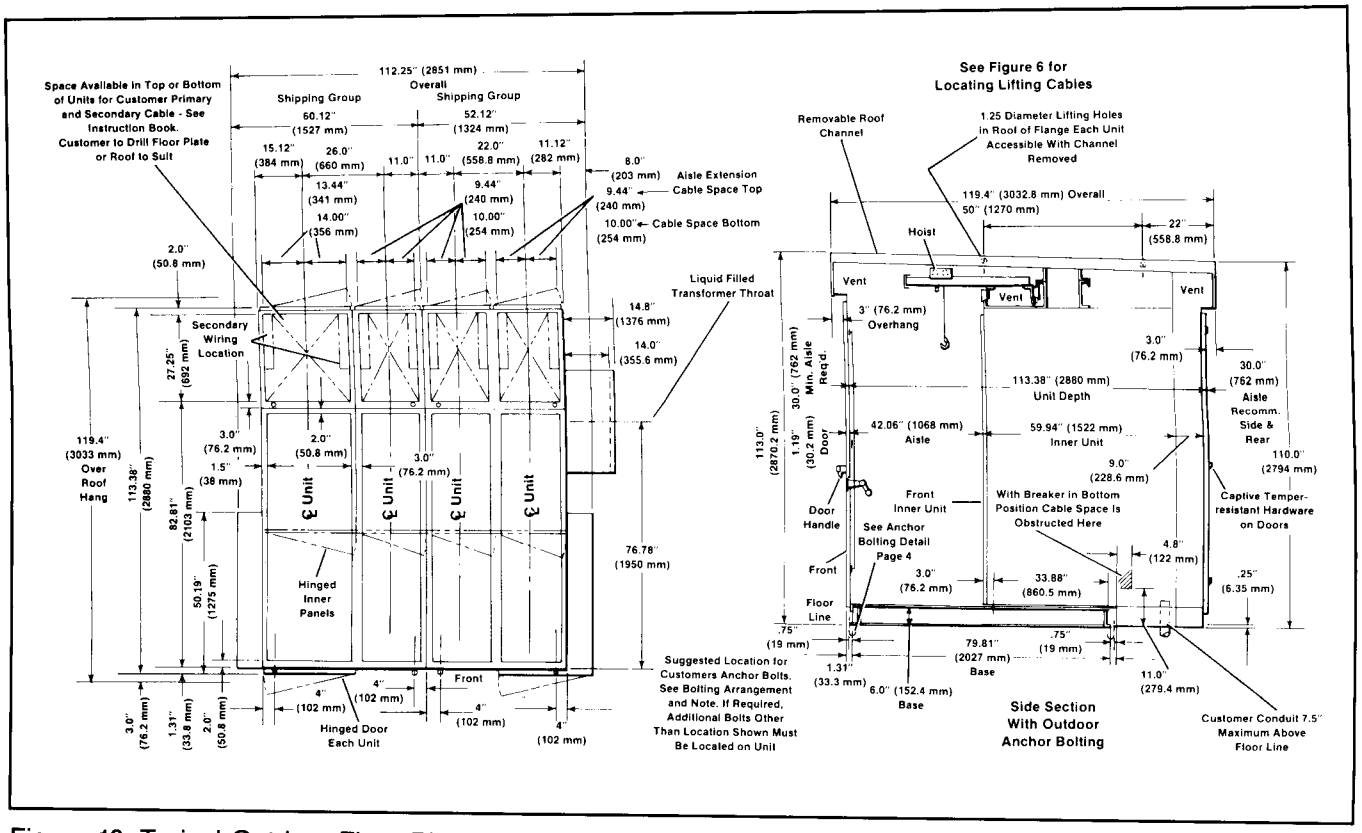


Figure 10. Typical Outdoor Floor Plan

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 transformer is part of the installation and in its correct location, the switchgear is positioned next to the transformer as shown in Figure 16. the shipping section should be kept high enough to just clear any conduits and then moved toward the transformer to the dimensions shown on the general arrangement drawing. At the same time align switchgear with the anchor bolt locations and conduit locations below. 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.

Plumbing and Leveling Instructions

As described under "Foundation," Pages 3 and 4 of this instruction book, the floor, sills, piers, or pilings are to be true and in a level plane, and within the area of the switchgear in the case of a slab or floor there are no projections such as pebbles in the concrete protruding above this plane. This being accomplished there should not be any problem in plumbing or leveling the switchgear.

Plumbing

To make certain that there has been no distortion of switchgear in shipping or handling each shipping section should be checked with a plumb line after it is resting on its 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 greater than 1/8" (3.2mm) usually indicates an uneven base and shimming may be required.

Leveling Indoor Switchgear

Examine each cubicle through its 4 anchor bolt holes, those shown on the general arrangement drawing, to make certain that in the area of the anchor bolt the cubicle is in firm contact with the mounting surface. In the absence of 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 with a thickness determined by the existing requirement or attained by stacking. Tighten anchoring hardware, and check for level. If line-up consist of more than one shipping section, the next section should be moved into place being certain that front panels are in line with those of the first section. Repeat the same plumbing as done on 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. Tighten 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 indoor. When resting on its permanent foundation cubicles should be plumb within 1/8" (3.2mm). Unlike indoor the equipment is anchored through the use of studs or "J"-bolts grouted into foundation and with clamp washers gripping the switchgear base. Examine area adjacent to each anchor stud 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 contact with the mounting surface of the slab, piers or pilings they must be brought into contact by use of shims. These shims will prevent distortion of the base when anchor hardware is drawn tight. With all points of contact checked and shipping section properly located tighten anchor hardware. If there are additional shipping sections each one in sequence should be aligned with that previously anchored. Check foundation contact, plumb and add shims as required in same manner as first group installed. Draw the anchor hardware tight, install and tighten the hardware bolting the sections together and proceed to the next section, if any. If the general arrangement drawing has been followed there should not be any shipping split (between two shipping sections) which is unsupported by pier or pilings. Install roof channels, one for each shipping split, as shown in Figure 11.

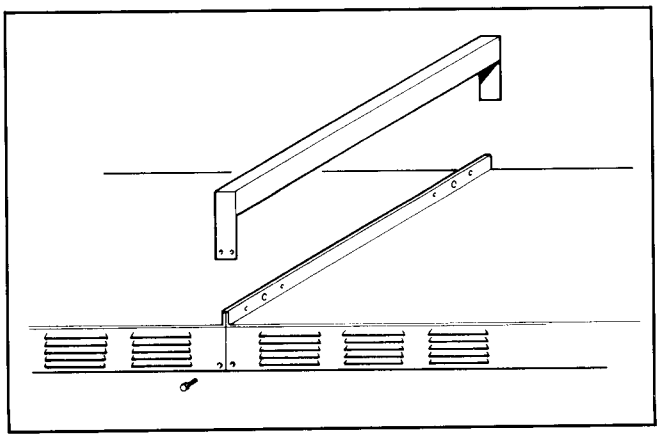


Figure 11. Outdoor Roof Channels

Installation of Traveling Crane

DANGER

HEAVY WEIGHTS

Traveling crane must be installed per the following instructions and Figure 12 with all hardware properly tightened.

Failure to do so may result in property damage or serious personal injury.

The traveling crane is furnished as standard equipment on outdoor switchgear and is shipped installed. On indoor switchgear the traveling crane is an optional item and only furnished when specified. When specified on indoor switchgear the crane is shipped loose with the accessories. To mount this crane it is necessary to remove stop angles from one end of the track, roll the crane onto the track and replace the stop angles. See Figure 12.

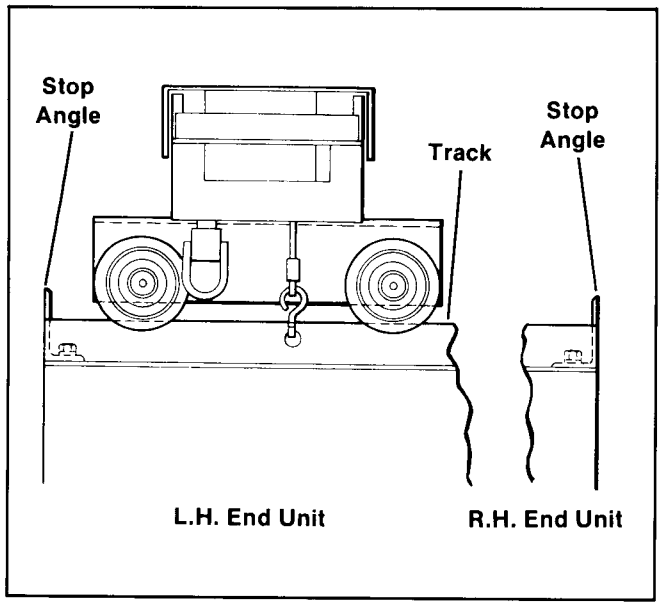


Figure 12. Traveling Crane

Safety Instructions

Before any work is done within the cubicle compartments make certain primary circuits are de-energized, tested, grounded, tagged or properly identified, and released for work in an authorized manner.

Cleaning

When switchgear installation is complete, but prior to energizing or installing circuit breakers all cubicle compartments must be thoroughly cleaned by vacuum or other means to make certain they are free of construction dust, chips or other debris. Do not use solvents without reading "Cleaning of Insulation" under maintenance.

Primary Connections

BUS BARS AND CONNECTORS

Bus bars, risers and various connectors may be of aluminum or copper as required by the specification of each order (Fig.13). When the specification calls for aluminum 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 as set forth by ANSI Standards, C37.20. At shipping splits and termination points the tin plated aluminum bars have holes for 1/2" hardware for coupling of splice plates or connectors to other equipment. When the specifications require a copper bus system 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.

Bolted Bus Joints

When bus joints are field assembled the following procedure shall be followed for both copper and aluminum conductors:

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 preventing compounds even where aluminum buses are 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 preventing compound.
4. For method of bolting joints, see Figure 14, and follow hardware tightening instructions.

Hardware Note

All bus joint hardware furnished is zinc plated, dichromate treated high strength steel. Cap screws are 1/2-13 SAE Grade 5, nuts are SAE Grade 2, hexagon, heavy. Sizes and grades other than above are not to be used. Tighten 1/2-13 hardware to within a torque range of 50-75 ft. lbs. (67.8 to 101.7 N·m). Should specifications call for special hardware as silicon bronze or stainless steel consult factory for proper torque range. For copper arrange hardware as shown in Figure 15 with flat washer on each side of joint and 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

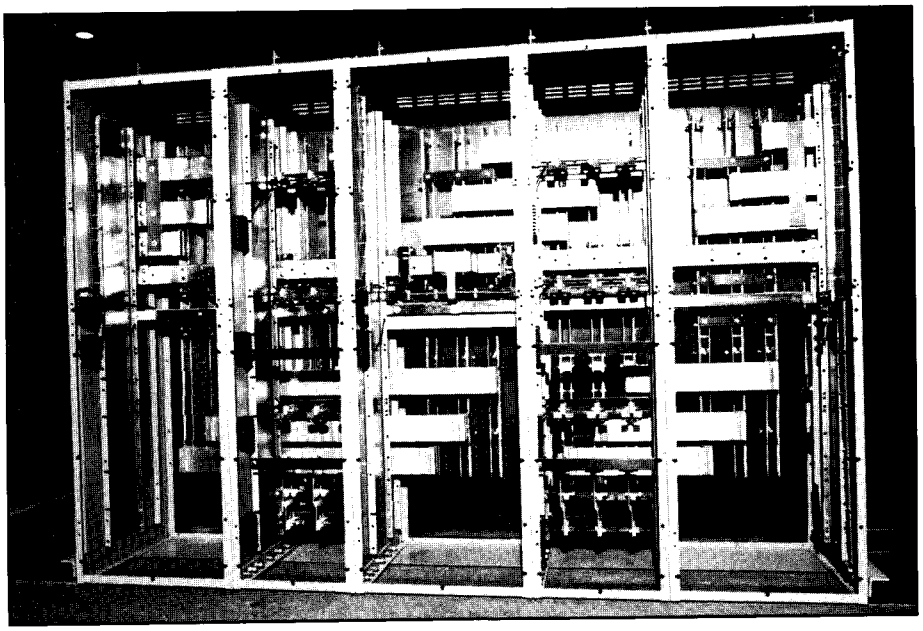


Figure 13. Bus and Risers

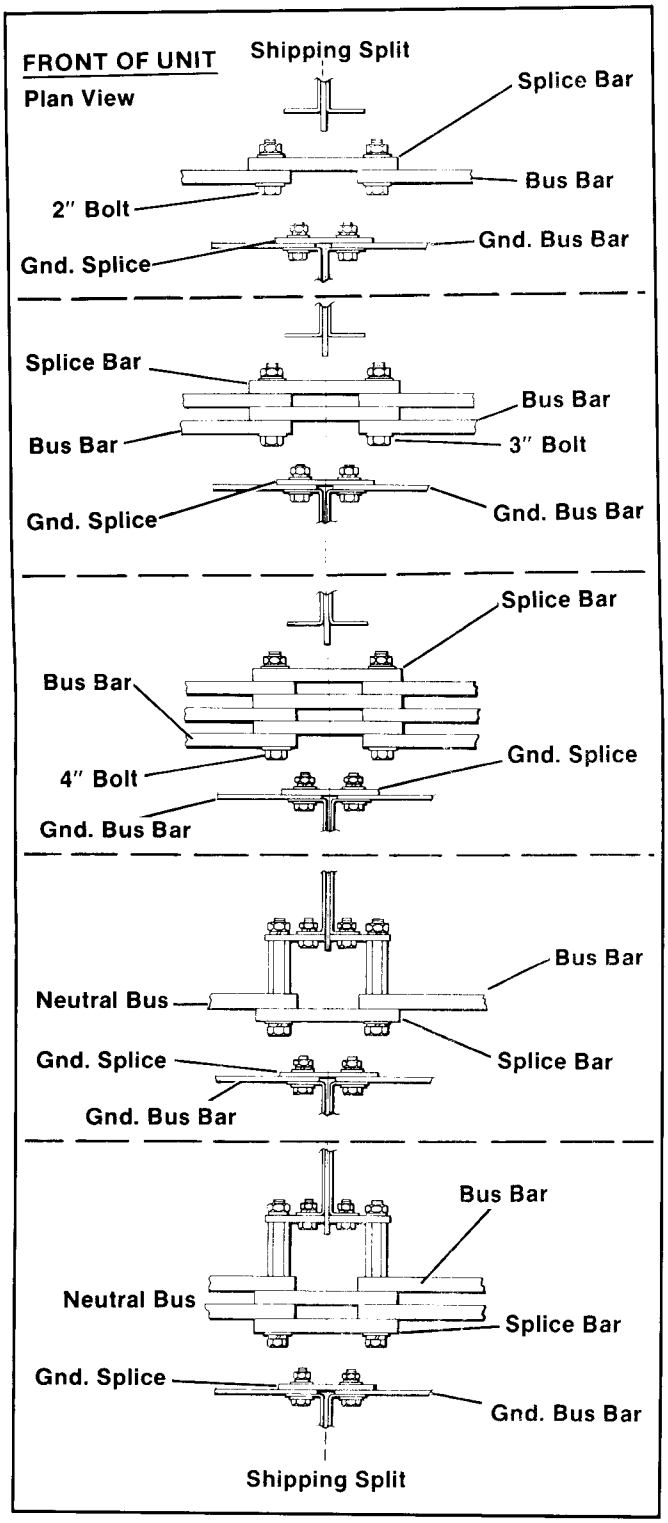


Figure 14. Bolted Bus Joints

replaced by a single "Belleville" spring washer. The concave side of this spring washer is placed against the bus or splice plate. Torque requirements are the same as described above. Do not exceed the torque range given. Forces within this range will produce a low resistance joint without cold flow or material (Fig.15).

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

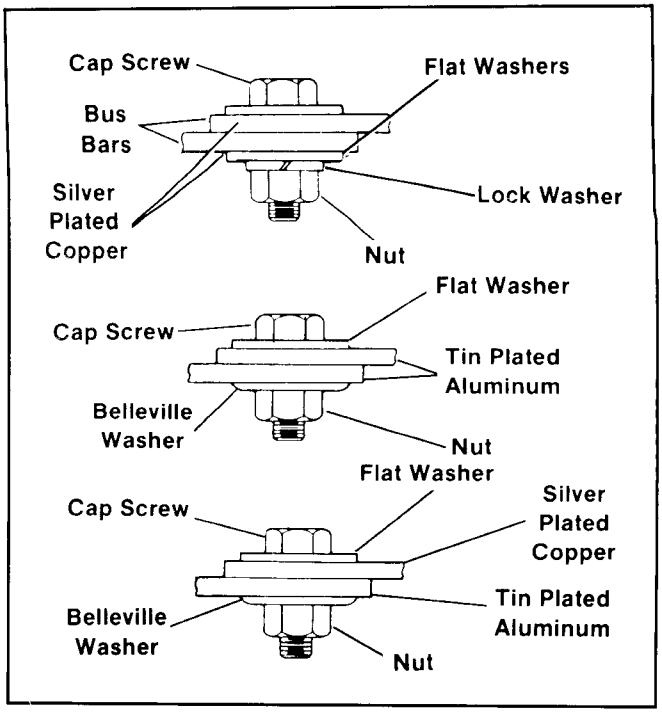


Figure 15. Bus Joint Hardware

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. 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 connections to dry type transformers are made within the transformer.

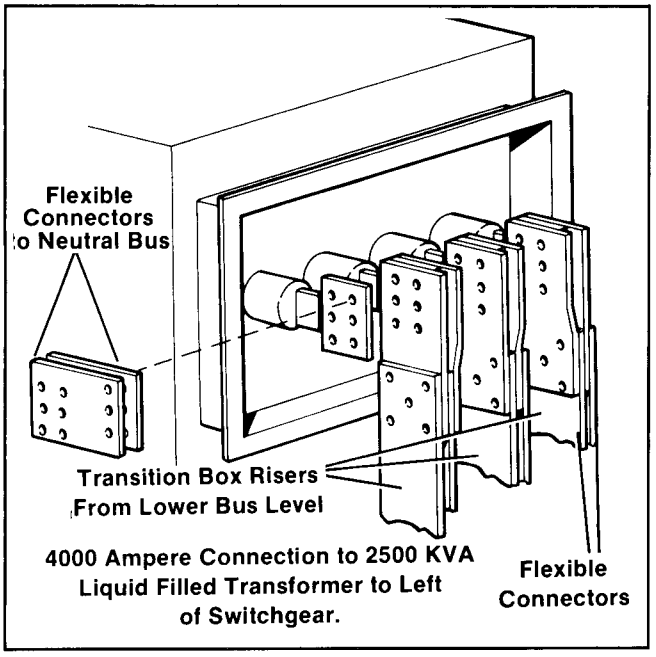


Figure 16. Transformer Connection from Lower Bus Level (Upper Bus Similar)

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 reconnect the flexible connectors to the transformer terminals.

Primary Cable Connections

PRIMARY CABLE CONNECTIONS

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

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

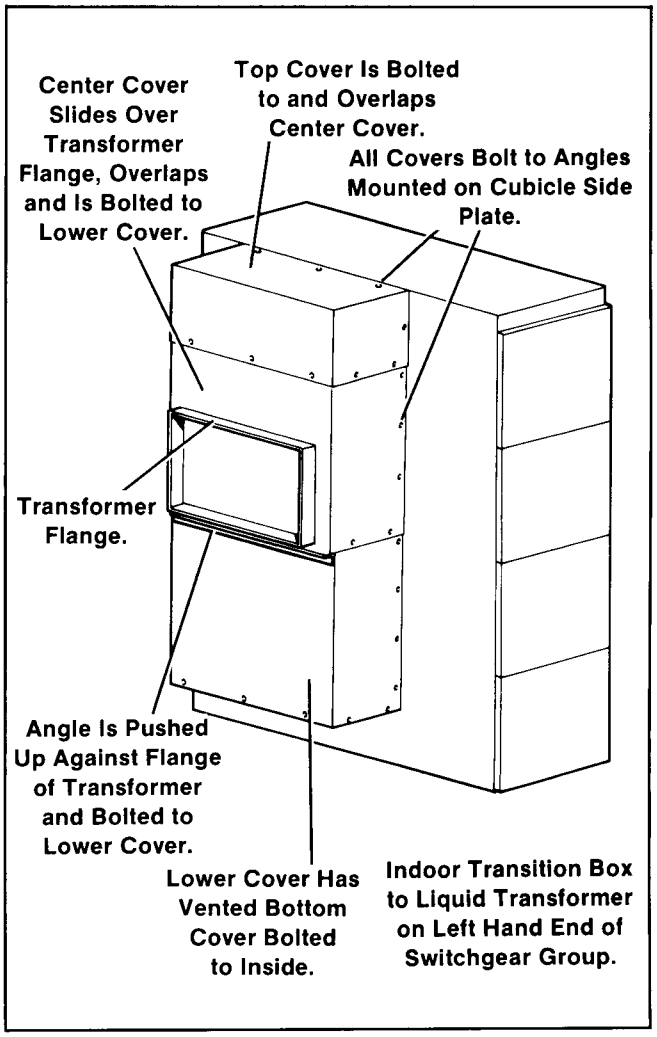


Figure 17. Transformer Hood

to cable supports to relieve strain on termination. If cable entry is from above, customer is to drill top plate or roof to suit. If cable entry is through the roof, install weather seal.

Before the cable connections are made, phase rotation will have to be considered (refer to Phasing Out under Inspection and Testing, pages 29 and 30).

Control Wiring

Terminal blocks are provided in the rear of the switchgear for customers' control wiring connections. See master wiring diagram for wire designations. Intersectional wiring at shipping

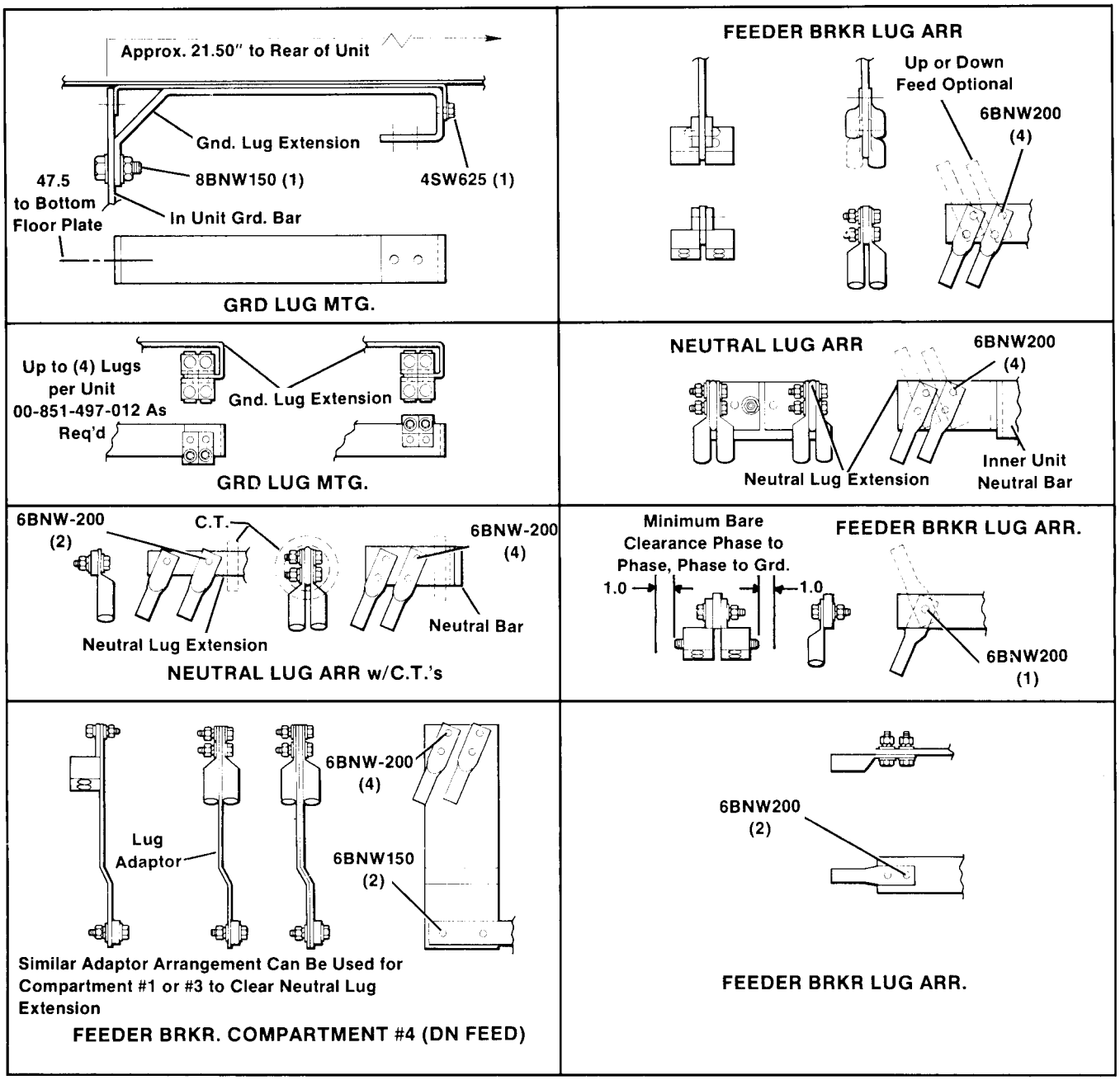


Figure 18. Lug Arrangement

splits is connected and tagged as shown on master wiring diagram for customers' ease in field connection. On 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 customer in the field. On 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.

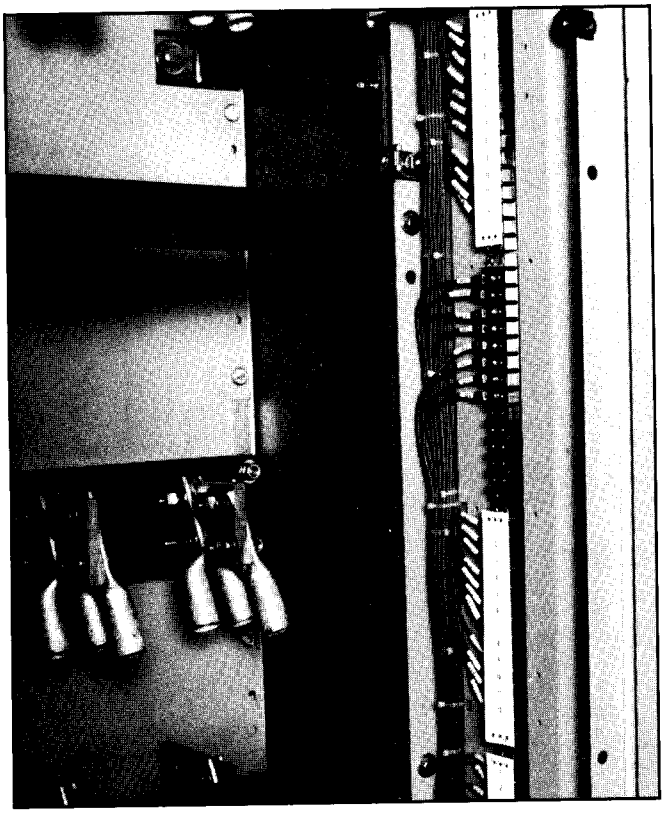


Figure 19. Control Wiring

Current Transformers

WARNING

Do not operate any current transformer with secondaries open circuited. To do so may cause property damage, burns or possible death.

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

Current transiormers for static trip device use are called "tripping transformers". They have a one ampere secondary and are not suitable for metering. They are mounted on the circuit breaker except when a ground fault trip 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 three-line diagram and may require that the neutral cables be connected to it with the cable lugs furnished.

Ground Connections

A common ground bus is incorporated in all cubicles for properly grounding the switchgear after installation. Each cubicle 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 customer in a reliable manner.

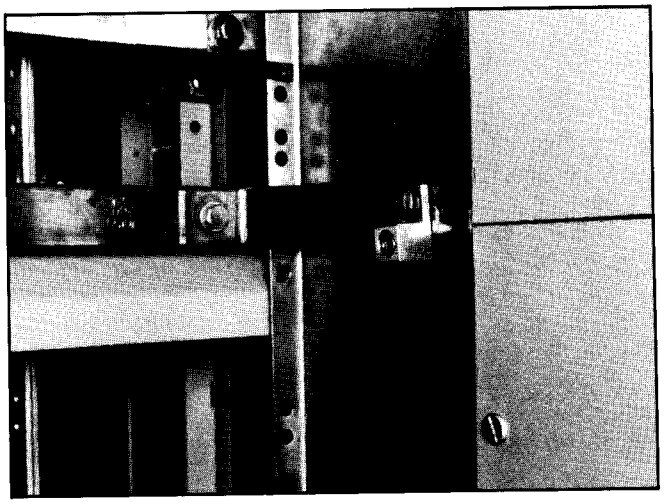
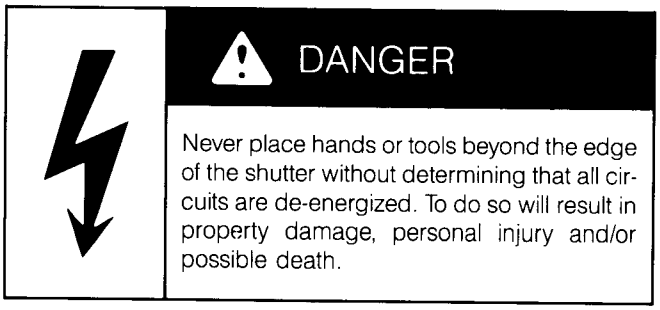


Figure 20. Ground Connection

Shutters

When shutters are specified as an optional item they are mounted to the breaker drawout compartment floor plate. The shutters automatically close when the breaker is removed from the compartment and open when the breaker is inserted.

When the breaker is installed on the sliding rails, and is pushed into the compartment the disconnect end of the breaker frame, which is engaged in the slide rail notch, 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. The above action has partially opened the shutter which folds outwardly at the gear hinge. Further inward movement of the breaker causes the lower portion of the breaker frame, that which hangs below the slide rails, 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 the primary disconnect studs.



⚠ DANGER

Never place hands or tools beyond the edge of the shutter without determining that all circuits are de-energized. To do so will result in property damage, personal injury and/or possible death.

If inspection or work must be performed behind the shutter (with the circuit breaker removed) 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 (see Fig. 21). 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 21-A.

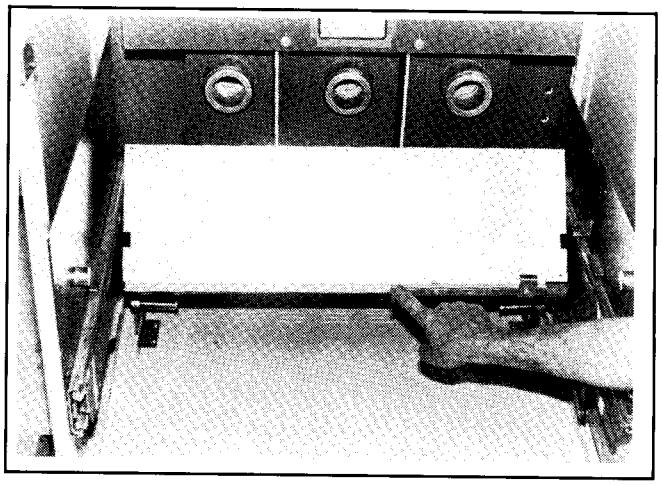


Figure 21. Metal Shutter

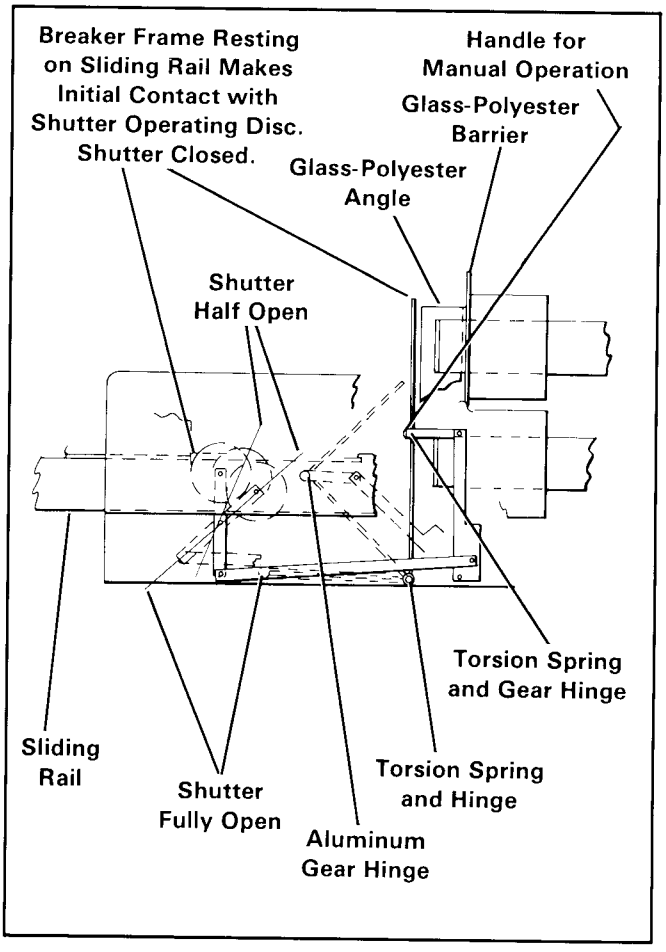


Figure 21A. Shutter Mechanism

(MOC) Switches

When mechanism operated cell (MOC) switches are specified as an optional item they are mounted on the righthand rear side plate 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 (Fig. 22A) 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 changes this movement to 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 four or eight contacts within the MOC switch may be individually set to be either open or closed as required (as an "a" or "b" switch). Contact segments are set 60° apart between open and closed stages. Contact segments are notched every 15° and may be adjusted in 15° increments about a hexagonal band on the switch shaft. When the switch cover plate is in place the contact segments are secured in their location and cannot be inadvertently dislodged. See Figure 22.

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

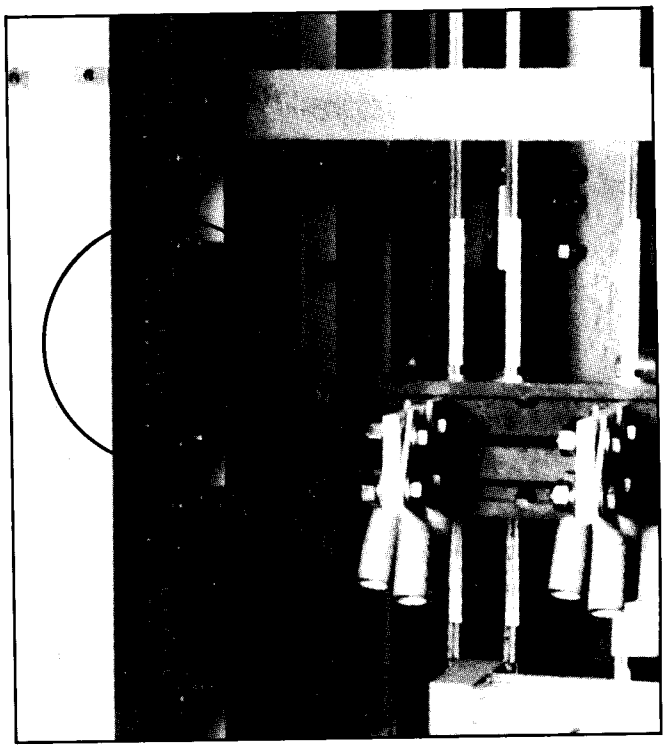


Figure 22. (MOC) Cell Switches

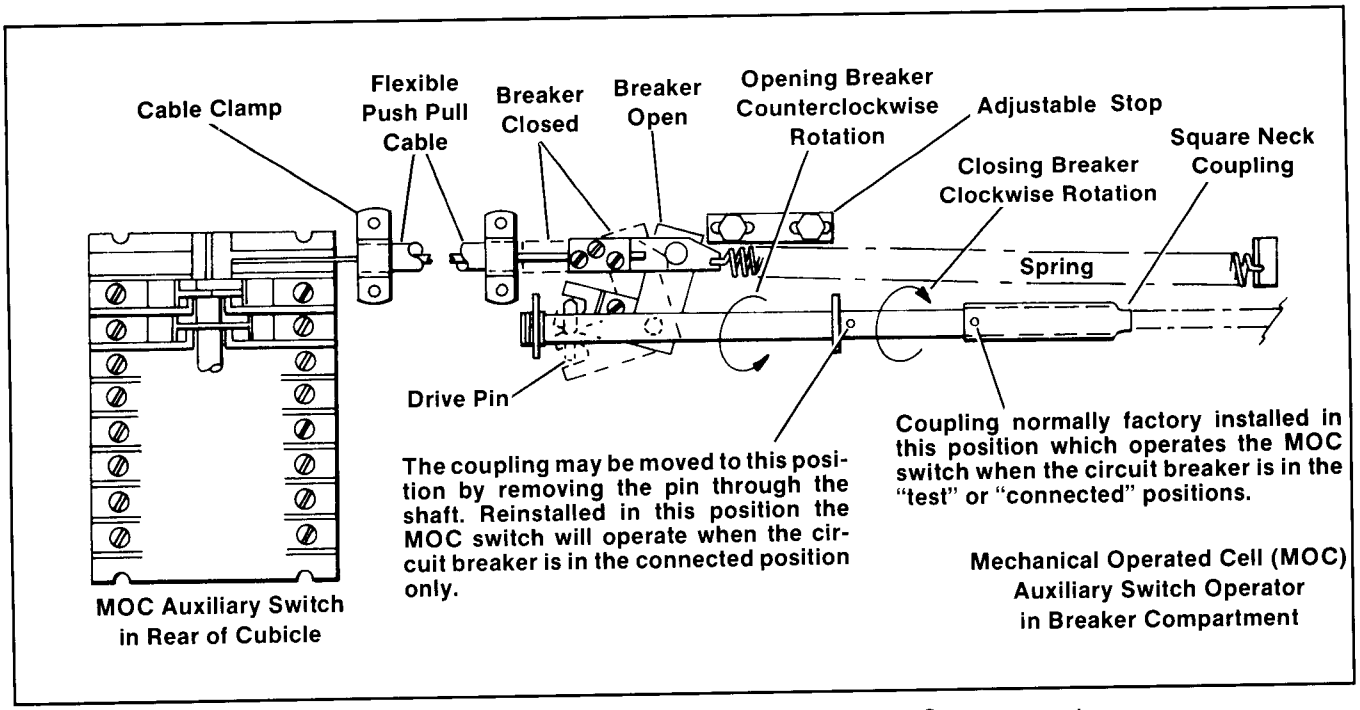


Figure 22A. Mechanism Operated Cell (MOC) Switch Operator in Breaker Compartment

(TOC) Switches

Truck operated cell (TOC) switches are similar to MOC switches except they reflect only the position of the breaker, that is, connected position or test-disconnect position. Opening and closing of the circuit breaker has no effect on this switch. This optional item is mounted on the right-hand side plate near the rear of the cubicle 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 may be 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 operation producing a quick make and quick break contact action within the switch. Figure 23A shows the cell switch operator in solid lines representing the condition when the circuit breaker is in the test position. The operator is an assembly of 3 small plates on which springs and linkages are mounted each performing their necessary function. Not shown on Figure 23A is a mechanism cover. This cover has been omitted as it would complicate the description of this device and it has no function in the operation. The 3 plates on which the various components are assembled are: a fixed plate which is attached to the cubicle, 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 raking the circuit breaker into the connected position,

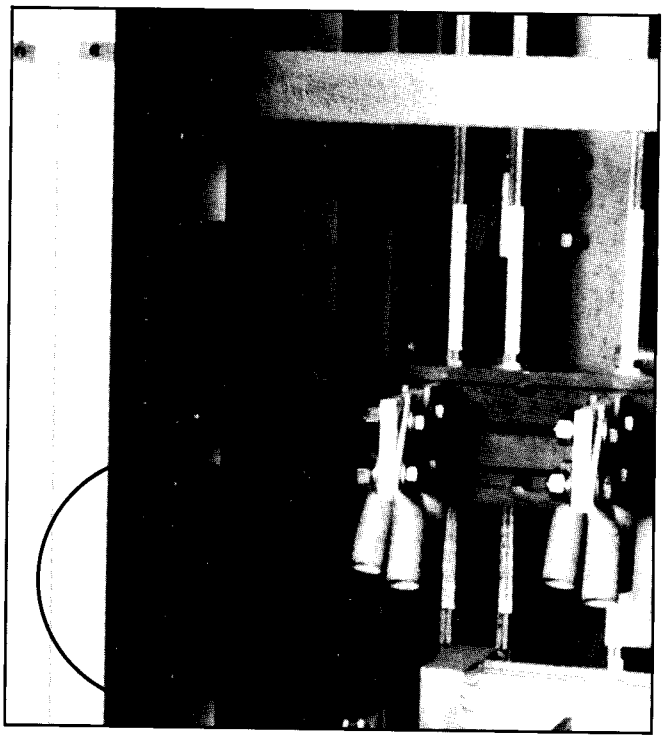


Figure 23. Truck Operated Cell Switch

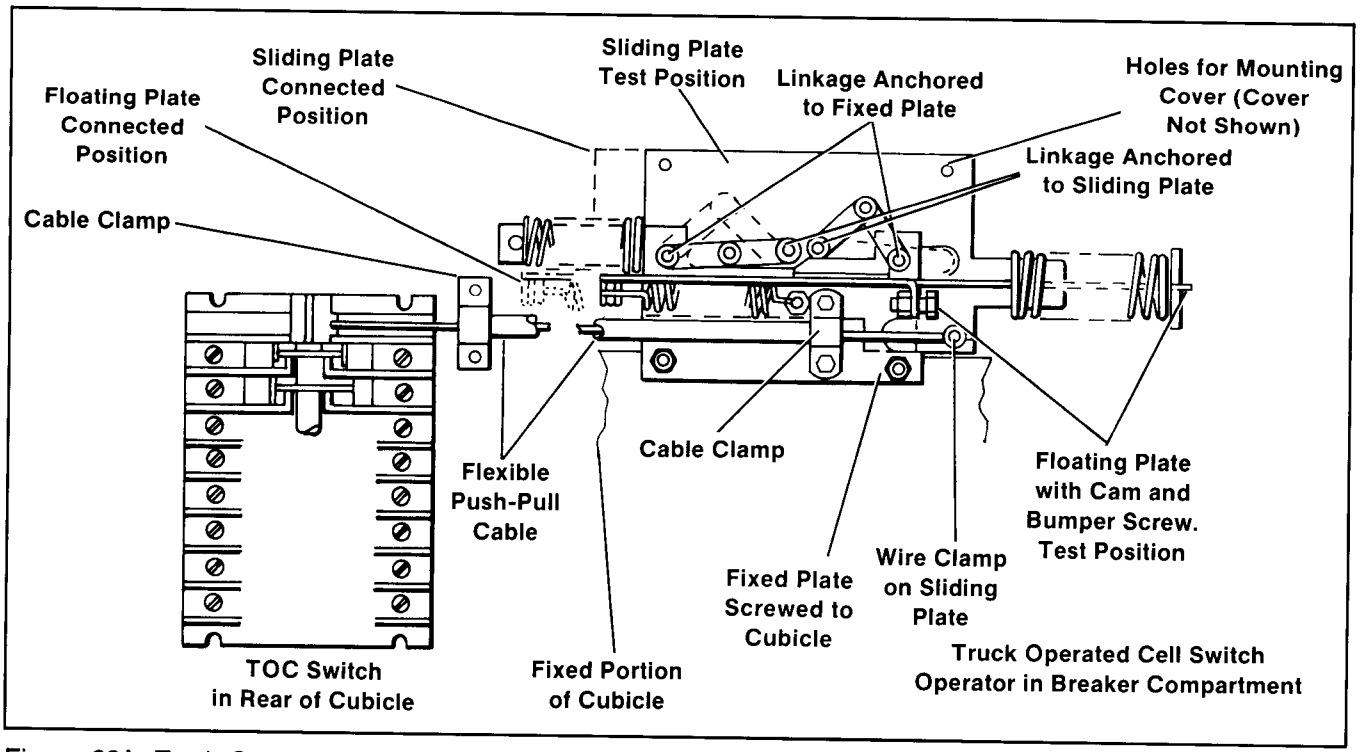


Figure 23A. Truck Operated Cell (TOC) Switch Operator in Breaker Compartment

and the other releases the energy of another charged spring when racking away from the connected position toward test position. Both toggle latches are linked between the fixed and sliding plates. In the process of racking the circuit breaker 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.

Key Interlock

Key interlock systems are available as an optional item. With lock bolt extended the breaker is held in a trip free condition and 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 and RFC-4000 ampere fuse carriages and their related breakers. These standard key locks may be incorporated with optional key interlock systems.

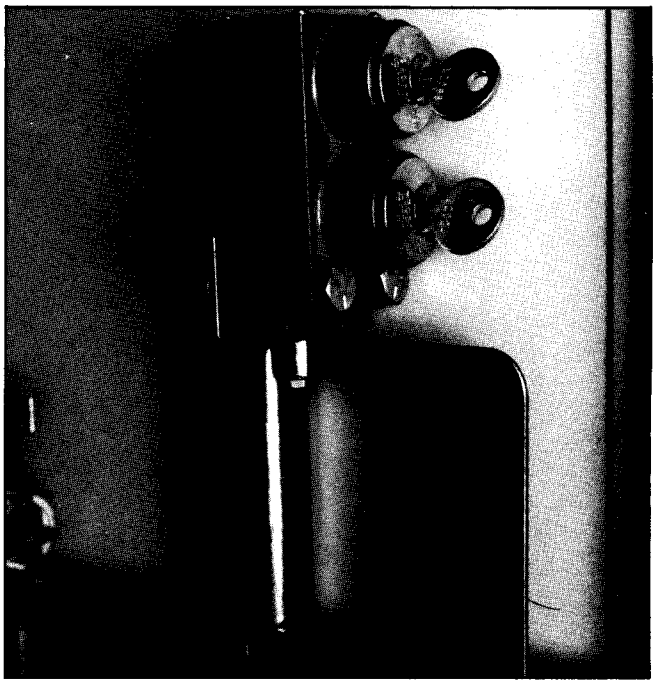
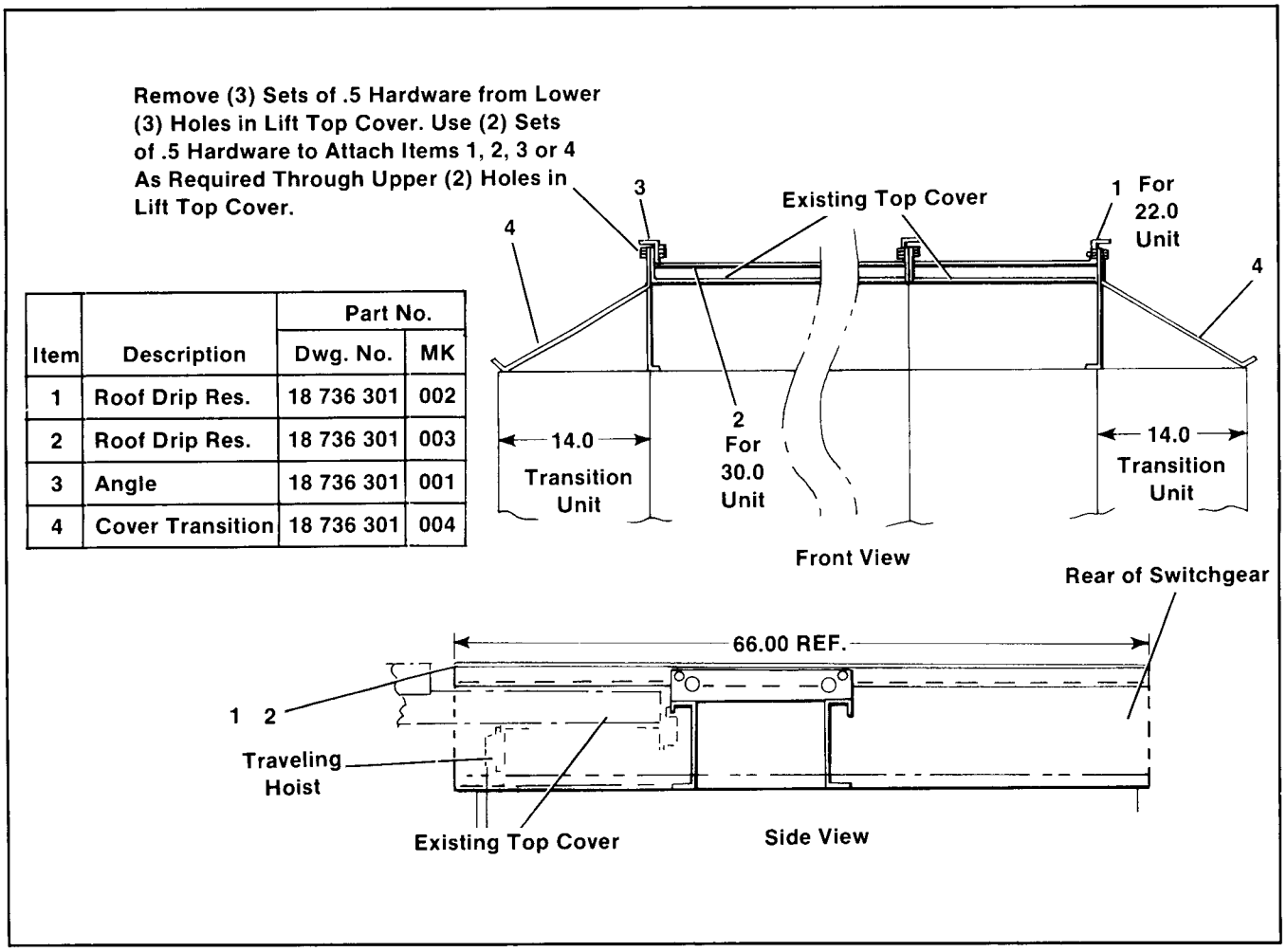


Figure 24. Key Interlock

Drip Resistant Switchgear (Indoor Option)

The purpose of the optional drip resistant shield is to prevent vertically falling liquid or dust from entering the swithgear. Before adding the drip shield or resistant arrangement the switchgear must be installed in its permanent location as lifting provisions will not be accessible after installation of the drip shield. The drip shield is a field installed arrangement of interlocking decks with an overhang beyond the switchgear and sloped downward toward the rear of the switchgear to shed any liquid. See Figure 25.



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 25. Drip Resistant Switchgear

General

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

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.

Ourdoor 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 cubicle. 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 line-up using the same procedure as discussed in the front part of this instruction book. Tighten anchoring hardware, make up primary and secondary connections, relocate the aisle wall door panel at the end of aisle and install the new panel, install the roof channel at the split, mount end plates and end channel.

Preparation

Circuit breakers are shipped in the closed position and are blocked to prevent accidental tripping during shipment. Remove all blocking and tags before opening circuit breaker. See Figure 26. Refer to circuit breaker instruction manual for detailed operating information, and lubrication of disconnect contacts.

1. Circuit breakers are shipped in the closed position and are blocked to prevent accidental tripping during shipment. Remove all blocking and tags before opening circuit breaker. (See Figure 26.) If breakers are shipped separately, the procedures for installation are outlined below. If breakers are shipped in their respective switchgear compartment, follow instructions in Figure 27 to remove from switchgear.

2. Circuit Breaker Preparation

   Refer to the circuit breaker instruction manual for detailed operating information. Lubricate disconnect contacts. (See page 32.)

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

⚠ CAUTION

Make certain that the hoist is properly lubricated before using, as outlined under Maintenance, Page 31.

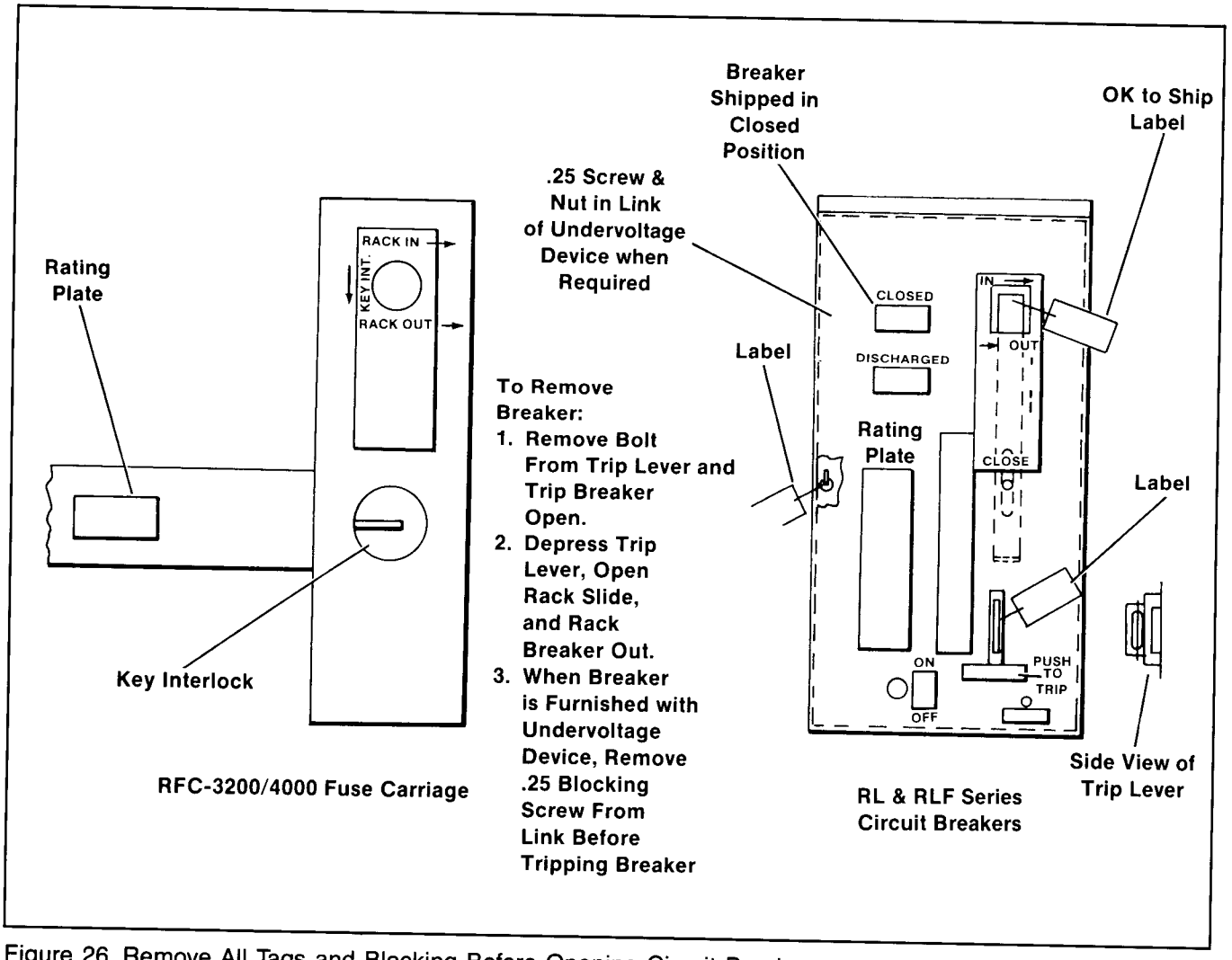
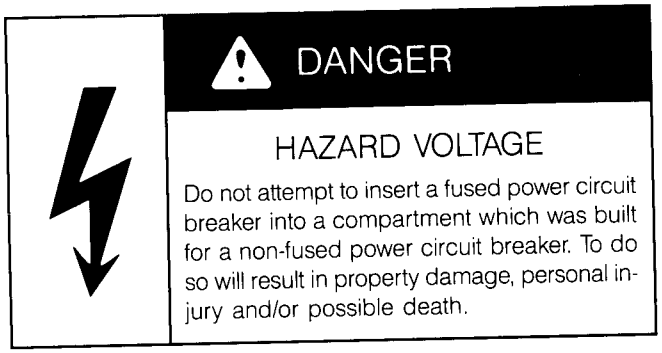


Figure 26. Remove All Tags and Blocking Before Opening Circuit Breaker

Compartment Identification

Before installing breaker in its compartment check the following items to be sure the circuit breaker is in the correct compartment. The three line diagram will show the following:

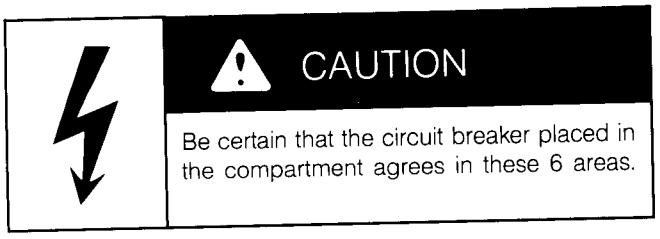


DANGER

HAZARD VOLTAGE

Do not attempt to insert a fused power circuit breaker into a compartment which was built for a non-fused power circuit breaker. To do so will result in property damage, personal injury and/or possible death.

1. Circuit breaker type example [RL-800 or RLF-800 (fused) RL-1600, etc.]
2. Trip transformer or sensor rating.
3. Static trip type (TS, TIG, etc.)
4. Type of operator (MO or EO) Manual Operation or Electrical Operation.
5. Wiring Diagram No.
6. Special Accessory (undervoltage trip, etc.)



CAUTION

Be certain that the circuit breaker placed in the compartment agrees in these 6 areas.

Placing Breaker In Compartment

Place circuit breaker in front of cubicle in which it is to be installed and attach lifting yoke (furnished with accessories). Attach crane cable to yoke 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 yoke and push the breaker into the compartment.

NOTE

On the heavier 3200A and 4000A breakers a snatch block (furnished on accessories) is connected to the lifting yoke to provide additional mechanical advantage.

Racking Breaker

Use the following sequence to rack breakers.

1. On electrically operated breakers, be certain that the control toggle switch on the front of the breaker is in the off position.
2. Depress red trip bar on front of the breaker, hold in depressed position and push the interlock slide to the left exposing crank racking screw. The breaker is trip free with interlock slide open and cannot be closed.
3. With 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 racking crank will move breaker through test position to connected position. In the process of 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 involved 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. 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 it's operating mode and no longer held trip free.

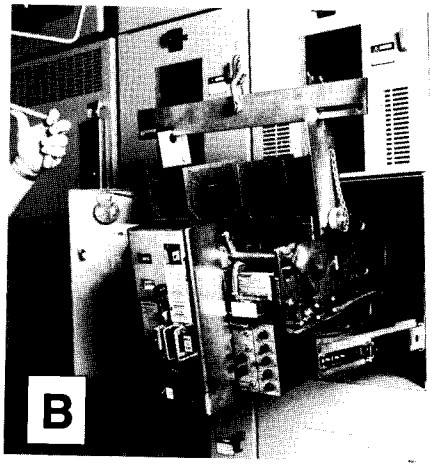
Handling Instructions

Place circuit breaker in front of unit and attach the lifting yoke.

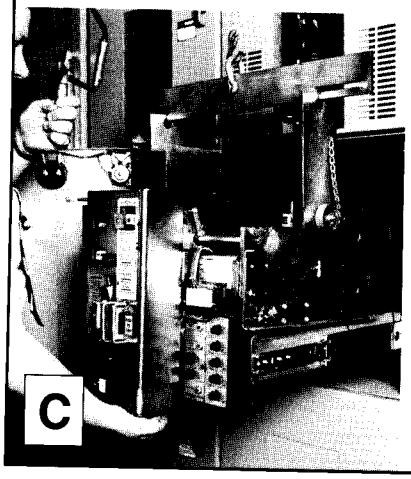
DANGER

HEAVY WEIGHTS

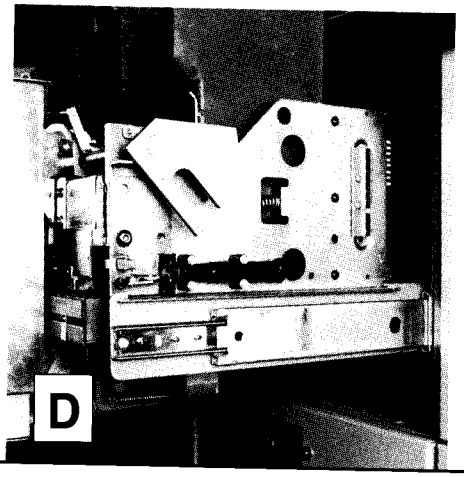
The use of the lifting device will place heavy weights overhead. Avoid excessive speeds and sudden starts or stops. Never lift a circuit breaker in an area where personnel are located. Failure to comply may result in property damage, serious personal injury or death.



Attach crane cable yoke and insert crank into the crane eye. Raise breaker above compartment rails and fully extend rails.



Lower breaker onto rails. Important! The rear of the breaker must be tilted downward so that the breaker engages the notch on the right hand rail.



With breaker securely on rails, remove the lifting yoke. Breaker is now ready for inserting into compartment.

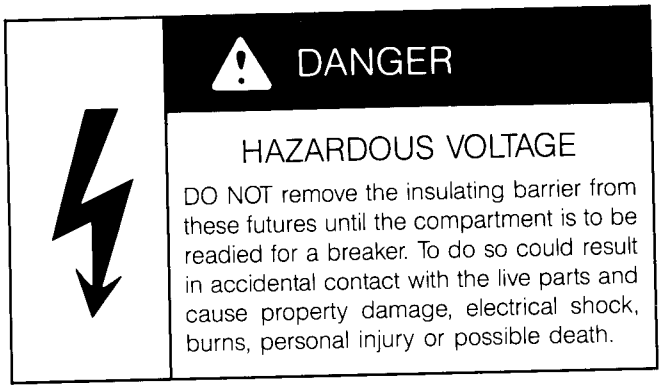
Figure 27. Circuit Breaker Insertion

Drawout Fuse Carriage (3200 AMP. & 4000 AMP.)

Drawout fuse carriages are used and interlocked with RLF-3200 and RLF-4000 breakers. They are allocated to specific compartment. (See three line diagram for location.) Racking and lifting is accomplished in the same manner as a breaker except lifing yoke is not required.

Future Breaker Compartments

These compartments have the primary contacts and bus work installed for future addition of circuit breakers. To prevent accidental contact with live parts, primary contacts are shielded by an insulating barrier.



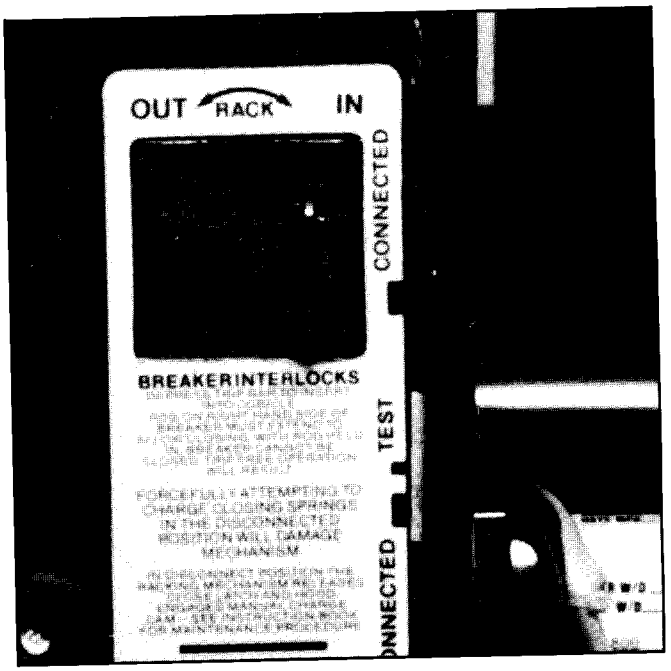
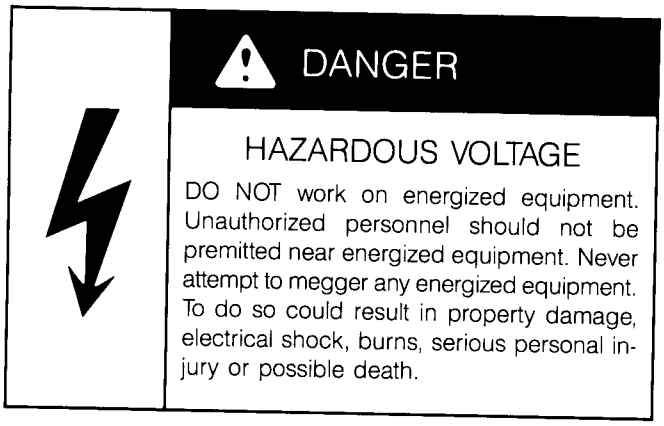


Figure 28. Circuit Breaker Position Indicator



Before any work is done within the cubicle compartments make certain the primary circuits are de-energized, tested, grounded, tagged or properly identified, and released for work in an authorized manner!

General

Before the switchgear is put in service, a thorough inspection and test should be made.

Inspection

Check for loose connections that may have developed in shipment. A thorough visual inspection and tightening of all bolted connections is recommended. Before main power is turned on, all electrical switches and manual controls should be checked for proper position.

Testing

If desired, primary circuits may be resistance tested phase to phase and phase to ground. In switchgear having remote connections, some of the circuits must be externally wired when the switchgear is installed. These circuits should be electrically tested before placing in service.

Current Transformers

Current transformer circuits are tested for continuity. As shown in Figure 30, with the switchgrear installed but not energized, disconnect the "grounded" lead at the current transformer 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 current transformers.

Secondary Load Circuits

Disconnect potential transformers at the secondaries. Test secondary lead circuit for open circuit between phases and then energize the circuit with test potential. See that proper potential appears at the terminals of each device.

Control Circuits

Test all control circuits for short circuits, open circuits and grounds. Apply the proper voltage and test the functioning of electrically operated devices.

Watt-Meters, Watt-Hour Meters and Directional Relays

Check watt-meters, watt-hour meters and directional relays for proper direction of rotation in actual service. Most present day directional control relays require the closing of the over current element in order for the directional element to operate. Ground directional relays can be tried on load by removing one of the three potential fuses and short-circuiting the other two current transformers of the remaining two phases. The relay should then operate in the tripping position. The directional control overcurrent element may have to be closed by hand, if the current is insufficiently high to operate it. In this test, the trip circuit of the relay can be opened so as not to cause an outage.

Static Overcurrent Trip Devices

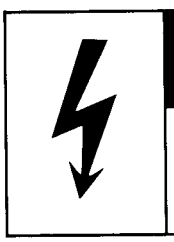
For information concerning static overcurrent trip devices, refer to the devices' instruction manual.

High Potential Tests

If high potential tests are desired, observe the following rules:

ANSI standards for field test on assembled swithgear previously tested at the factory.

Rated 250 volts . . . . . 75% of 1500 volts or 1125 volts
Rate 600 volts . . . . . 75% of 2200 volts or 1650 volts
Secondaries and control . . . 75% of 1500 volts or 1125 volts



⚠ CAUTION

Certain control devices (motors, pushbuttons, bell alarm contacts, etc.) - 75% of 900 volts or 675 volts.

These tests voltages are for use at altitudes not over 3300 feet above sea level in an ambient temperature not exceeding 40 deg. C. Above that, correction factors are as follows:

3300 feet (1000 meters) 1.00
4000 feet (1200 meters) 0.98
5000 feet (1500 meters) 0.95
10,000 feet (3000 meters) 0.80

Open-circuit all potential and auxiliary transformers and remove all grounds while high-potting primary or secondary connections.

Phasing-Out

After the switchgear is installed and tested, it should be properly phased-out. (See Figure 29.) This means:

1. Phase rotation must be in 1-2-3 sequence so that correctly connected motors run in the right direction, and so that instruments and relays on the switchgear may operate or function properly.
2. Phases labeled 1-2-3 in one section of the installation site must likewsie be 1-2-3 in other parts of the site so that identically labled phases are tied together.

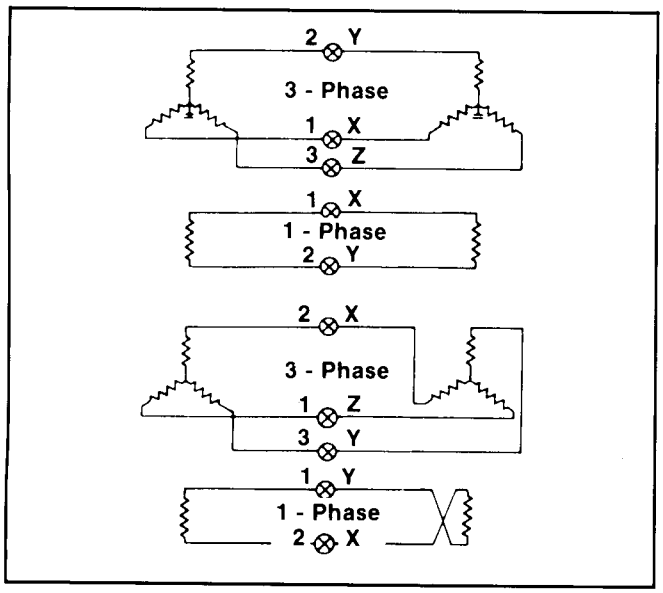


Figure 29. Proper Phasing

Phasing-out is essential in stations supplied from more than one source as paralleling out of phase means a three-phase short circuit. A positive phasing-out against a circuit of known phase relations establishes correct phase rotation as well.

Phasing-out consists of connecting the two sources through lamps. If the two sources are in phase, the lamps will not glow as there is no potential across them. If the circuits are out of phase, the lamps will glow.

In phasing-out three-phase sources, the three lamps should have a voltage rating equal to phase-to-phase voltage. In phasing-out single-phase circuits, use two lamps in series.

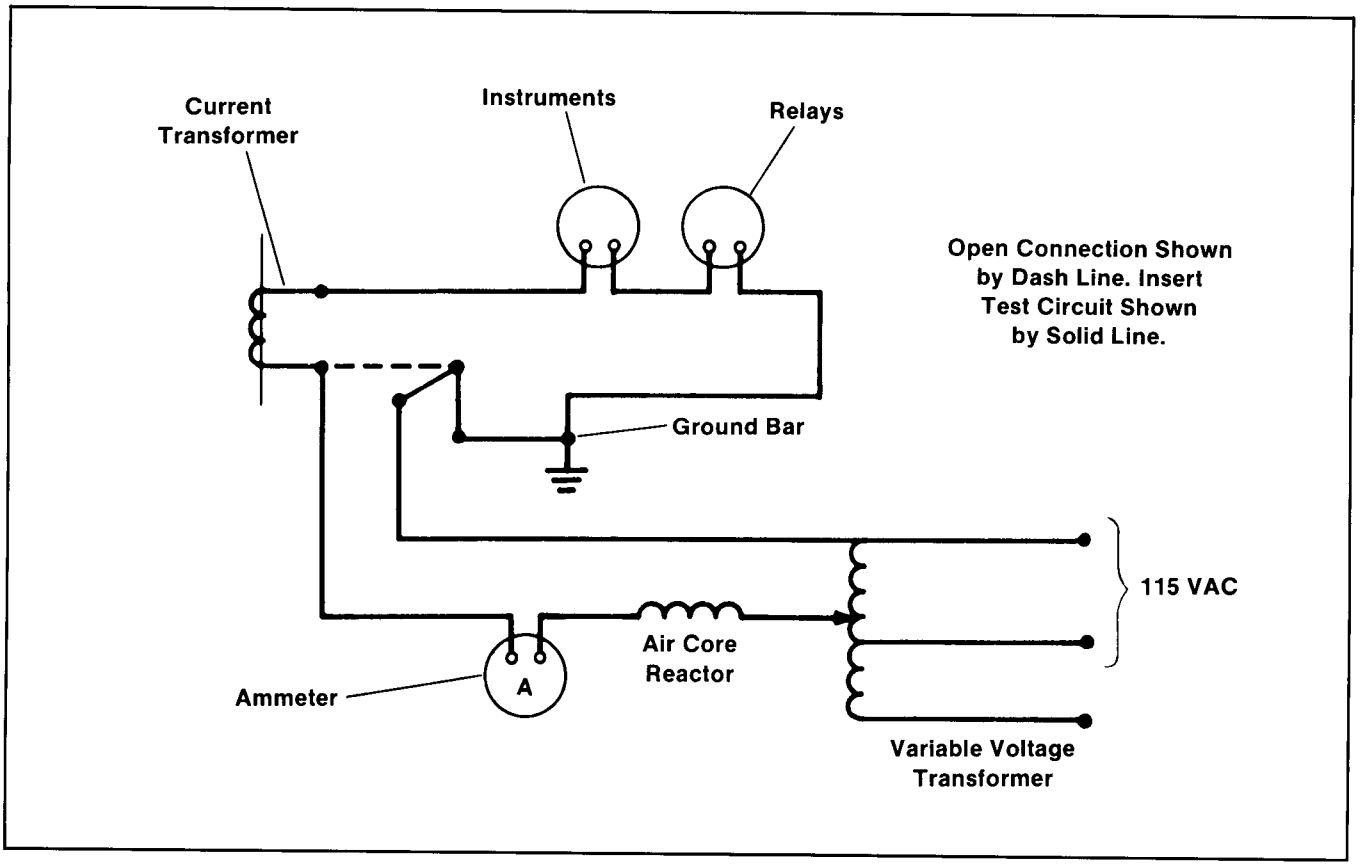
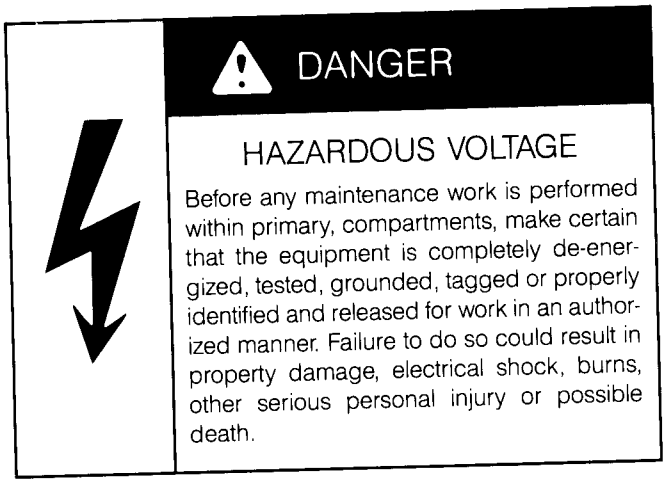


Figure 30. Current Transformer Testing



DANGER

HAZARDOUS VOLTAGE

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. Failure to do so could result in property damage, electrical shock, burns, other serious personal injury or possible death.

General

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.

Time Interval

Thorough inspections at periodic intervals are important for satisfactory operation. The frequence of inspection depends on installation conditions and is determined by experience and practice. Inspections should be made at least once a year and more frequently if local conditions require. Conditions affecting inspection and maintenance scheduling are weather, atmosphere, dust and an unusual number of operations.

Inspection

After the frequence of inspection and maintenance is established, include the following items in your inspection procedure:

1. Inspect swithgear interior for accumulation of dirt, dust or any other foreign matter. It is especially important that all insulation surfaces be wiped clean.
2. Clean air filters by washing in water containing a mild household detergent.
3. Check instrument control siwtches and check their contacts.
4. Examine indicating lamps and replace as required.
5. Check terminal block screws for loose connections.
6. Inspect bus bars and cable connections for proper conditions. If bus or cable connections are overheating, check for loose connections or overload.
7. Check for proper condition of instrument transformers, and check their primary and secondary connections. Check associated fuses and replace any which may be burned out.
8. Examine automatic shutter (if any) for proper operation.
9. Check (optional) MOC switches and their operating mechanisms for proper operation and check their contacts.
10. Check (optional) TOC switches and their operating mechanisms for proper operation and check their contacts.
11. Examine all safety interlocks for proper functions.
12. Check space heater and their associated thermostats for proper operation.
13. Perform maintenance of circuit breakers as outlined in the respective circuit breaker instruction manual.

Cleaning Insulation — Caution

Most 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 materials reducing its dielectric strength. **ISOPROPYL ALCOHOL IS THE ONLY RECOMMENDED SOLVENT CLEANER.** Isopropyl alcohol normally would not be required and in most cases wiping with a clean dry cloth is adequate.

Lubrication

Lubrication is most essential in maintaining the performance of switchgrear and should not be treated indifferently. It will aid protecting the switchgear from corrosion, wear and help assure that operating mechanisms work freely. As with other maintenance measures, lubrication should be performed annually and at more frequent intervals when under severe operating conditions, or when exposed to corrosive atmosphere.

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