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# Switchboards

Instruction and installation guide  
11-A-1077-01 Rev.3

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# Introduction

## Section 1.0 – Introduction

The purpose of this manual is to assist the user in developing safe and efficient procedures for the installation, maintenance and operation of the equipment. For additional information, refer to NEMA Standards Publication PB2.1 “General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards rated 600 volts or less” which is available from the NEMA web site ([www.nema.org](http://www.nema.org)). Contact the nearest Siemens representative if any additional information is required.

Siemens warrants that on the date of shipment all goods manufactured by Siemens are free of non-conformities in workmanship and materials. If within one year from date of initial operation, but not more than eighteen months from date of shipment by Siemens, of any item of the goods, purchaser discovers that such item was not as warranted above, and promptly notifies company in writing thereof, company shall remedy such defect by, at company's option, adjustment, repair or replacement of the item and any affected part of the goods. Refer to “Standard Terms and Conditions of Sale” for complete warranty terms.

### 1.1 Qualified person

For the purpose of this manual a **Qualified Person** is one who has the skills and knowledge related to the construction and operation of electrical equipment and installations and has received safety training to recognize and avoid the hazards involved. In addition, this person has the following qualifications:

- 1.1.1. Training and authorization to energize, de-energize, clear, ground and tag circuits and equipment in accordance with established safety practices.
- 1.1.2. 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.
- 1.1.3. Training in rendering first aid.
- 1.1.4. Knowledgeable of NEC requirements and other applicable codes, laws and standards.

### 1.2 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:

- 1.2.1. **Danger** – Indicates an imminently hazardous situation which, if not avoided, **will** result in death or serious injury.
- 1.2.2. **Warning** – Indicates a potentially hazardous situation which, if not avoided, **could** result in death or serious injury.
- 1.2.3. **Caution** – Indicates a potentially hazardous situation which, if not avoided **may** result in minor or moderate injury.

### 1.3 Dangerous procedures

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

- 1.3.1. **Danger!** High Voltage. Qualified personnel only. Lock off all power to this equipment before working inside. Always work on de-energized equipment. Always de-energize equipment before performing any tests, maintenance or repair.
- 1.3.2. **Warning!** Always perform maintenance on the interrupting device after the closing mechanism(s) are discharged.
- 1.3.3. **Caution!** Always let an interlock device or safety mechanism perform its function without forcing or defeating the device.
- 1.3.4. **Caution!** Hydrocarbon spray propellants and hydrocarbon compounds will cause degradation of certain plastics. Contact your local Siemens representative before using these products to clean or lubricate components during installation or maintenance.

### 1.4 Field service

“Siemens Industrial Services” can provide the following support services for switchboards. Call 1-800-241-4453 to obtain additional information and schedule an appointment.

- Start-up Commissioning
- Component and System Testing
- Maintenance (Scheduled and Preventative)
- Repair and Refurbishing
- On Site Operational Training

### 1.5 General description

Siemens switchboards are designed and manufactured to perform efficiently under normal operating conditions. The instructions included in this manual are provided to aid in obtaining long and economical service from your switchboards. For proper operation and maintenance, this information should be distributed to the owner's operators and engineers.

These instructions cover the standard construction details of Siemens switchboards including auxiliary equipment and necessary accessories. Any special equipment furnished in accordance with purchase order requirements are covered by supplementary instruction books.

The switchboards described in this manual are the deadfront type as defined in NFPA70 (NEC), UL891 and NEMA PB2. All parts, conductors, and insulation materials are designed and constructed to suit the voltage class of the equipment and are enclosed within grounded metal enclosures.

The equipment furnished has been designed to operate in a system having the circuit capacity specified by the purchaser. If, for any reason, the equipment is later used in a different system, or if the short-circuit capacity of the system is increased, the momentary rating of the switchboards, the interrupting capacity of the protective devices and the bus capacity must be checked. Should the service be changed, the equipment must be checked to assure that the short circuit capacity, amperage and voltage class of the equipment meets or exceeds the requirement of the new system.

Switchboards are free-standing units rated 6000 amperes or less at 600 volts AC or less. A typical switchboard will contain the service entrance section with main devices and distribution sections with branch devices. The sections contain disconnect devices, protective devices, auxiliary equipment, and any current transformers for metering, control, or ground fault protection.

## Safety precautions and switchboard preparation

Devices are applied in a broad range of sizes and mounting arrangements. Outdoor switchboards consist of indoor equipment enclosed in a weatherproof housing and a door over the inner front panels.

### Section 2.0 - Safety precautions



- 2.1. Only qualified persons familiar with the construction and operation of switchboards should perform work described in this set of instructions. Such work should be performed only after reading this complete set of instructions.
- 2.2. Follow safety related work practices, as described in NFPA 70E, at all times.
- 2.3. Hazardous voltages in electrical equipment can cause severe personal injury or death. Energizing a switchboard for the first time after initial installation or maintenance is potentially dangerous. Inspection and maintenance should be performed on switchboards and equipment to which power has been cut off, disconnected, and electrically isolated so that no accidental contact can be made with energized parts.
- 2.4. Some types of electrical equipment will cause harmonics in the electrical system which may result in overheating. Consider this condition when determining switchboard loading, as possible de-rating of equipment may be necessary.

### Section 3.0 - Switchboard preparation

#### 3.1 Receiving

Prior to shipment, each switchboard is inspected to ensure structural and electrical construction is in compliance with applicable specifications, codes, and standards. Depending on the size and number of sections, the switchboard is divided into shipping sections of one or more vertical sections and placed onto wooden skids. Each shipping section is packaged, securely blocked and braced for shipment. Whatever method of shipment, every precaution is taken to minimize the possibility of damage and to ensure its safe arrival. Relatively delicate instruments or devices may be included and the assembly must be handled carefully when unloading.

When the equipment arrives at the destination, the packing list or marking tag(s) should be checked against the equipment actually received to make sure the shipment is correct and complete. Claims for shortages or incorrect material must be made in writing within 30 days after receipt of the shipment and failure to give such a notice constitutes unqualified acceptance and a waiver of all such claims.

On shipments with more than one shipping group, marking tags are attached to each crate or package for identification. In lieu of the marking tags, the rating label on each section contains the section marking. Refer to the general arrangement drawing for the location of each unit within the group lineup.

#### 3.2 Inspection

Inspect the equipment as soon as possible after receiving for any damage that may have occurred in transit. Carefully remove packing to inspect for any possible damage. Retain the packing material for equipment storage or return shipment if necessary. The switchboard should remain in an upright position and secured to the shipping skid to prevent distortion of the bottom frame when moving or handling.

#### 3.3 Shipping damage claims

All claims for lost or damaged goods in transit are to be handled by purchaser directly with the carrier. 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.

- 3.3.1. 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.
- 3.3.2. Make immediate inspection upon arrival for visible damage. This should be done prior to unloading when possible. When total inspection cannot be made on vehicles prior to unloading, close inspection during unloading must be maintained and visible damage noted. Take pictures if possible.
- 3.3.3. 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.
- 3.3.4. If driver will not sign the delivery receipt with damage noted, the shipment should not be signed for by the consignee or his agent.
- 3.3.5. Notify the Siemens Sales Office immediately of any damage.
- 3.3.6. Arrange for a carrier inspection of damage immediately. **IMPORTANT:** Do not remove equipment from the place it was set when unloading. Be sure this location is properly protected to ensure further damage will not occur. 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.
- 3.3.7. Be sure equipment is properly protected from any further damage by covering it properly after unloading. Equipment should be stored in a clean dry place having a uniform temperature to prevent condensation and protected from further damage.

## Switchboard preparation

3.3.8. 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 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 making any corrective action to repair. Also notify Siemens Sales Office immediately.

3.3.9. 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, the documents requested must be in Siemens hands. The carrier inspection report and/or driver's signature on the delivery receipt does not constitute approval to repair.

### 3.4 Handling

Each switchboard shipping section has provisions for attaching lifting equipment. The lift points are designed for use with a crane of adequate height and capacity. To estimate the maximum required crane capacity, multiply the number of sections to be lifted by 2,000 pounds.

**NOTE: 2,000 LBS IS AN AVERAGE WEIGHT. SOME SECTIONS MAY HAVE A WEIGHT OF GREATER THAN 2,000 LBS. PLEASE CALL THE SIEMENS SALES OFFICE TO VERIFY SECTION WEIGHTS.**

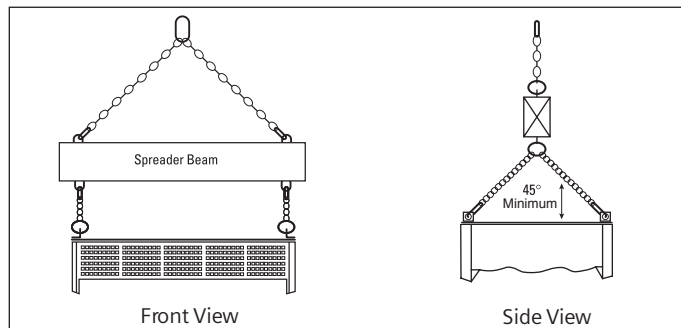
Switchboard sections may be moved by crane with lift cables attached to the lifting bars on the top of the switchboard. If crane facilities are unavailable, or if tight spaces prevent use of a crane, rollers under the skids may be used.

Recommended lifting is by means of four cables connected to an overhead crane or by fork lift.

#### 3.4.1 Lifting by means of an overhead crane

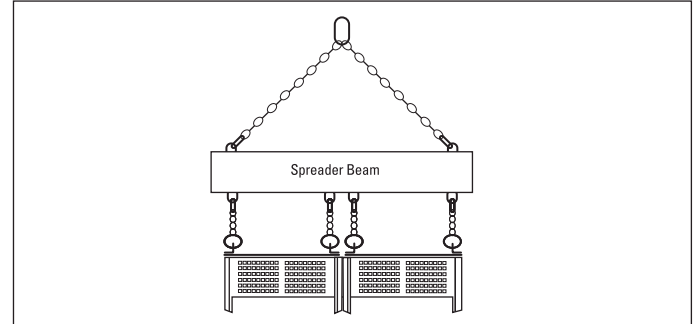
**Single section lifting** – The cables are connected to the lifting brackets, mounted at the top front and top rear mounting locations (See Fig. #1A). A crane with sufficient height should be used so the load angle (from horizontal) on the lifting cables will be a minimum of 45 degrees, when viewed from side of section. The lifting cables must have spreaders from side to side to prevent twisting the lifting brackets.

Figure 1A



**3.4.2 Multi-section lifting** – The method of lifting a multisection unit is similar to lifting single section. The cables need to be connected to all lifting brackets. The lifting cables must have correct spreader from side to side (See Fig #1B). A crane with sufficient height and lift is required.

Figure 1B

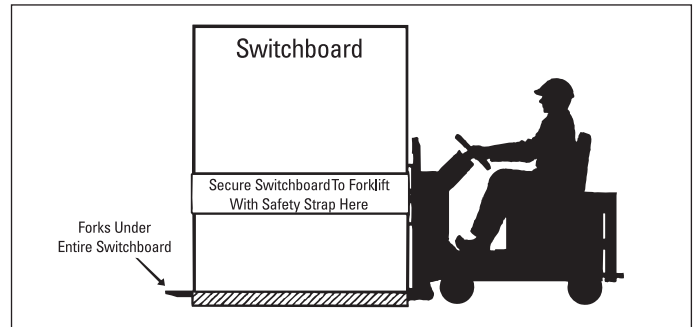


#### 3.4.3 Lifting by means of a forklift

Forklift trucks should be used with care as improper lift points could cause damage to equipment. Balance the load carefully and use safety straps when handling with a forklift. Jacks may be used to lift switchboard sections which are properly supported by sturdy timbers. To prevent distortion of the enclosures, rollers and cribbing of equal height must be used in sufficient number to evenly distribute the load.

Figure 2 shows a method of using a forklift on an indoor switchboard.

Figure 2



For alternate handling means, please refer to the **NEMA Standards Publication PB 2.1**.

### 3.5. Storage

#### 3.5.1 Indoor switchboards

When switchboard is not to be installed immediately, it should be unpacked, inspected and stored in a clean dry location having adequate air circulation and uniform temperature to prevent condensation. If switchboard is to be stored for any length of time prior to installation, restore the packing for protection. If the packing material is removed, cover the switchboard to protect from dust, debris, and moisture.

Indoor switchboards are neither weatherproof nor drip-proof. Therefore, it should be stored indoors. If it is to be kept either outdoors or in a humid, unheated area, provide an adequate covering to protect against weather and dirt, and place a heat

## Installation

source of approximately 250 watts output within each vertical section to prevent condensation. Space heaters are not standard equipment on indoor switchboards. Remove any loose packaging or flammable materials inside the switchboard before energizing the heat source. Lubricate any moving parts such as hinges, shutters, etc., if storage is for an extensive period of time.

### 3.5.2 Storage – Outdoor switchboards

It is important that outdoor switchboards are stored exactly as described for indoor switchboards. When it is necessary to store outdoor switchboards in an area exposed to the weather or under humid conditions, they should be kept clean and dry as described above. Energize the self-contained space heaters (if provided) and make certain that louvers and vents are uncovered to allow air to circulate and cover shipping splits to protect from the elements. Refer to wiring diagram drawing for space heater circuit connections. Lubricate hinges, shutters, and other moving parts.

### Section 4.0 – Installation

The proper switchboard installation method depends on whether the units are shipped as one complete group (maximum of 84.0") or in two or more shipping sections. The general arrangement drawing supplied by the factory will indicate the shipping groups and their respective location within the lineup. Units must be assembled in accordance with the general arrangement drawing.

#### 4.1. Location

Find the designated area on the building plan where the switchboard will be installed. If this area is not specified, the location chosen for installation should provide working clearances complying with article 110.26 of the National Electrical Code (NEC). Front accessible switchboards require that field connections including mains, branches, ground, and neutral are accessible and maintainable from the front. Equipment drawings identify switchboards that require rear access.

#### 4.2. Foundation requirements

Extreme care should be taken in layout of foundation or floor. Refer to general arrangement drawing for exact location of anchor bolts, area for conduits, other limitations, and instructions. Foundations must be sufficiently strong to support the weight of the equipment. Conduit couplings should be stubbed flush with or below the finished floor level. (Refer to NEC 408.5) After the equipment has been lowered to the foundation and set in place, conduit extension sleeves may be screwed into couplings.

Floors and sills must have a smooth level surface and be in the same plane. The surface of the foundation must not protrude above the grouted sills or bed plates at any point. Grouted sills or bed plates must be set true and level and be in an aligned position in the same plane to each other over the entire length.

Outdoor equipment is usually installed on a concrete pad with a level and smooth surface. Outdoor equipment which has been assembled on formed base plates must be supported at each section. Adjacent units at each shipping split must be supported on a single support, and this must be taken into consideration when the foundation is designed and constructed.

#### 4.3. Positioning of sections

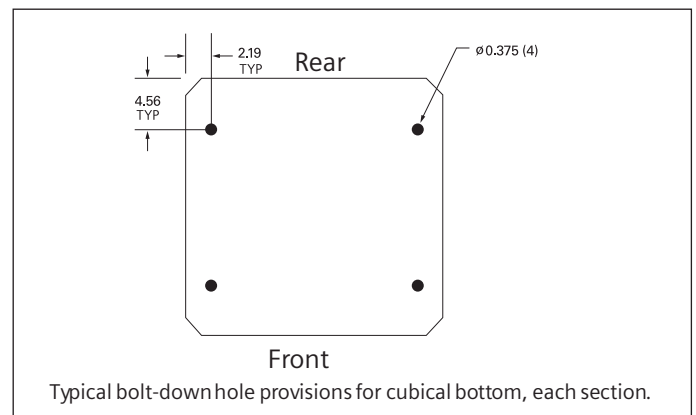
Positioning and connection of the switchboard sections at the installation site is done in the following manner.

- 4.3.1. Space to the front and rear should be sufficient for opening of doors, insertion and withdrawal of removable breakers, inspection, and maintenance. Service entrance equipment should be located as close as possible to the incoming service of the building.
- 4.3.2. Clean the mounting surface to remove all dirt and debris. Start with the left end shipping group and continue in sequence. Maneuver the section into the desired position using procedures described under "Handling." Use care in locating sections over conduit areas and beware of any conduits which stub-up above floor level as these may block sliding the section in either direction.
- 4.3.3. Prepare for the connections across shipping splits before the equipment is moved into final position. Bus supports and bus joints should be removed using side, rear and front access options as required. Note the mounting position and orientation and save hardware for use in reinstallation.
- 4.3.4. Remove the shipping skid and stand the section in an upright position. Remove all packing material and the bottom floor plate if one is installed in the section. To protect the bottom channel, any sliding force must be carefully applied across the bottom 4 inches (100mm) of the side to fully distribute the sliding force.
- 4.3.5. All shipping sections must be leveled and aligned to each other in order to maintain proper alignment of the horizontal main through bus and splice bus connections. Bolt all section frames together and connect all through bus and ground bus at shipping breaks using the splice plate bus and hardware supplied. Tighten bolted connections in accordance with torque specifications indicated on the instruction label supplied.

#### 4.4. Anchoring, leveling and assembly

Indoor switchboard shipping groups are held in alignment by boltsholding the vertical sections to each other. The entire shipping group is to be anchored and leveled as a single element without loosening any hardware until entire shipping group is leveled and anchored. Supporting surfaces for the switchboard at each anchoring bolt location must be level and in the same plane. There must not be any projection above this plane within the area covered by the switchboard cubicles.

Figure 3



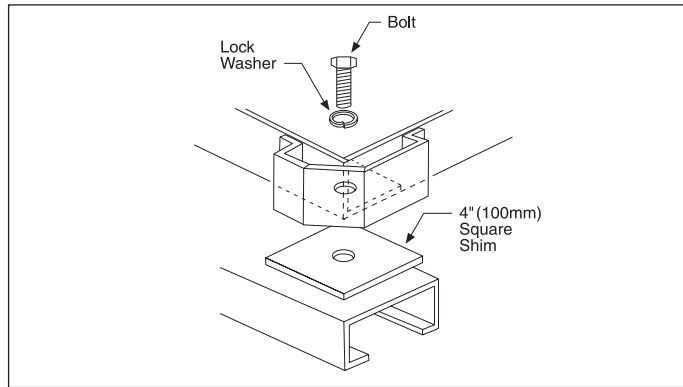
# Installation

If the floor or ground sill channels do not meet this requirement, it may be necessary to shim in the following manner. All anchor bolt locations in each cubicle must freely rest in firm contact with the mounting support surfaces. There must not be any projection or obstruction in other areas which may distort the cubicle. Do not force cubicle in firm contact by drawing down anchoring bolts as such drastic means will distort cubicles. Add 4" (100mm) square shims adjacent to anchor bolts until firm contact is achieved. Check each anchor bolt location (See **Figure 3 and 4**).

- 4.4.1. If side mounted lifting bars are supplied on shipping sections, it is necessary to remove the lifting bars. If top mounted lifting brackets are supplied on shipping sections, removal is optional.
- 4.4.2. Tighten anchor bolts or weld to sills.
- 4.4.3. If line-up consists of multiple groups, move the next group into position, with the rear of units in line and tight against the adjacent group. Do not bolt groups together at this time. Check that the cubicles are in firm contact with the foundation at each corner and anchor point and that bolt holes are in alignment. Add square shims as necessary. Tighten the anchor bolts. Now bolt groups together as described in "Joining Shipping Sections."
- 4.4.4. Repeat Step 3 above until all shipping groups have been installed securely and in the correct order per the front elevation drawing supplied from the factory.

**Note: For seismic installation, refer to installation instructions furnished with the equipment.**

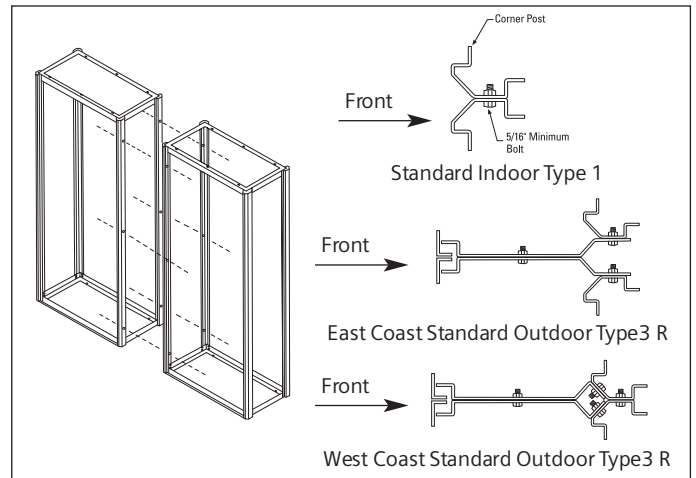
**Figure 4**



### 4.5. Joining shipping sections

The front panels and, if possible, the back plates should be removed so that adjacent shipping section frames can be bolted firmly together. Place 5/16-16 x 1.00 inch steel bolts through the holes in each front and rear corner post as shown in **Figure 5**. Torque the bolts to 12 ft lbs.

**Figure 5**



### 4.6. Electrical connections

Electrical connections within switchboards are made using either bus bar or cable. Bus bar is furnished for connections between the main bus, circuit breakers fusible devices and pads for cable terminations.

Switchboards are designed to fully comply with standard electrical clearances. However, since cable and bus connections are being made in the field, care must be taken to ensure that all minimum clearances are maintained for electrical connections.

Between live parts of opposite polarity	0-125V	126-250V	251-600V
Through Air	1/2"	3/4"	1"
Over Surface	3/4"	1 1/4"	2"

Between live parts and grounded metal	0-125V	126-250V	251-600V
Through Air	1/2"	1/2"	1"
Over Surface	1/2"	1/2"	1"

### 4.7. Through bus splice connections

When a switchboard group is split for shipping purposes, the cross bus and ground bus connections must be made when installing the equipment. To make these bolted connections, refer to Figures 6 through 12 and these instructions:

- 4.7.1. Access to the main bus from the cable termination area is achieved by removing the main bus compartment barrier which separates the main bus from the cable area. For some arrangements, it may be necessary to remove items between the main bus barriers and the rear of the unit in order to gain full access. After completion of the bus assembly and installation, these items should be reassembled in reverse sequence.



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- 4.7.2. All surfaces must be free of dust, dirt or other foreign material. Do not use any abrasive cleaner on plated contact surfaces. Cleaning is normally not necessary and should not be done unless parts are badly tarnished. If cleaning is necessary, use a mild cleaner and thoroughly remove all residue. Keep cleaning agent off insulation.
- 4.7.3. Before assembling any bus bar joint, check that the bar is inserted through bus supports (when required). Observe the relationship of the bus bar and maintain this relationship when connecting bus bars. Spacers may be required in some bus joint connections.
- 4.7.4. Assemble all joints with the parts dry. Do not use grease or "no-oxide" product.
- 4.7.5. Use the hardware provided with the Splice Plate Kit. Using smaller or different grade hardware may result in over-heating of the connection.
- 4.7.6. Single Bolt Connections: Insert the bolt through the hole on the tie plate and the through bus. Next, place the large diameter Belleville washer on the 1/2-13 bolt. Hand tighten the nut and then torque to 50 ft. lbs. Duplicate for each set.
- 4.7.7. Four Bolt Connections: Position the (4) 3/8, -16 carriage bolts in the slotted holes in the splice plate and the through bus. Hand tighten the 3/8, -16 belleville washer nut and then torque to 20 ft lbs. Duplicate for each set.

Figure 6 (Typical bolt alignment for tie plates)

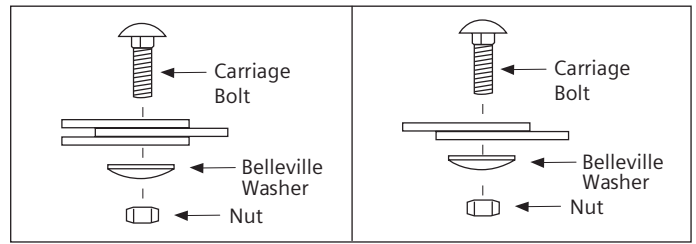


Figure 7 (Splice plate – Single hole)

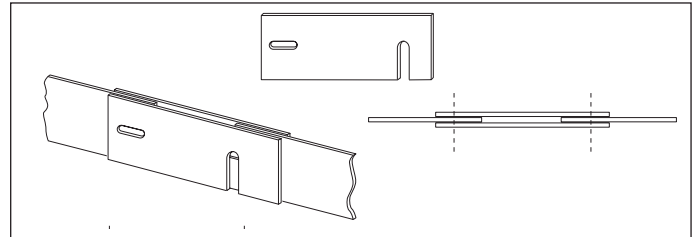


Figure 8 (Straight tie plate – Single hole)

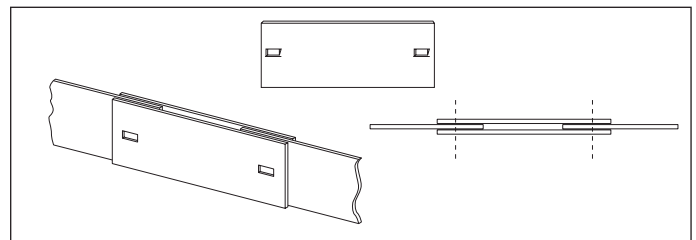


Figure 9 (Angle tie plate – Single hole)

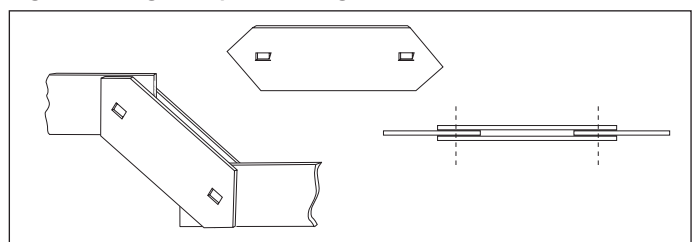
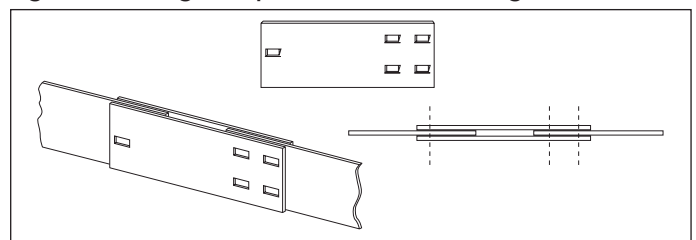


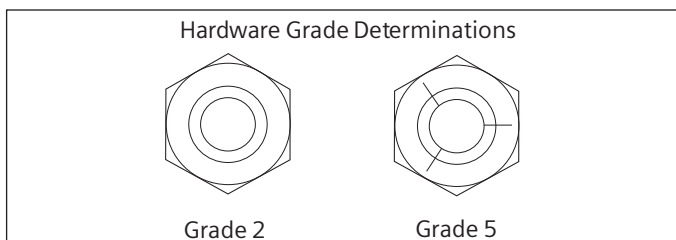
Figure 10 (Straight tie plate – Four hole to single hole)



HARDWARE	GRADE	MAX. TORQUE
3/8 -165		20 FT/LBS
1/2 -135	1)	50 FT/LBS
1/2 -132		22FT/LBS

**WHEN MORE THAN ONE SPLICE PLATE IS PROVIDED PERP HASEI NSTALLO N EACH SIDE OF THET HRU BUS.**

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1) Older switchboards used Grade 2 hardware. See Hardware Grade Determination Detail for determining which type of bolt is installed in the gear. Also, refer to the torque table provided with the gear.

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Figure 11 (Offset tie plate – Four hole to single hole)

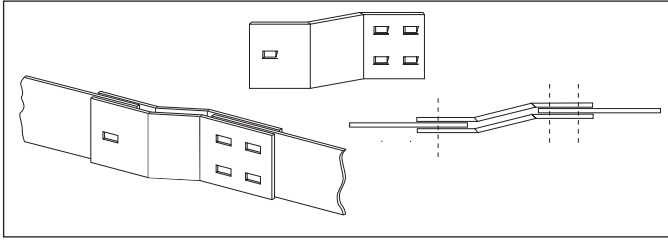
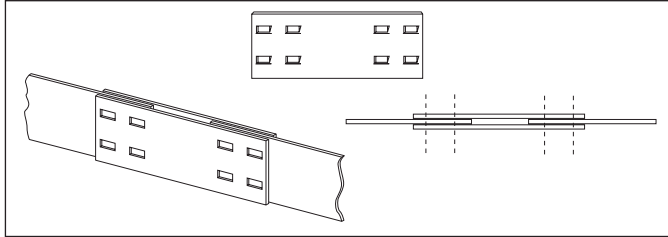


Figure 12 Straight tie plate)

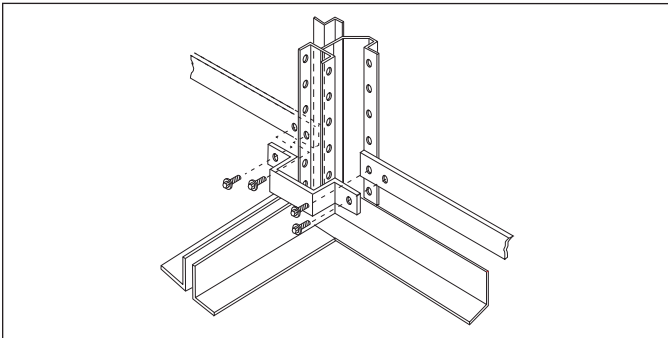


### 4.8 Ground bus splice connections

Remove ground bus splice plate and rotate the bar into place. Align and secure the ground bus splice connection between shipping sections. Refer to **Figure 13** for connection. Torque connections to 6 ft lbs.

**NOTE: Proper installation is essential for safe and proper operation of ground fault protection system (when provided).**

Figure 13



### 4.9. Grounding and bonding

4.9.1 For grounded systems used as service equipment or as a main switchboard on a separately derived system, follow the steps below:

- 4.9.1.1. Run a grounding electrode conductor from the grounding electrode at the installation site to the switchboard grounding electrode conductor terminal. Select the proper material and size the grounding conductor to comply with sections 250.62, 250.66, and 250.166 of the National Electric Code (NEC). Install the grounding electrode conductor as specified in section 250.64(B) of the National Electric Code (NEC). No ground conductors are allowed on load side of neutral disconnect link or ground fault sensor.

4.9.1.2. If required, the main bonding jumper between the neutral bus and the ground bus will be installed at the factory. Ensure that the bonding jumper is in place and properly labeled.

4.9.1.3. It is important that none of the grounding conductors are connected to load side of any neutral disconnecting link or any sensor used for ground fault protection.

4.9.1.4. When the system is a dual fed (double ended) and has ground fault protection, refer to switchboard front elevation drawing for proper grounding and handling.

4.9.2. For ungrounded systems used as service equipment, or as main switchboard on a separately derived system, follow the steps below:

- 4.9.2.1. Run a grounding electrode as described in part 4.9.1.1. above.

4.9.3. If the system is grounded at any point ahead of the switchboard, the grounded conductor must be run from that point and connected to the ground bus as described in paragraph 250.24(C) of the National Electric Code (NEC). This conductor is required even if the switchboard supplies only phase to phase loads.

4.9.4. For a switchboard not used as service equipment or as a main switchboard on a separately derived system:

- 4.9.4.1. Use equipment grounding conductors sized according to Table 250.122 of the National Electric Code to ground the switchboard frame and ground bus to the service ground, or by bonding to the raceway enclosing the main supply conductors in accordance with sections 250.118 and 250.120 of the National Electrical Code.

### 4.10 Busway connection

Refer to the SENTRON™ Busway Storage, Installation and Maintenance Instructions Piece No. 31-9918-01 supplied with the Busway for installation of the busway runs.

### 4.11 Switchboard busway flange connection

In some cases, the Sentron Busway standard stubs are shipped to the job site already factory connected to the switchboard. In applications where the flange stub is not installed from the factory, refer to the following instructions below:

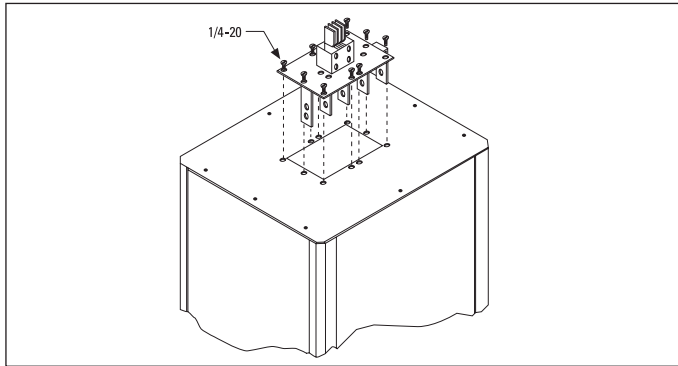
- 4.11.1. From inside the switchboards, remove the  $\frac{3}{8}$ " bolts that fasten the switchboard bus to the busway flanges.
- 4.11.2. Remove the screws from the switchboard that are around the opening busway cutout.
- 4.11.3. Insert the busway flange end into the switchboard bus connectors in the switchboard and align the holes.
 

**NOTE:** Top plate is not designed to support weight of busway. Busway must be supported by other means.

## Installation

- 4.11.4. Insert the  $\frac{3}{8}$ " bolts at bus joint and torque to 20 ft lbs. Tighten bus joint connections, all phases, neutral and ground bars.
- 4.11.5. Insert the screws that attached the busway flange to the switchboard top plate or outer cover.
- 4.11.6. Verify busway flange phasing with switchboard phasing (i.e., ABCN, front to rear).

**Figure 14**



### 4.12 Conduit area

All conduits and stubs must be located to avoid cable interference with structural members and live bus. Conduit shall not be more than 3 inches above bottom of enclosure (NEC 408.5).

Deep switchboard frames may need to have side-to-side frame support removed. Install conduit properly, with appropriate hubs or sleeves and ring connectors to protect cables and prevent water from entering and accumulating in the switchboard. Bond all metallic conduit and stubs to the switchboard with electrical connections sized according to 250.122 of the National Electric Code. Before pulling cable, verify that their size, temperature rating, and conductor insulation comply with the switchboard markings. (Ref NEC 110.14(C)).

**NOTES: 1) If bottom plates are furnished, holes for any conduit entering the bottom of the switchboard must be made by the customer. After making the holes, reinstall the bottom plate. 2) Top plate is not designed to support weight or conduit. Conduit must be supported by other means.**

### 4.13 Cable pulling

Siemens switchboards are constructed according to NEMA standards for cable arrangements. It is important that all cables enter the switchboard in the conduit area shown on the front elevation drawing and per the instructions shown below:

- 4.13.1. Use only cable sizes suitable for a proper fit with the corresponding lugs.
- 4.13.2. Pull the proper number of line side and load side cables as per the load served.
- 4.13.3. Position the cables inside the switchboard so that they are not subject to physical damage.
- 4.13.4. Maintain the maximum possible bending radii and proper clearance to bus bars and grounded parts. If any cables are lying or bearing on structural members, support them to relieve this condition or place suitable protective material at the bearing point to protect the cable insulation.

- 4.13.5. Where cables enter or leave the switchboard, or pass through any metal which has magnetic properties, be certain to run all phase and the neutral conductors through the same opening. See 300.20 (A) of the National Electrical Code.
- 4.13.6. Cables entering or exiting the switchboard should be in the same section in which they are terminated, except as noted in 408.3 of the National Electrical Code. See Article 300 of the National Electrical Code for proper wiring methods.
- 4.13.7. For Class 2 and Class 3 remote control, signaling and power-limited circuits separation requirements, see 725.136 of the National Electrical Code.
- 4.13.8. Conductors of size 1/0 AWG and larger may be run in parallel. When these conductors are run in parallel they should be of the same size, length and material to assure the equal division of current, as required by 310.4 of the National Electrical Code.

### 4.14 Cable termination

- 4.14.1. Strip a length of insulation from the end of the cable sufficient to fit into the full length of the lug barrel, being careful not to nick or ring the strands. Use a proper insulation stripping tool.
- 4.14.2. Thoroughly clean aluminum cable contact surfaces with a wire brush.
- 4.14.3. Apply an acceptable joint compound to the bare aluminum.
- 4.14.4. If compression type lugs are furnished on any switch or circuit breaker, or as the main incoming power lugs, unbolt and remove them. Insert the cable into the lug barrel and, using the recommended crimping tool, make the specified number of crimps. Wipe excess sealant from the connector and insulation. With the cables connected, remount the lugs onto the bus bars, switches, or circuit breakers. Torque the bolts per the chart on page 16.
- 4.14.5. Set screw type lugs may be furnished as main incoming lugs and are standard on all devices supplied by Siemens. Torque values for these lugs are marked on these units. Torque values for other switchboard lugs are marked on the switchboard.

### 4.15 Cable lashing requirements

For conductor lashing instructions on switchboards marked **65kA, 100kA or 200kA** short circuit current ratings, refer to the following instructions:

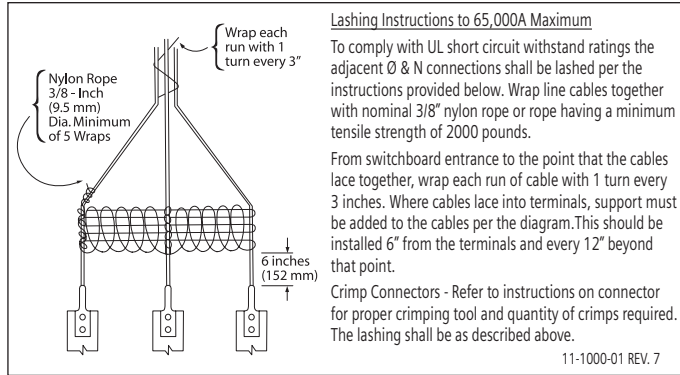
- 4.15.1. Switchboards with a single fusible main switch rated 4000A or less do not require lashing.
- 4.15.2. Switchboards with a single main molded case circuit breaker rated 4000A or less do not require lashing. When using a WL Circuit Breaker, lashing is required.
- 4.15.3. Switchboards with a single main fused circuit breaker rated 4000A and less do not require lashing.

## Pre-energizing, inspection and testing

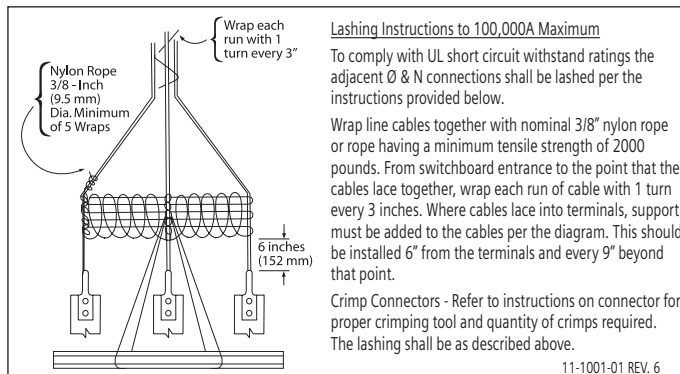
4.15.4. Switchboards of single section construction with fusible disconnects, circuit breakers, or fusible circuit breakers do not require lashing.

For switchboard sections requiring lashing, refer to the instructions below:

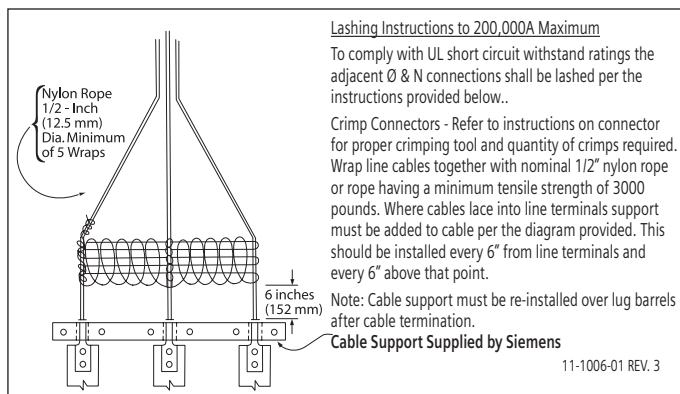
### 65kA



### 100kA



### 200kA



## 4.16 Control wiring

Control wiring is carefully installed and checked at the factory. Inter-group wiring at shipping splits can be readily connected by referring to wire markings. These wires are of sufficient length to be routed to their termination point after cubicles are bolted together. Terminals for these leads are furnished by others to suit the available crimping tools. When required, terminal block hardware is furnished with the switchboard. All wiring diagrams needed for installation are furnished in advance.

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

All control wiring installed by the factory is neatly bundled and secured to the cubicle side plate or wiring pan. Make all field connections in a similar manner. Check that all parts and components clear any additional wiring installed. All field wiring is to be routed behind the cable retainer which is removable for installation purposes. Use plastic or nylon ties to secure all field installed wire to the cubicle structure.

## SECTION 5.0 – Pre-energizing, inspection and testing

Before the equipment is energized, it must be thoroughly inspected and tested. Correct any deviations and re-inspect equipment before energizing.

“Siemens Industrial Services” can provide the following support services for switchboards. Call 1-800-241-4453 to obtain additional information and schedule an appointment.

- Start-up Commissioning
- Component and System Testing
- Maintenance (Scheduled and Preventative)
- Repair and Refurbishing
- On Site Operational Training

### 5.1 Inspection

Check the following points:

- 5.1.1. Visually inspect switchboard for any damage that may have affected bus bar supports, device mountings or reduced electrical clearances within the switchboard (minimum clearance values are listed on Page 6).
- 5.1.2. Electrical disconnecting contacts, machine parts, shutter, etc., checked for lubrication and operation.
- 5.1.3. Blocking, supports and other temporary ties removed from breakers, instruments, relays, etc.
- 5.1.4. Check torque of all accessible bus bar connections, including factory and field installed connections. Access to connections may require temporary removal of certain barriers. (Torque values are listed on Page 16.)
- 5.1.5. Proper fuses correctly installed.
- 5.1.6. Manually operate all devices (circuit breakers, switches, etc.) Check for alignment and proper operation.
- 5.1.7. Operate all electrically operated devices (circuit breakers, switches, meters, relays, etc.). An auxiliary power source may be required.
- 5.1.8. Temporary wiring jumpers (used on the secondaries of current transformers tied to external devices, as shown on wiring diagrams) removed.
- 5.1.9. Check current transformer shorting terminal block screw position.

## Pre-energizing, inspection and testing

- 5.1.10. All protective devices and relays are shipped from the factory with all adjustable settings configured at the lowest possible values. Adjustments based on required system coordination study must be done by the end user. Siemens Technical Services can be contracted to perform the system coordination study and system commissioning.
- 5.1.11. Make sure ground connections properly made.
- 5.1.12. Make sure incoming primary and secondary connections properly made and checked for shorts or undesired grounds.
- 5.1.13. Make sure all equipment which has been removed during assembly has been replaced.
- 5.1.14. Confirm that interlocks performing properly.
- 5.1.15. Disconnect devices checked per instruction books.
- 5.1.16. Make sure any filters in vent areas are clean and free of foreign material.
- 5.1.17. Inspect and remove any tools or objects left inside the equipment.
- 5.1.18. Make sure all covers are installed. Close doors and ensure that all conductors are not pinched or nicked.

### 5.2 Testing

- 5.2.1. A megger test should be performed to ensure that all connections made in the field are properly insulated. Test from phase to phase, phase to ground, phase to neutral, and neutral to ground with the neutral isolated overcurrent devices in the open position. See NEMA PB2.1, Section 7.6. Resistance readings of 1 Megohm or greater are preferred. If low readings are observed and an investigation for possible corrections does not correct test readings, then contact your Siemens Sales Office for assistance.
- 5.2.2. A dielectric test, if possible, should be made on the high voltage (power) circuit for one minute at the appropriate test voltage.

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

- 5.2.3 Voltage transformers, control power transformers, surge arresters, surge protective devices and surge capacitors must be disconnected during these tests.

**NOTE:** The dielectric test voltage is given as a reference only for those using dielectric tests to verify the integrity of connected cable installations without disconnecting the cables from the switchboard. It represents values believed to be appropriate and approximately equivalent to the corresponding power frequency withstand test values specified for each voltage rating of switchboard. When performing dielectric tests, the voltage should be raised to the test value in discrete steps and held for a period of one minute.

In accordance with ANSI C37.20.02 Clause 5.5, Field Dielectric Tests are also recommended when new units are added to an existing installation, or after major field modifications. The equipment should be put in good condition prior to the field test. It is not expected that equipment shall be subjected to these tests after it has been stored for long periods of time or has accumulated a large amount of dust, moisture, or other contaminants without being first restored to good condition.



### 5.3 Ground fault protection system

**THIS CIRCUIT PROTECTED  
BY GROUND FAULT PROTECTION**

11-1004-01 Rev. 3

NEC Section 230.95 requires ground fault protection on all service disconnects rated 1000 amperes and larger in switchboards when fed by a solidly grounded wye system of more than 150 volts to ground. When provided, all ground fault protection equipment for the switchboard is tested before shipment from the factory. The ground fault protection system, when provided, must be tested when first installed in accordance with NEC Section 230.95 paragraph C.

There are exceptions to this rule: Ground fault protection is not required on fire pumps or continuous industrial loads where a non-orderly shutdown would cause additional hazard.

Health care facilities, such as hospitals require additional levels of ground fault protection. These requirements are described in NEC Article 517.

Sections 215.10 and 240.13 of the NEC require ground fault protection on all 1000 ampere and larger devices, breakers, and switches, applied in a system as described above, unless there is ground fault protection upstream.

Many utilities use a grounded Wye secondary transformer and bring a connection from the grounded mid-point to the service section ground bar. When this is the case, ground fault protection is required.

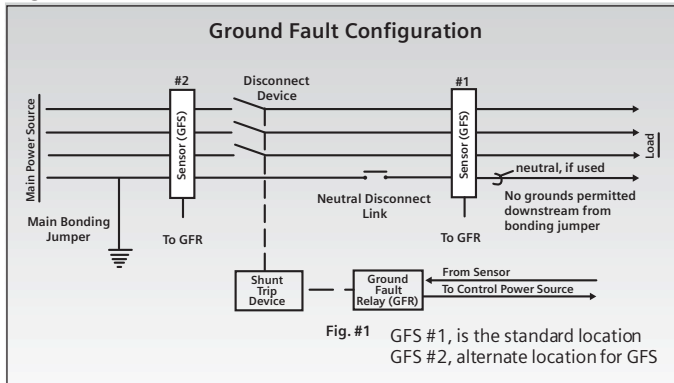
## Ground fault inspection and testing

For a 1000 ampere or larger 480 volt, 3-phase 3-wire service section, an inquiry should be made to determine if the utility is using a 3-wire delta secondary transformer. Should this be the case, no ground fault protection is required.

### Ground fault relay



Figure 15



**WARNING:** The following should be performed only by qualified personnel as defined in NEC article 100. The ground fault sensor (GFS), ground fault relay (GFR), must be installed as in Figure 15.

**Note:** Test report and test record forms found on Page 18 and 19 of this manual can be used to record ground fault field testing.

### 6.0 Ground fault inspection and testing

“Siemens Industrial Services” can provide the following support services for switchboards. Call 1-800-241-4453 to obtain additional information and schedule an appointment.

- Start-up Commissioning
- Component and System Testing
- Maintenance (Scheduled and Preventative)
- Repair and Refurbishing
- On Site Operational Training

#### 6.1 External ground fault

6.1.1. Disconnect main power source.

6.1.2. Remove the neutral disconnect link. Make sure the neutral is grounded only by the main bonding jumper, which must be on the line side of the sensor.

6.1.3. Close all branch devices.

6.1.4. Using a “megger” type meter, measure the resistance of the load phase and neutral to ground. This is to ensure that no ground connections exist in the system. Resistance readings of one (1) Megohm or greater are preferred.

6.1.5. Re-install the neutral disconnect link.

6.1.6. Open all devices.

6.1.7. Connect the main power source.

#### To test the entire system including the disconnect device.

- Check for control power (LED should be illuminated).
- Press the “push to test” switch on the relay.
- The trip indicator should go to the “trip” position and the disconnect device will open.
- Release the “push to test” switch on the relay.
- Reset the relay, and the disconnect device. System is now back to normal.

#### To test the ground fault relay and sensor only (the sensor will trip the relay in this test).

- Check for control power, “LED” should be illuminated.
- Press and hold the “shunt trip bypass” switch on the relay.
- Press the “push to test” switch. The ground fault relay will trip.
- Reset the relay, then release the “shunt trip bypass” switch. System is now back to normal.

**Note:** Test Report form found on page 19 of this manual can be used to record ground fault field testing.

### 6.2 Internal ground fault

The procedures below are for SJD6, SHJD6, SCJD6, SLD6, SHLD6, SCLD6, SMD6, SHMD6, SCMD6, SND6, SHND6, SCND6, SPD6, SHPD6, DG, FG, JG, LG, MG, NG, PG, WL fixed mount and WL drawout.

#### 6.2.1 General

Siemens VL, Sensitrip III and WL circuit breakers may be equipped with integral ground fault protection. The National Electrical Code® requires that these devices be performance tested when first installed (230.95(C)). The following instructions are intended to guide the installer in meeting this requirement or Sensitrip III circuit breakers. Use the “Guide for Primary Injection Testing WL Circuit Breakers” P/N 11-C-9036-00 for WL circuit breakers and “Ground Fault Test Procedure” P/N 806946A00 for VL circuit breakers which are both available at [www.usa.siemens.com/circuitbreakers](http://www.usa.siemens.com/circuitbreakers)

#### General instructions

6.2.1.1. The interconnected system shall be evaluated when initially installed by qualified personnel. It is also suggested this be done periodically thereafter.

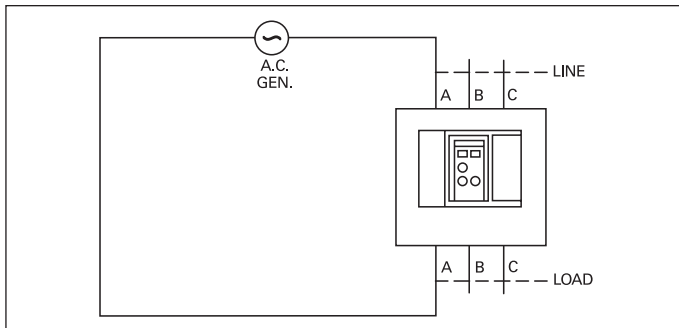
6.2.1.2. The proper location of the sensors around the bus of the circuit to be protected shall be determined. This can be done visually, with knowledge of which bus is involved.

## Energizing and operation

- 6.2.1.3. The grounding points of the system shall be verified to determine that ground paths do not exist that would bypass the sensors.
- 6.2.1.4. The polarity of the sensor connections must agree with the installation instructions to avoid improper operation.
- 6.2.1.5. A simulated test is to be done using a low voltage, high current source. This test is not intended to verify the calibration of the ground fault protection but to verify it is properly functioning.
- 6.2.1.6. The results of this testing should be recorded on the form provided at the end of this document or on other appropriate forms and should be available to the inspection authority.
- 6.2.1.7. These breakers may be set for different modes of operation. Residual or Ground Return, as described in the instructions supplied with the circuit breaker. For further information on applications, refer to the NEMA standards publication No. PB 2.2 Application Guide for Ground Fault Protective Devices for Equipment.
- 6.2.1.8. Operation test  
Switch Setting – Residual Outgoing Circuit Method
- 6.2.1.8.1. 3 Phase / 3 Wire  
Using **Figure 16**, individually test breaker poles A, B and C for proper Ground Fault operation.

Each of the circuit breaker's front panel controls should be set to the highest setting. Using a low-voltage current source, apply a test current equal to 125 percent of the ground fault pickup setting to one pole of the circuit breaker. The circuit breaker must trip.

**Figure 16**



Warning: Never pass test current through an unterminated Neutral Sensor. Permanent sensor damage may occur if operated in this manner.

### 6.2.1.8.2. 3 Phase/4 Wire

Using **Figure 17**, individually test breaker poles A, B and C in conjunction with the proper Neutral Sensor for proper GroundFault operation.

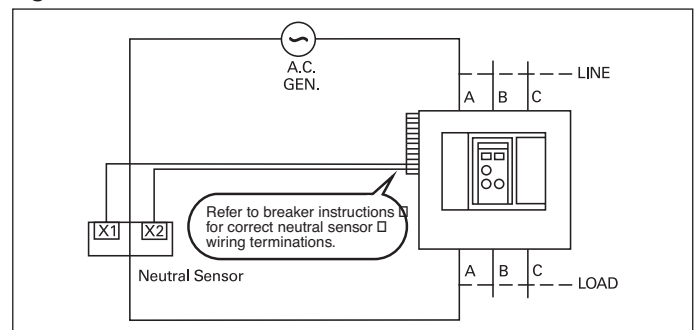
Each of the circuit breaker's front panel controls should be set to the highest setting. Using a low-voltage current source, apply 125 percent of the ground fault setting to one pole of the circuit breaker. The circuit breaker must not trip. Reduce the test current to zero.

Using a suitable means, short the X1/wire and X2/wire connections together on the Neutral Sensor. Re-apply the 125 percent test current to the breaker pole under test. The breaker must trip. Reduce the test current to ZERO and remove the shorting means from the Neutral Sensor.

### 6.1.2.9. GF Switch Setting – Ground Return Ground Return Method

- 6.1.2.9.1. 3 Phase/3 Wire or 3 Phase/4 Wire Each of the circuit breaker's front panel controls should be set to the highest setting. Using a low-voltage current source, apply a current equal to 125 percent of the ground fault pickup setting per **Figure 17**. The circuit breaker must trip.

**Figure 17**



**Note:** Test report form found on page 18 can be used to record ground fault field testing.

	<b>⚠ DANGER</b>
	<p><b>Hazardous voltage.</b> Will cause death or serious injury.</p> <p><b>Keep out.</b> Qualified personnel only. Disconnect and lock off all power before working on this equipment.</p>

FAILURE TO PROPERLY MAINTAIN EQUIPMENT CAN RESULT IN DEATH, SERIOUS INJURY OR PRODUCT FAILURE. THE INSTRUCTIONS CONTAINED HEREIN SHOULD BE CAREFULLY REVIEWED, UNDERSTOOD AND FOLLOWED. THE FOLLOWING MAINTENANCE PROCEDURES MUST BE PERFORMED REGULARLY.

## SECTION 7.0 - Energizing and operation

**WARNING: HAZARDOUS VOLTAGES IN ELECTRICAL EQUIPMENT CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. ENERGIZING A SWITCHBOARD FOR THE FIRST TIME AFTER INITIAL INSTALLATION OR MAINTENANCE IS POTENTIALLY DANGEROUS.**

### 7.1 Placing equipment into service

Only qualified persons familiar with the construction and operation of switchboards should perform work described in this set of instructions. Such work should be performed only after reading this complete set of instructions.

## Switchboard loading and maintenance

Proceed as follows:

- 7.1.1. Check all interrupting devices. Set all devices to open position. Check and open all control circuits.
- 7.1.2. Energize primary incoming power source to equipment.  
**Note:** The primary incoming power source should not exceed the normal rating of equipment.
- 7.1.3. Close control circuit to check all instruments, relays, meters, etc., during this time. **Note:** There should be no load on switchboard when it is energized.
- 7.1.4. Energize in sequence starting at the source and work towards the load. Close main device, then feeder devices, then branch devices to source load. As the smallest branch load is added, observe instruments. Allow several minutes before connecting additional load.
- 7.1.5. Gradually connect more loads to equipment. Observe instruments and allow several minutes before adding additional load. Follow this procedure until the full load is connected.
- 7.1.6. After all mains and branch devices have been closed, down stream loads such as lighting load, contactors, heaters, and motors may be turned on.
- 7.1.7. Check primary and secondary circuits for overheating. Also check all instruments during the first week of operation.

### SECTION 8.0 – Switchboard loading

- 8.0.1. Main Lug Switchboards (without main). The total continuous load current through the supply bus should not exceed the current rating of the switchboard.
- 8.0.2. Single Main Switchboards  
The total continuous load current on main device should not exceed 80 percent of main device unless rated for 100 percent of its ampere rating. The same will apply to each main of a multi-main switchboard. Feeders and branch circuits follow same 80 percent rule for load applied to feeder and branch circuit.
- 8.0.3. Some types of electrical equipment will cause harmonics in electrical systems. This may result in overheating. When determining loading of switchboard, this condition should be considered. Possible de-rating of equipment may be necessary.

### SECTION 9.0 – Maintenance

	<p><b>⚠ DANGER</b></p> <p><b>Hazardous voltage. Will cause death or serious injury.</b></p> <p><b>Keep out. Qualified personnel only. Disconnect and lock off all power before working on this equipment.</b></p>
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FAILURE TO PROPERLY MAINTAIN EQUIPMENT CAN RESULT IN DEATH, SERIOUS INJURY OR PRODUCT FAILURE. THE INSTRUCTIONS CONTAINED HEREIN SHOULD BE CAREFULLY REVIEWED, UNDERSTOOD AND FOLLOWED. THE FOLLOWING MAINTENANCE PROCEDURES MUST BE PERFORMED REGULARLY.

#### 9.1 Inspection and maintenance intervals

Periodic inspections and maintenance are essential to obtain safe and reliable operation. When equipment is operated under "Usual Service Conditions," maintenance and lubrication is recommended at least annually. 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. Where equipment is exposed to these conditions, more frequent maintenance is recommended.

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 and other recognized safety practices such as those contained in the National Electric Code and OSHA 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 preventative maintenance schedule will depend upon the operating conditions. NFPA Publication 70B, "Electrical Equipment Maintenance" may be used as a guide to establish such a program.

**A preventative 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.**

#### 9.2 Recommended maintenance

Periodic maintenance includes cleaning, lubrication and the exercising of component parts. The interval between maintenance checks can vary depending on the amount of usage and environmental conditions of each installation.

The maximum recommended inspection interval should not exceed one year and should include all the tests shown in the section below, "Maintenance Tasks."

Always inspect the switchboard after a fault (see section 10.0 on "Adverse Conditions"). Instruction manuals for the various disconnecting and overcurrent devices mounted in the switchboard are indicated in the "Supplemental Instruction Manuals" section and are available through your local Siemens sales office.

A permanent record of all maintenance work should be kept. The record should include a list of periodic checks and tests made, the date they were made, the condition of the equipment, and any repairs or adjustments that were performed.



# Maintenance

## 9.3 Maintenance tasks

9.3.1. **Before any maintenance is performed on a switchboard that has been energized for at least 3 hours, it is recommended, just prior to inspection, a simple hand test be performed. This test should consist of placing your hand on the front and side of the equipment enclosure, the dead front surfaces of circuit breakers, switches, interior trims, doors for at least 3 seconds. If you cannot maintain contact with the surfaces due to the extreme temperatures, this may be an indication of trouble and immediate investigation is required.**

**Warning: Switchboards contain voltages that may cause severe injury or death. Power to the switch board should be turned off, disconnected and electrically isolated so that accidental contact cannot be made with energized parts during inspection and maintenance, unless otherwise specified.**

9.3.2. Before starting work on the equipment, the following should be completed on any equipment that will affect the area of the work:

- A. Disable remote control and automatic transfer schemes.
- B. De-energize all direct and back feed power and control sources, test and ground
- C. Disconnect all voltage and control power transformers.
- D. Open all disconnects.

9.3.3. Include the following items in your procedure:

- A. Check general condition of switchboard installation.
- B. Inspect interior for accumulation of dust, dirt or any foreign matter. Vacuum the interior to remove any dirt or dust deposits. Do not use an air hose as pressurized air may blow dust into critical electrical contact areas.
- C. Check the interior carefully for moisture, condensation buildup, or signs of any previous wetness. Inspect all conduit entrances and cracks and seal off any leaks to eliminate moisture. Clean air filters by washing in a mild household detergent.
- D. Examine indicating lamps and replace as required.
- E. Check terminal blocks 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 de-energized insulators.
- I. Inspect bus bars and connections for proper condition. If bus bars are overheating, check for poor or loose connections or for overload.
- J. Examine fuse clip contact pressure and contact means. If signs of over-heating or looseness, contact sales for replacement.
- K. Look for and replace deteriorated insulated material where sealing compound has melted.

- L. Examine all safety interlocks to insure they are functional and in proper working order.
- M. Carefully inspect all devices for any worn, cracked, or missing parts. Manually open and close devices several times to insure they are in proper working order. Perform maintenance of interrupting devices as out lined in the device instruction manual. Do not open sealed breaker or trip unit as calibration may be disturbed. Return to factory for any replacement. For reference, see NEMA AB4.
- N. Check space heaters and thermostat (if equipped) for proper operation.
- O. Maintain other auxiliary equipment per their respective instruction book requirements.
- P. Lubricate mechanisms, contacts, and other moving components. Do not lubricate parts of molded case circuit breakers.
- Q. Inspect painted surfaces and touch up as needed.
- R. Check for signs of rodent or insect nesting inside the switchboard.
- S. Replace, reassemble, re-insulate, return all items to proper operating conditions and remove grounds prior to energization.
- T. Ensure satisfactory operation of relays and instruments as per instruction books furnished separately. Do not leave device covers off longer than necessary. When a cover has been broken, cover the device temporarily and replace broken glass as soon as possible.
- U. Test ground fault protection system (if furnished).
- V. Conduct an electrical insulation resistance test to ensure that the switchboard is free of short circuit and ground.

9.3.4 THIS CHECKLIST 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 PROCEDURES BE DESIRED OR SHOULD PARTICULAR PROBLEMS ARISE WHICH ARE NOT COVERED SUFFICIENTLY FOR THE PURCHASER'S PURPOSES, THE MATTER SHOULD BE REFERRED TO THE LOCAL SALES OFFICE.

DANGEROUS VOLTAGES ARE PRESENT IN THE EQUIPMENT WHICH CAN CAUSE DEATH, SERIOUS INJURY OR PROPERTY DAMAGE. ALWAYS DE-ENERGIZE AND GROUND THE EQUIPMENT BEFORE MAINTENANCE. MAINTENANCE SHOULD BE PERFORMED ONLY BY QUALIFIED PERSONNEL. THE USE OF UNAUTHORIZED PARTS IN THE REPAIR OF THE EQUIPMENT, TAMPERING BY UNQUALIFIED PERSONNEL, WILL RESULT IN DANGEROUS CONDITIONS WHICH CAN CAUSE DEATH, SERIOUS INJURY OR EQUIPMENT DAMAGE. FOLLOW ALL SAFETY INSTRUCTIONS CONTAINED HEREIN.

## 9.4 Cleaning insulation

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

# Adverse conditions and informational charts

## Section 10.0 – Adverse conditions

### 10.1 Ambient temperatures

Switchboards are designed for installation where the average ambient temperature will not exceed 40°C (104°F). For higher temperatures, derating may be required. Contact the nearest Siemens representative to discuss your special application.

### 10.2 Short circuits

Overcurrent protective devices will normally prevent electrical damage except at the actual point where the short circuit or fault condition occurred. However, the high mechanical stress developed by short circuit currents may cause damage to conductors, insulation, or other equipment installed within the switchboard. After any fault, a thorough inspection of the entire system must be made to ensure there is no damage to conductors, insulation or equipment (Refer to inspection and maintenance procedures.)

In addition, overcurrent protective device(s) which performed the short-circuit interruption must be inspected for possible arcing damage to contacts, arc chutes, and/or insulation. Do not open any sealed devices or breaker trip units. Equipment should be hi-pot tested prior to being placed back in service.

If device is damaged, replacement of that device is required.

### 10.3 Arcing damage

During a fault, some organic insulation materials carbonize when subjected to the intense heat of an electrical arc, and lose their insulation qualities. Any carbon deposits or tracking must be completely removed with a dry, lint-free cloth, or the material must be replaced before re-energization. Contact your local Siemens sales representative before clean up and corrective action.

### 10.4 Water damage

Completely de-energize the switchboard if there is any sign of moisture or water damage. If damage is believed to be extensive, or if the equipment has been subjected to moisture for extended periods, contact your local Siemens sales representative. Additional information is also available from NEMA publication, "Guidelines for Handling Water Damaged Electrical Equipment."

### 10.5 Corrosive atmospheres

Switchboards are designed to give optimum performance when installed in normal indoor or outdoor locations. Where corrosive atmospheres are encountered, special precautions must be taken to minimize their effect. Exposed metallic surfaces, non-insulated bus bars, disconnect switches, primary and secondary disconnecting contact, 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.

Two Electrical Contact Lubricants are available for this application: Siemens Electrical Contact Lubricant, Part No. 15-172-791-214 available in 8 oz. tubes and Siemens Electrical Contact Lubricant 11-B-9824, available in 50 gram tubes and 400 gram cartridges. Apply these materials in a layer .03-.06" thick.

Siemens WL circuit breakers are shipped with Siemens Electrical Contact Lubricant 11-B-9824 applied, as required, at the factory. This lubricant, Part No. 11-B-9824, should not be mixed with other lubricants, as they may interact and lose essential properties.

Siemens Electrical Contact Lubricant, Part No. 15-172-791-214 may be used for other applications.

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.

## Section 11.0 - Informational charts

### 11.1 Torque values

**NOTE**

This equipment has been tested and inspected before shipment. However, shipping conditions may have loosened some connections. Before energizing, it is recommended that the tightness of all connections be checked.

Size	MACHINE THREAD BOLTS & NUTS <sup>(1)</sup>		THREAD FORMING SCREWS						
	Torque		Torque in lb-in <sup>(2)</sup>						
	lb-in	lb-ft	0.125	0.188		0.250		>0.25	
			AL	CU	AL	CU	AL	CU	AL/CU
8-32	-	-	20	25	30	35	30	35	-
10-24	-	-	20	25	30	50	30	50	-
1/4-20	72	6	30	50	30	72	50	72	-
5/16-18	144	12	-	-	108	144	108	144	144
3/8-16	240	20	-	-	-	-	-	-	240
1/2-13	600	50	-	-	-	-	-	-	-

(1) For use with all washer types      (2) Based on material thickness

BREAKER CONNECTING MACHINE SCREWS	
Screws	Torque in lb-in
#10	20
1/4"	72

**BRANCH LOAD CONDUCTORS-PANEL MOUNTED DEVICES**

This switchboard is designed for the installation of conductors per NEC 312.6. Refer to branch circuit devices for cable size and torque.

As a minimum, wire bending space as required (NEC Tables 312.6(A) and 312.6(B)) for this product is based on wire or cable sizes per Table 310.16 of the NEC. Circuits 110 amp and less are sized from the 60°C aluminum column. Above 110 amp circuits are sized from the 75°C aluminum column. 400 amp circuits are based on (2) 250 or (1) 500 kcmil cables per phase. 600 amp circuits and greater are sized based on multiple 500 kcmil cables per phase.

**FIELD WIRED CONNECTORS - TIGHTENING TORQUE**

When not marked on the device or component, torque all connectors to the values indicated in the table below:

Hex Socket Head Set Screw		Slotted Head Screws		
Allen Wrench	Torque	AWG Wire	Torque lb-in	
Size	lb-in	Size	Small Hole	Large Hole
			#6 - Max.	1/0 Max.
7/32"	150	#14-#10	20	35
1/4"	200	#8	25	40
5/16"	275	#6	35	45
3/8"	375	#4	-	45
1/2"	500	#3-1/0	-	50
9/16	600	-	-	50

Connectors used to terminate field made connections are suitable for use with CU or AL 60°C or 75°C rated conductors unless noted otherwise on the devices. Maximum continuous loads are not to exceed 80% of the rating of the overcurrent protective device, other than in motor circuits, except where the overcurrent protective device is specifically marked as suitable for continuous operation at 100% rating.

**CAUTION:** If this switchboard is used as service equipment, it is limited to six disconnects. (NEC Article 230.71)

**BOLTED PRESSURE EXCEPTION:** When cables are mounted directly to bolted pressure switch terminals, refer to cable selection instructions on switch.

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## Informational charts

### 11.2 Wire bending requirements

Wire Bending space at terminals shall be measured in a straight line from the end of the lug or wire connector (in the direction that the wire leaves the terminal) to the wall, barrier, or obstruction. For reference, see NEMA 312.6 (A and (B).

For removable and lay-in-wire terminals intended for only one wire, bending space shall be permitted to be reduced by the number of inches shown in parenthesis.

For use with SB1, SB2 and SB3 Switchboards – includes copper straps, cover plates and necessary hardware for switchboards.

### 11.3 Strap kits

#### 11.3.1 Connecting strap kits – Circuit breaker

For use with SB1, SB2 and SB3 Switchboards – includes copper straps, cover plates and necessary hardware for switchboards.

Breaker type	Strap kit catalog number	Height (inches)	Mounting
BL, BLH, HBL, BQD	SBLBD	3.75	D
NEB, HEB	SEBD	3.75	D
NGB	SNBD	3.75	D
ED2, ED4, ED6, HED4, HED6, HHED6	6E62	3.75	D
CED6	6CLE2	3.75	D
ND, HD, LD	SDGD	5D	
QJ2, QJH2, QH2-H	6QJ2	5D	
FD6, FXD6, HFD6, HFXD6, HHFD6, HHFXD6	6F62	5D	
CFD6	6CLF1	5S	
NF, HF, LF	SFGD	5D	
JXD2, JD6, JXD6, HJD6, HJXD6, HHJD6, HHJXD6, Single Branch	6JJ61	8.75	S
JXD2, JD6, JXD6, HJD6, HJXD6, HHJD6, HHJXD6 Double Branch	6JJ62	8.75	D
CJD6	6CLJ1	8.75	S
SJD6, SHJD6	6SJL1	8.75	S
SCJD6	6SCJ1	8.75	S
NJ, HJ, LJ	SJG2D	6.25	D
NJ, HJ, LJ	SJG1D	6.25	S
LD6, LXD6, HLD6, HLXD6, HHLD6, HHLXD6	6LL61	8.75	S
CLD6	6CLL1	8.75	S
SLD6, SHLD6	6SLL1	8.75	S
SCLD6	6SCL1	8.75	S
NL, HL, LL	SLGD	6.25	S
LMD6, LMXD6, HLM6, HLMXD6	SLM1D	8.75	S
MD6, MXD6, HMD6, HMXD6, CMD6	SMND	10	S
SMD6, SHMD6, SCMD6	SSMND	10	S
NM, HM, LM	MG1D	8.75	S
ND6, NXD6, HND6, HNXD6, CND6	SMND	10	S
SND6, SHND6, SCND6	SSMND	10	S

**Note:** D = Denotes double branch or twin mounting

S = Denotes single mount

### 11.3.2 Filler plates

For use with SB1, SB2, and SB3 Switchboards.

Breaker frame	Filler plate catalog number
BQ, BQH, HBQ, E2, E4, E6, HE4, HE6, E2-A, E-4A, E6-A, HE4-A OR HE6-A and ED2, ED4, ED6, HED4, HED6	QF3
NEB, HEB	EBF1

**Note:** When a front filler plate is not completely filled with breakers, the openings in the unused space must be closed with 1-pole filler plates from table.

### 11.3.3 Connecting strap kits Vacu-Break and HCP

For use with SB1, SB2 and SB3 Switchboards. Includes copper straps and necessary hardware for switchboards.

Ampere rating	Unit	Height (inches)	Catalog number
30-30		5, 7½	VB657
30-60		5, 7½	
60-60		5, 7½	
60-1007		½	
100-1007		½	
1007		½	
2007		½, 10	VB671
200-2001		0	VB610
400-6001		5	VB6150
800-1200 (HCP)		16¼	F6162D

### 11.3.4 Blank plates – Circuit breaker and Vacu-Break

For use with SB1, SB2, and SB3 Switchboards.

Height (inches)	Catalog number
1¼	6FPB01
2½	6FPB02
3¾	6FPB03
5	6FPB05
10	6FPB10

# Informational charts

## 11.4 Ground fault test record – Internal

## Performance test report Ground fault protection

Job: \_\_\_\_\_

Location: \_\_\_\_\_ Date of Test: \_\_\_\_\_

Circuit: \_\_\_\_\_

Switchboard: \_\_\_\_\_ Single/Double End \_\_\_\_\_

Disconnect Device: \_\_\_\_\_

GF Protective Device: \_\_\_\_\_

GF Sensor: \_\_\_\_\_

Test Equipment: (Describe on back or attach a page.)

Test Setup and Method: (Describe on back or attach a page.)

### A. Inspection

- 1. Wiring and conductors
- 2. Connections and wire clamping
- 3. Bonding, splice bussing and grounding
- 4. Sensor mounting and wiring
- 5. Control circuit overcurrent protection
- 6. Other: \_\_\_\_\_

### B. Insulation resistance

- 1. Neutral-to-ground
- 2. Neutral-to-enclosure
- 3. Enclosure and grd. bus-to-ground
- 4. Grounded service conductor-to-ground
- 5. Other: \_\_\_\_\_

### C. Operation test

1. GF protective device setting: \_\_\_\_\_ A, \_\_\_\_\_ sec. Time Curve: \_\_\_\_\_
2. Control Power: \_\_\_\_\_
3. Test Current: (a) \_\_\_\_\_ A, x \_\_\_\_\_ turns = \_\_\_\_\_ At  
 or (b) Test set signal: \_\_\_\_\_  
 or (c) Primary Current: \_\_\_\_\_ A
4. Trip operation
5. Time Delay: one second or less
6. Test button, lamp, indicator operation
7. Other: \_\_\_\_\_

### D. Label affixed

### E. Equipment restored to operational condition

GFP settings (as left) \_\_\_\_\_

Tested by: \_\_\_\_\_

(1) This test record to be retained by those in charge of the building electrical installation.

(2) Make the report available to the authority having jurisdiction.

# Informational charts

## 11.5 Ground fault test record– External

## Performance test report Ground fault protection

Job: \_\_\_\_\_

Location: \_\_\_\_\_ Date of Test: \_\_\_\_\_

Circuit: \_\_\_\_\_

Switchboard: \_\_\_\_\_ Single/Double End \_\_\_\_\_

Disconnect Device: \_\_\_\_\_

GF Protective Device: \_\_\_\_\_

GF Sensor: \_\_\_\_\_

Test Equipment: (Describe on back or attach a page.)

Test Setup and Method: (Describe on back or attach a page.)

**Ground fault testing**

**Warning:** The following should be performed only by qualified personnel as defined in N.E.C. Article 100. The ground fault sensor (GFS), ground fault relay (GFR), must be installed as in Fig. 1.

The diagram illustrates the electrical setup for ground fault testing. It shows a Main Power Source on the left, connected to a Main Bonding Jumper which is grounded. Two Ground Fault Sensors (GFS) are installed: #2 is located upstream of a Disconnect Device, and #1 is located downstream of it. A Neutral Disconnect Link is connected between the two sensors. A Shunt Trip Device is connected to the Disconnect Device and the Ground Fault Relay (GFR). The GFR is connected to the GFS sensors. The GFS #1 sensor is also connected to a control power source. The GFS #2 sensor is connected to the GFR. The Disconnect Device is connected to a Load. A note indicates that no grounds are permitted downstream from the bonding jumper.

Fig. #1

GFS #1, is the standard location  
GFS #2, alternate location for GFS

1. Disconnect Main Power Source.
2. Remove the neutral disconnect link. Make sure the neutral is grounded only by the main bonding jumper, which must be on the line side of the sensor.
3. Close all branch devices.
4. Using a "megger" type meter, measure the resistance of the load phase and neutral to ground. This is to ensure that no ground connections exist in the system. Resistance readings of (1) Megohm or greater are preferred.
5. Re-install the neutral disconnect link.
6. Open all branch devices.
7. Connect the main power source.
8. To Test The Entire System.
  - a. Check for control power. (LED should be illuminated).
  - b. Press the "push to test" switch on the relay.
  - c. The trip indicator should go to the "tripped" position and the disconnect device should operate.
  - d. Release the "push to test" switch and return the trip indicator to the "reset" position.
  - e. Reset or "close" the disconnect device for normal operation of the switchboard.
9. This test meets the requirements of the National Electrical Code Section 230.95 (C).

### Test record

Date	By	Amp setting	Time setting	Notes

## Service bulletins

### Section 12.0 - Service bulletins

For service bulletins reference the technical information at:  
[www.usa.siemens.com/circuitbreakers](http://www.usa.siemens.com/circuitbreakers)

#### Reference information

NFPA70 (NEC)

NFPA 70 E

NEMA PB2

NEMA PB2.1

NEMA PB2.2

NEMA AB4

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Siemens Industry, Inc.  
5300 Triangle Parkway  
Norcross, GA 30092

For more information, please contact  
our Customer Support Center.

Phone: 1-800-241-4453

E-mail: [info.us@siemens.com](mailto:info.us@siemens.com)

**[usa.siemens.com/switchboards](http://usa.siemens.com/switchboards)**

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