

# Metal-Enclosed Switchgear

## 2.4 kV to 38 kV



## **NOTICE**

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this manual to warn of potential hazards and to call attention to additional information which clarifies or simplifies a procedure.

### **DANGER**

Used where there is a hazard of severe bodily injury or death. Failure to follow a "DANGER" instruction *will* result in *severe* bodily injury or death.

### **WARNING**

Used where there is a hazard of bodily injury or death. Failure to follow a "WARNING" instruction may result in bodily injury or death.

### **CAUTION**

Used where there is a hazard of equipment damage. Failure to follow a "CAUTION" instruction may result in damage to equipment.

### **NOTE**

Provides additional information to clarify or simplify a procedure.

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## SECTION 1—INTRODUCTION

This bulletin contains instructions for the proper installation, operation, and maintenance of Square D metal-enclosed switchgear. This product line offers switching, metering, and interrupting capabilities for medium voltage systems ranging from 2.4 kV to 38 kV. The equipment is available in a variety of arrangements in both indoor and outdoor enclosures. Metal-enclosed switchgear enclosures house the following types of equipment:

- Load interrupter (HVL) switches, fused and unfused. See the HVL switch instruction bulletin provided with your equipment for operating instructions.
- VISI/VAC® circuit interrupters. See the VISI/VAC interrupter instruction bulletin provided with your equipment for operating instructions.
- Bus transition and special enclosures

Metal-enclosed switchgear is often used with unit substations, applied as service entrance equipment, chosen for protecting substation transformers, or used to sectionalize high voltage feeder systems.

Equipment may be furnished in single or multiple bay units. Sections are shipped completely assembled for ease of handling and installation. The bus material can be copper or aluminum, and carries a continuous rating of 600, 1200, or 2000 amperes with momentary short circuit ratings of 20, 40, or 61 kA. Square D metal-enclosed switchgear is designed, manufactured, and tested in accordance with ANSI standards C37.20.3, C37.57, and NEMA SG5 where applicable.

### Accessories And Optional Equipment

When accessories or optional equipment are included with metal-enclosed switchgear, refer to the instruction bulletins that accompany the shipment. Follow the manufacturer's instructions carefully when operating these devices.

### General Description—Assembly

Metal-enclosed switchgear units are designed and manufactured as either single bay or a multiple bay lineups. Each bay is a separate, rigid, self-contained structure fabricated of heavy gauge steel.

Multiple bay switchgear generally consists of a lineup of individual feeder switch bays connected to a common main bus. A ground bus is bolted to the frame of each bay for the complete length of the lineup. The end cubicle can be adapted to accept future feeder switch bays.

### Indoor Enclosures

Indoor switchgear enclosures (figure 1, page 2) include these standard features:

- Lifting eyes at the top corners of each section
- Provisions for future expansion (when using main cross bus)
- Clear acrylic window for inspection of blade position
- Steel enclosure per ANSI C37.20.3
- Ground pad in single bay enclosures and full-length ground bus in multiple bay enclosures

**Indoor Enclosures (cont.)**

- Door interlock (electrical and/or mechanical) which prevents opening the front door while the switch or circuit interrupter is closed
- Switch or circuit interrupter interlock (electrical and/or mechanical) which prevents operating the main device while the front door is open
- Provisions for padlocking the switch handle (HVL) or the locking pull handle (VISI/VAC)
- Provisions for padlocking the front door
- Key interlocking, available when requested



*Figure 1: Indoor switchgear*

**Outdoor Enclosures**

Outdoor switchgear enclosures (figure 2, below) are designed and manufactured with the following standard features:

- Roof sloped to rear for precipitation runoff
- Operating handles are enclosed to prevent tampering
- Formed steel welded base
- Full-height front doors with gasketing
- Steel enclosure per ANSI C37.20.3
- Removable full-height rear panels
- Strip heaters in each switch bay
- Stay rods to hold hinged doors in open position



*Figure 2: Outdoor switchgear*

## SECTION 2—SAFETY PRECAUTIONS

### **DANGER**

#### **HAZARD OF ELECTRICAL SHOCK OR BURN.**

- Only qualified electrical workers with training and experience on high voltage circuits should perform work described in this set of instructions. Such work should be performed only after reading this complete set of instructions.
- The successful operation of metal-enclosed switchgear depends upon proper handling, installation, operation, and maintenance. Neglecting fundamental installation and maintenance requirements may lead to personal injury, as well as damage to electrical equipment or other property.
- Metal-enclosed switchgear has interlocks designed to prevent unsafe operation, but it is not possible to eliminate every hazard with interlocks. Therefore, the person using this device is responsible for recognizing the potential hazards, for wearing protective safety equipment, and for taking adequate safety precautions.
- Do not make any adjustments to the equipment or operate the system with safety features removed. Contact your local Square D representative for additional instructions if the device does not function as described in this manual.
- Before performing visual inspections, tests, or maintenance on the equipment, disconnect all sources of electric power. Assume that all circuits are live until they have been completely de-energized, tested, grounded, and tagged. Pay particular attention to the design of the power system. Consider all sources of power, including the possibility of backfeeding.
- Before replacing covers or closing doors, carefully inspect the bus work area for tools and objects left inside the equipment. Use care while removing or installing panels so that they do not extend into the energized bus; avoid handling the panels, which would cause personal injury.
- Before making any electrical connection, take every precaution to see that all leads to be connected are de-energized with proper safety grounds applied.

**Failure to observe these precautions will result in severe personal injury or death!**

### SECTION 3—RECEIVING, HANDLING, AND STORAGE

#### Receiving

Metal-enclosed switchgear is shipped on skids with protective wrapping to prevent damage during normal transit. Check the packing list against the equipment received to ensure the order and shipment are complete. Claims for shortages or other errors must be made in writing to Square D within 30 days after receipt of shipment. Failure to do so constitutes unqualified acceptance and a waiver of all such claims by the purchaser.

Also upon receipt, immediately inspect the switchgear for damage which may have occurred during transit. If damage is found or suspected, immediately file a claim with the carrier and notify Square D.

#### Handling

Use care when uncrating, rolling, hoisting, or handling the switchgear. Removable lifting eyes are provided for inserting hooks to lift each section as shown in figure 3. Metal-enclosed switchgear is designed to be handled only in an upright position.

Use only lifting equipment suitable for the weight of the switchgear. Review the shipping documentation for the actual weight of the equipment to be handled. When an overhead crane is not available, rollers or pipes may be used for moving the switchgear to its location.

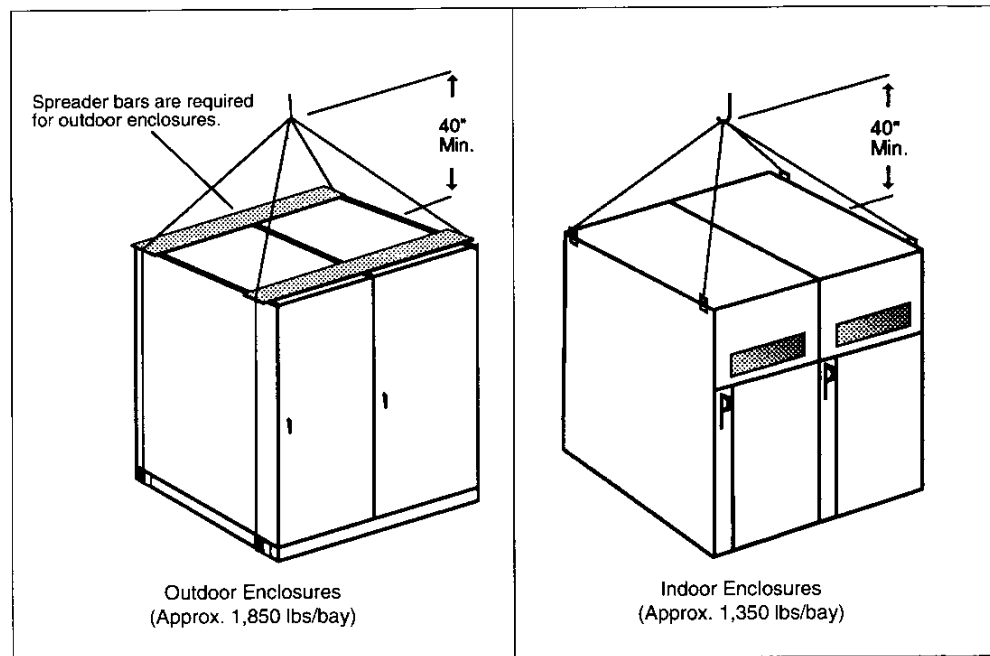


Figure 3: Lifting methods

**Handling (cont.)**

After outdoor equipment is placed in its planned location, apply a bead of caulk or similar material between the base of the switchgear and the foundation, as well as between the shipping sections, to prevent water from entering beneath the switchgear. Caulk after the equipment is placed in its final location.



**CAUTION**

**HAZARD OF PERSONAL INJURY OR EQUIPMENT DAMAGE.**

Do not remove the skids until the shipping sections are at the final location. Always use the skids to prevent equipment distortion.

**Failure to observe this precaution can result in personal injury or product damage.**

**Storage**

If the switchgear is stored before being placed into service, keep it in a clean, dry place that is free from corrosive elements and mechanical abuse. Energize the heaters inside the switchgear, or add heat from a separate source, such as a light bulb or blower. Use a minimum of 100 watts of heat per vertical section to keep the equipment dry during storage.

Covering the equipment with a tarpaulin may be necessary to protect it from contaminants or moisture. Do not store indoor units outdoors.

In areas of high humidity, such as installations near oceans or rivers, monitor the equipment closely. If necessary, use additional heat to keep the switchgear dry. Contact the factory if the internal heaters do not adequately prevent condensation for your location.



## SECTION 4—INSTALLATION

### Site Preparation

Good site preparation is necessary to eliminate costly, time-consuming installation problems and ensure proper switchgear operation. Compare the site plans and specifications with the switchgear drawings to be sure there are no discrepancies. Check the site to ensure that the equipment will fit properly.

The floor should be flat and level within 1/16 inch per foot, or a maximum of 1/4 inch within the area of the switchgear, to prevent distortion of the enclosures. Allow aisle space at the front, back, and ends of the switchgear to permit access for equipment maintenance; usually a minimum of five feet is needed on all sides.

Provide area ventilation at all times to maintain the ambient temperature around the equipment between 0°C and 40°C degrees.

Adequate lighting and convenience outlets should be available near the switchgear. Route sewer, water, and steam lines away from the equipment. Provide floor drains to prevent water buildup.

### Switchgear Installation

Review the assembly drawings to ensure that the switchgear sections will be assembled in the correct order. If the switchgear will connect to an existing lineup, mount the connecting sections first.

Mount the various shipping sections on the same plane and level them to ensure proper connection. After leveling each section, bolt it to the previously installed switchgear.

Each section includes the necessary means for anchoring it to the floor. Fasten indoor units to the floor using the holes located in the bottom flanges of the enclosure. Fasten outdoor enclosures to the foundation using the holes located in the bottom cross channels (see figure 4).

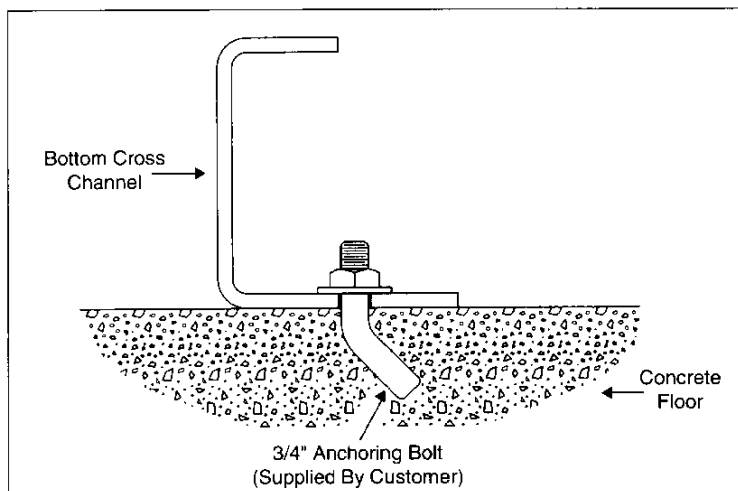


Figure 4: Anchoring method for outdoor enclosures

**Switchgear Installation (cont.)**

Remove the lifting angles from the side of the base and store. To block entry of water, extraneous objects, or wildlife, replace hardware in the holes where the lifting angles were removed. The bus connectors for the shipping splits are included with the switchgear.

 **CAUTION**

**HAZARD OF EQUIPMENT DAMAGE.**

Install the shipping split bus connectors only after the shipping sections are fastened in place and no additional movement will be made to the assembly.

**Failure to observe this precaution can result in personal injury or equipment damage.**

Follow these steps when installing the switchgear:

1. Make sure the bus connector contact surfaces are clean and bright. Install the bus connectors one phase at a time. Loosely bolt the bus joints.

After all three bus bars are in place and properly aligned, tighten the bolts using a torque wrench. See table 1 for torque values.

**Table 1  
Torque Values (ft lbs)**

<b>Bolt Size</b>	<b>Sheet Metal Joints (SAE #2 Steel Bolts)</b>	<b>Electrical Connections (SAE #5 Steel Bolts)</b>
1/4-20	7 ft lbs	10 ft lbs
5/16-18	14 ft lbs	20 ft lbs
3/8-16	21 ft lbs	35 ft lbs
1/2-13	42 ft lbs	70 ft lbs

2. Connect the ground bus splice at each shipping section. Remove the hardware, position the splice plate, and tighten the hardware per table 1.

 **CAUTION**

**HAZARD OF PERSONAL INJURY OR EQUIPMENT DAMAGE.**

The ground bus *must* be connected and bonded in accordance with applicable industry standards and/or codes to ensure proper operation of equipment and safety of personnel.

**Failure to observe this precaution can result in personal injury or product damage.**

**Switchgear Installation (cont.)**

3. Consult the customer wiring diagrams for re-connection of control wiring at the shipping breaks, when applicable. Each wire has been identified and previously connected during assembly when tested at the factory.

Make all outgoing control connections according to the wiring diagrams. After wiring is complete, carefully check all connections to ensure they are tight and correct.

**Cable Connections**

Before making the cable connections, determine the phase identity of each cable. Viewing the switchgear from the front, standard bus sequence is normally phased A-B-C left to right, top to bottom, or front to rear, unless labeled otherwise.

When cable terminations are made, follow the cable manufacturer's instructions in stripping the shield and cleaning the unshielded portion of the cable. Install the appropriate stress cone in accordance with the stress cone manufacturer's instructions.

**Forming Cables**

When forming cables for termination within switchgear, avoid sharp turns, corners, and edges which could damage or weaken the cable insulation. Follow the cable manufacturer's instructions carefully in determining the minimum bending radius of cables.

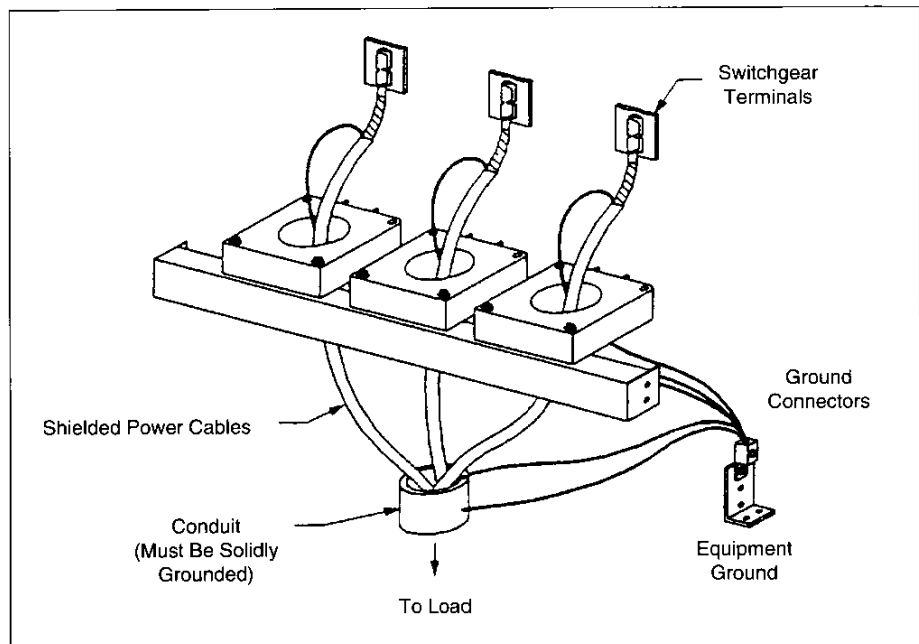


Figure 5: Shielded cable connections (through current transformers)

### Shielded Cables Through Window-Type Current Transformers

When routing shielded cable through window-type current transformers (figure 5) or ground sensor current transformers (figure 6), the shield-ground connection wire is normally routed back through the current transformer and solidly grounded. Occasionally, special four-wire systems require a different routing of the neutral conductor.

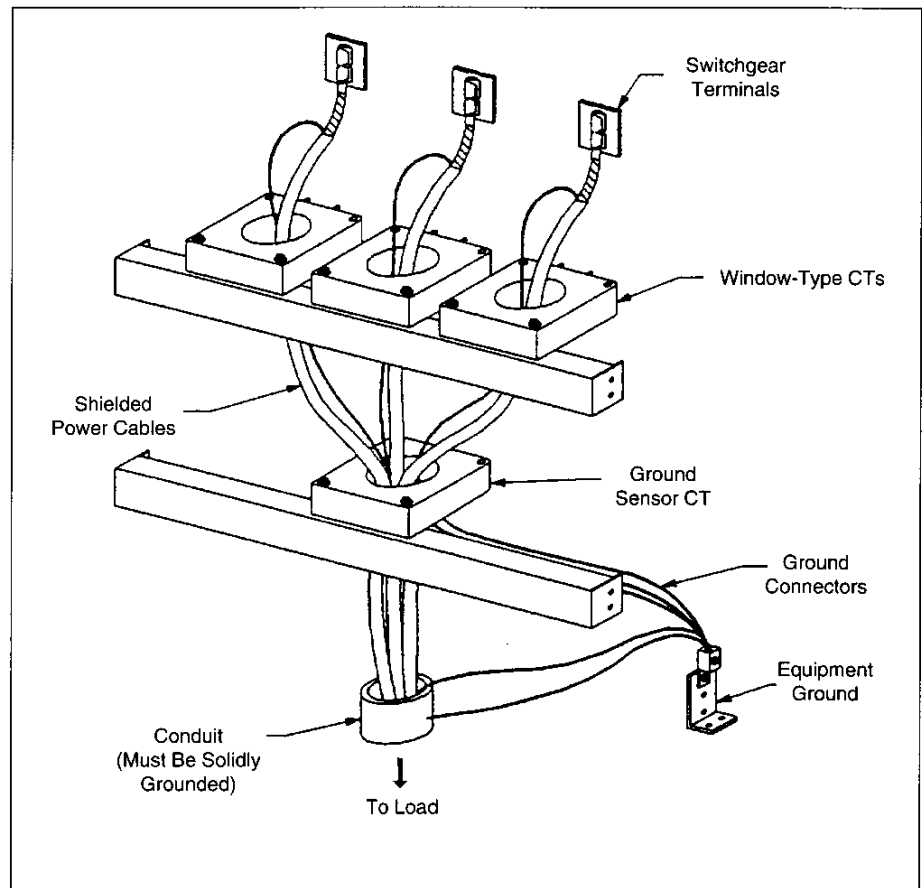


Figure 6: Shielded cable connections (through ground sensor current transformers)

**Unshielded Cable Connections**

To meet switchgear requirements, provide adequate clearances between cables, conduits, and bus (figure 7). These items must be securely fastened or braced to withstand short circuit forces and to prevent strain on the terminals.

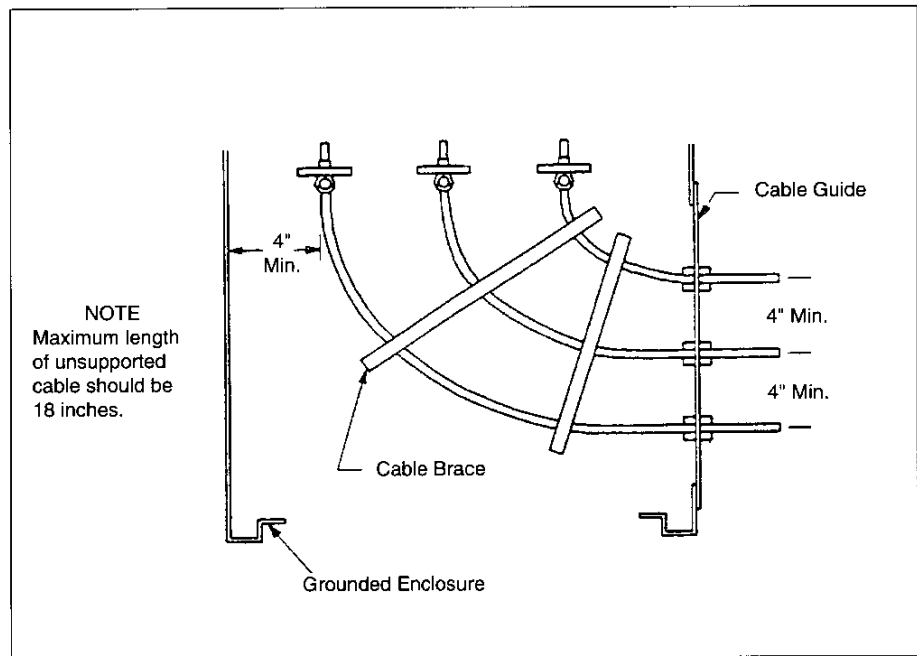


**WARNING**

**HAZARD OF ELECTRICAL SHOCK OR BURN.**

Maintain a minimum clearance of 4 inches between insulated cable and ground metal parts or other phases.

**Failure to observe this precaution can result in severe personal injury or death!**



*Figure 7: Example of unshielded cable bracing*

## SECTION 5—INITIAL PREPARATION

After the switchgear is installed and all interconnections are made, test the equipment and give it a final check before placing it in service.



### **WARNING**

#### **HAZARD OF BODILY INJURY OR EQUIPMENT DAMAGE.**

Exercise extreme care to prevent the equipment from being energized while conducting the preliminary tests. If disconnect switches cannot be opened, disconnect the line leads.

**Failure to observe these precautions can result in severe personal injury, death, or equipment damage!**

If the switchgear has been stored for several months or has been exposed to high humidity, a standard 60 cycle hi-pot test will normally indicate if the equipment is satisfactory for service. See table 2 on page 14 for test values and additional information. Follow other equipment testing procedures as required by customer in-house standards.

When all connections are made and preliminary testing is complete, perform the following inspections:

1. Check all control wiring with the wiring diagrams; ensure that all connections are properly made, all fuses are installed, current transformer circuits are complete, and loose connections are tightened.
2. Before any source of electric power is energized, make a final check of the equipment. Inspect every compartment for loose parts, tools, litter, and miscellaneous construction items.
3. Ensure that all insulating surfaces, including the primary support insulators and isolation barriers, are clean and dry.
4. Check all conductor fasteners and bolted connections for proper tightening torque (see table 1, page 7, for torque values).
5. Ensure that all barriers and covers are fastened in place.
6. Review key interlock schemes carefully (if used). Insert only the proper keys in the locks. Remove all extra keys; store them where only authorized personnel can access them.

## SECTION 6—INTERLOCKS

Mechanical interlocks are designed as standard features to minimize hazards to the operator while operating the switchgear. For example, the door interlock prevents opening the front door while the load interrupter switch is closed.

Key interlocks are optional equipment, often supplied in conjunction with metal-enclosed switchgear to direct proper operation of the equipment. The key interlock schemes are usually described on the switchgear assembly drawings.

## SECTION 7—OPERATING INSTRUCTIONS

### Switch Operation

For specific information regarding operation of switches or circuit interrupters, refer to the separate instruction manuals for those devices.

### High Voltage Fuses

High voltage fuses provide overcurrent protection for the high-voltage switch; they also give short-circuit interrupting protection up to the short-circuit rating of the equipment. Square D equipment can use either current limiting fuses or boric acid fuses.

When replacing or performing maintenance on fuses, always follow the steps listed in the warning statement below.



## WARNING

### HAZARD OF SEVERE PERSONAL INJURY OR DEATH.

Before entering the fuse compartment, always follow the five steps listed below:

1. To prevent inadvertent closure, de-energize, padlock, and tag all upstream or downstream sources which could energize the fuses.
2. Open the access door to the fuses. Confirm that all electric power to the fuses has been disconnected (use a voltage sensor designed for this purpose).
3. Wearing rubber gloves, grasp the fuse with a "hot stick" and remove it from the fuse clip assembly. Follow the procedures prescribed by the fuse manufacturer.
4. Still using rubber gloves and a hot stick, install new fuses.
5. When replacing "bolted-in" fuses, it may be necessary to handle the fuses by hand. Use *extra caution* in confirming that the bus is de-energized and grounded before replacing these types of fuses.

**Failure to observe these precautions could result in severe personal injury or death!**



## SECTION 8—MAINTENANCE

### Inspection Schedule

Perform inspection and maintenance on the basis of operating conditions and experience. Abnormal conditions may require immediate attention while regularly scheduled maintenance will depend on availability of "down time" and qualified personnel.

After a circuit experiences a fault current or stressful condition, inspect the equipment at the first opportunity. Otherwise, inspect the switchgear at least once each year.



### WARNING

#### HAZARD OF PERSONAL INJURY OR EQUIPMENT DAMAGE.

Inspection and maintenance should only be performed with the primary source(s) of power disconnected and locked open. Be absolutely sure there is no backfeed through any feeder circuit.

**Failure to observe this precaution can result in severe personal injury or death!**

### Individual Devices

The maintenance schedule for individual devices—such as meters and relays—should be based upon recommendations contained in the individual instruction manual for each device. Coordinate the various schedules with the overall maintenance program.

### Inspection Procedure

Give the equipment installation a thorough overall maintenance check at least annually in the six areas described below.

**Bus And Connections.** De-energize the primary circuits before cleaning. Perform a standard 60-cycle hi-pot test to measure bus integrity.

Table 2  
Field Test Voltages

Equipment Rating	Field Test Voltage	
	(AC)	(DC)
4.76 kV	14 kV	20 kV
15 kV	27 kV	38 kV
25 kV	45 kV	63 kV
38 kV	60 kV	85 kV

**Inspection Procedure (cont.)**

Apply the voltage to each phase individually for one minute with the other two phases and the enclosure grounded. To avoid damage during the test, disconnect the instrument transformers and remove the fuses.

If the test is unsuccessful, inspect the insulators for leakage paths. If necessary, clean the surface of the insulator(s) and re-test.

**Connections.** Inspect connections for symptoms which might indicate overheating or weakened insulation. Remove dust from busses, connections, supports, and enclosure surfaces. Wipe clean with a solvent such as denatured alcohol.

**Instruments, Relays, And Other Devices.** Maintain each device according to the specific instructions supplied. Inspect the devices and their contacts for dust or dirt; wipe clean.

**Control Wiring.** Check wiring connections for tightness and damage.

**Mechanical Parts.** Manually operate mechanical moving parts such as switch assemblies, interlocks, and doors.

**Ventilation.** Check all bus areas, grille work, and air passages for obstructions and dirt accumulation.

## SECTION 9—REPLACEMENT PARTS

When ordering renewal or spare parts, include as much information as possible. In many cases, the part number of a new part can be obtained from identification of the old part.

Always include the description of the part. Specify the rating, vertical section, and factory order number of the equipment in which the part is to be used.

**Table 3**  
**Replacement Parts**

Description	Part No.
Insulator—Porcelain 15 kV (6")	80029-002-03
Insulator—Glass Poly. 15 kV (6")	29903-01930
Strip Heater (1000W, 240V)	80031-030-01
Contact Grease (Mobilux EPI)	1615-100790

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330 Weakley Road  
Smyrna, TN 37167 U.S.A.

Order No. 6040IM9202

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