

Beyond X™

**Susol
UL LV Switchboard**

LSB Series
Installation Operation Maintenance Manual



LS ELECTRIC

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1. INTRODUCTION

This manual provides instructions for the general installation, operation, and maintenance of the LSB Series equipment manufactured by LS ELECTRIC.

The LSB2 Series is typically applied in unit substation layouts, such as rear-accessible sites, while the LSB1 Series may be used in both unit substation and load center layouts.

Supervisors responsible for engineering, installation, and operation shall familiarize themselves with this manual and become acquainted with the appearance and characteristics of each component mounted in or contained within the switchboard.

1.1 Inspection and packaging

These instructions and procedures apply to installations of LSB Series products supplied by LS ELECTRIC. Each LSB Series product is carefully inspected and packaged at the assembly facility. Quality control personnel perform both structural and electrical inspections to verify compliance with applicable standards, codes, and specifications.

1.2 Document replacement

After completion of pre-shipment inspections, the switchboard is disassembled as required for packaging and is securely packaged to prevent damage during transportation. The factory order number, identification number, and shipping weight are clearly marked on each shipping section.

1.3 Intended use

If any instruction sheets are lost or damaged, contact your local LS ELECTRIC representative for replacements.

1.4 Disposal after the end of service life

LSB Series switchboards are designed exclusively for switching and distributing electrical energy. They shall be used only within the scope of the specified standards and the technical data provided for the switchboard. Any other use constitutes improper operation and may result in personal injury or equipment damage.

Upon request, a material and recycling data sheet is available for proper disposal of the switchboard at the end of its service life. Disposal services are performed by the manufacturer's service center and are subject to an additional fee.

Liability Disclaimers

The manufacturer shall not be held responsible for any damage if:

- The instructions in this manual are not followed;
- The switchboard is not operated in accordance with its intended use (see above);
- The switchboard is assembled, connected, or operated improperly;
- Accessories or spare parts not approved by the manufacturer are used;
- The switchboard is modified without the manufacturer's approval, or inadmissible parts are added.
No liability is accepted for parts provided by customers (e.g., power cables).

SAFETY PRECAUTIONS

WARNINGS

The low-voltage switchboard is safe and effective when proper precautions are observed. However, exposure to hazardous voltage and energy levels may cause serious injury or death if safety precautions are not followed.

1. Never work around a live or energized bus. Do not remove bolted covers, bolted doors, or bolted access plates when the equipment is energized. The live bus is enclosed behind metal panels and these panels should not be removed unless the bus is de-energized.
2. Never use a circuit breaker rated above the maximum voltage rating of the equipment. Never use a lower interrupting rating than the system is designed for.
3. Only qualified personnel should maintain or operate the switchboard. Maintenance personnel should be qualified to work with low-voltage equipment and familiar with switchboard components and use. Operators should be trained in the proper use of switchboard and its components. Both should have electrical shock and burn medical training.
4. Do not touch the shutters when the switchboard is energized. Voltage exists behind the shutters. They are automatically closed when the breaker is removed, to prevent accidental contact.
5. Do not insert partially disassembled breakers, test breakers, ground-and-test devices, or other items into an energized cell. Tests using these devices must only be conducted when the main bus is de-energized.
6. Never manually close a circuit breaker into a live circuit.
7. Never disconnect or open the secondary circuit of current transformers when they are on energized circuits. Hazardous voltages may develop between contacts. Keep spare current transformers shorted on their secondary circuits.
8. When circuits are opened for maintenance, repair or inspection, lock circuit breakers or disconnect switches in the open position and tag or mark to indicate that they are locked open for safety purposes. In addition, the bus should be grounded to prevent accidents caused by accidental closure or backfeeding.

2. SAFETY PRECAUTIONS

Before operating or working on any electrical equipment, read this manual carefully to understand the safety functions.

In this manual, safety precautions are divided into two types: **[DANGER]** and **[CAUTION]**

DANGER

A danger notice with this symbol indicates that failure to follow the recommended practice could result in serious injury.

CAUTION

A caution notice with this symbol indicates that failure to follow the recommended procedure or practice could result in minor or moderate personal injury and/or property damage.

Note that ignoring caution notices may lead to serious injury or damage in certain situations.

The safety notice contains important information and must be read before beginning any work with the relevant products.

2.1 Handling electrical machinery and apparatus

In order to prevent accidents, anyone handling electrical machinery or apparatus must be thoroughly familiar with the precautions noted below and with those in Section 2, "Electric Shock Prevention." Most accidents can be prevented by exercising caution. Always observe proper safety precautions.

SAFETY PRECAUTIONS

2.1 Handling electrical machinery and apparatus

2. SAFETY PRECAUTIONS

2.1.1 General Precautions

Observe the following precautions when performing maintenance or inspection in order to avoid electric shock or a short circuit. (Accidents can be caused by dropping metal tools, flashlights, or other conductive materials)

DANGER

Working Preparations

Treat electrical equipment as highly flammable material at all times.

- Do not smoke or use open flames in the vicinity of the equipment.
- Wear a helmet, safety shoes, and appropriate work clothing when working on the equipment.
- Cut off the power supply; otherwise, there is a risk of electric shock from live busbars and other current-carrying parts when the switchboard or other electrical panels are opened.
- Ensure there is no voltage in the circuit before performing any electrical work, and ground the panel. Make sure the panel is grounded. (use a voltmeter/circuit tester or the like).
- Never work in the charging area, except in emergencies.
- Inspect the surroundings for potential hazards and inform your colleagues of your planned work.
- Provide sufficient lighting in the work area.
- Maintain an orderly work area: do not scatter tools.
- Learn the proper use of a circuit tester and other necessary tools.
- Read and understand section 2, “Electric Shock Prevention.”

CAUTION

Inspection and Maintenance

- Daily inspection
 - Check the appearance for any damage. Pay special attention to noise, unusual odors, and discoloration.
- Periodic inspection
 - Check each busbar fixing section, device mounting section, and wiring section for any loose components or connections. If any looseness is found, retighten the bolts.
 - Check the appearance of each device (Air circuit breaker, protective relay, current and voltage transformer, fuse, module card, etc.) for any missing or damage components. If any failure or damage is found, replace it with spare parts.
 - Check each device (Air circuit breaker, protective relay, current and voltage transformer, fuse, module card, etc.) for noise, unusual odor, or discoloration. If any noise, unusual odor, or discoloration is detected, replace the device with spare parts.
 - Check the mechanical operating section of each device (vacuum circuit breaker, vacuum contactor, protective relay, etc.) for any mechanical malfunction. If any malfunction is detected, replace the device with spare parts.

2. SAFETY PRECAUTIONS

2.1 Handling electrical machinery and apparatus

2.1.2 Precautions for Hot-line Work

Never perform hot-line work unless it is unavoidable. If repair of live circuits or electrical devices is unavoidable, refer to section 2, “Electric Shock Prevention” and follow the precautions listed below.



Hot-line Work

Treat electrical equipment as highly flammable material at all times.

- In the presence of, and/or under the supervision of competent personnel, perform the work while observing the following preparatory steps.
 - Provide sufficient lighting for the work area.
 - Remove wristwatches, rings, and other metal articles from the body.
 - Wear long sleeve work clothes that fit close to the body, and make sure clothing and shoes are dry.
 - Insulate yourself from the equipment, and place insulating material over any devices or structural components that may be accidentally touched.
 - Cover tools with vinyl tape wherever possible.
 - When performing electrical work, cover live parts with insulating material or safety shutters to protect against dropped tools, scrap wire, and inadvertent contact with live parts.
 - Place insulation between the live section of the circuit and the section to be worked on.
 - Wear rubber gloves on both hands (and wear rubber boots).
- Work with the dominant hand as much as possible, and take care not to lose your balance. A loss of balance due to movement of the equipment can cause an accident.
- In the event of an emergency, the site manager should cut the power off immediately and report the issue to the appropriate personnel.

SAFETY PRECAUTIONS

2.1 Handling electrical machinery and apparatus

2. SAFETY PRECAUTIONS

2.1.3 Guidelines for Fire Extinguishing

In the event of an electrical fire, quickly perform the following procedures.

DANGER

Fire Extinguishing

- Cut off the power to the circuit or device that started the fire.
- Cut off the power to other circuits or devices which may be damaged by the fire, including those that could be affected by fire spread.
- Do not cut off power to any devices that could cause a serious accident if power is removed.
- Inform your supervisor or anyone in the vicinity of the fire.
- Use a fire extinguisher (powder or halide type) to put out the fire.
In a small room or section, there is a danger of asphyxiation from the fire extinguishing material. Be careful to avoid this.
In the case of electrical fires, always cut off the power supply first.
- Be careful when using water to extinguish an electrical fire.
The person putting out the fire could be electrocuted by current flowing through the water.
- Carefully consider whether to use seawater or a fire extinguisher.
Once electrical devices have come into contact with seawater, it is difficult to restore them to their original condition.
In some cases, a fire extinguisher may be preferred even if it takes longer than seawater to extinguish the fire.

2.1.4 Maintenance and Inspection of ACB

CAUTION

Maintenance of ACB

See the operating instructions of the specific breaker for correct maintenance, inspection, and replacement procedures.

For some types and mounting configurations, the entire switchboard must be de-energized for [Fixed type].

For others, only a restricted area of the switchboard must be de-energized for [Draw-out type].

2. SAFETY PRECAUTIONS

2.1 Handling electrical machinery and apparatus

2.1.5 Precautions for ACB Operation



ACB Operation

- Before operating circuit breakers and switches, confirm the following to avoid putting others in danger.
 - Ensure that energizing any or all devices in the circuit will not cause problems.
 - Verify that there are no other individuals working on the same circuit.
If there are, inform them of the breaker or switch you will be operating and advise them to exercise caution.
 - Confirm that the protective devices (protective relay, fuses, etc.) of all circuits are in proper order.
- Operate breakers and switches in the following manner:
 - Perform all operations with the dominant hand. Keep the other hand back and away from the breaker or switch, except for operations that require both hands.
 - Operate knife switches with one quick motion.

2.1.6 Precautions for Current and Voltage transformer Operation



CT and VT Operation

Do not open the secondary side of a current transformer.
If the secondary side must be opened for repair work, do not leave it open. High voltage may be produced in the secondary side as current flows through the primary side. Periodically check the connections of the secondary side to ensure they are tight.

SAFETY PRECAUTIONS

2.1 Handling electrical machinery and apparatus

2. SAFETY PRECAUTIONS

2.1.7 Precautions for Changing Fuses

DANGER

Changing Fuses

- Changing fuses
 - When removing a fuse, carefully unscrew the fuse cap.
 - While inserting the fuse into the fuse clip, do not allow the conductive part of the fuse to touch the gap between fuse clips. Failure to follow this procedure may result in a short-circuit accident.
 - When changing a fuse, do not make contact with energized devices or any other live parts nearby (e.g., busbar etc.). Failure to follow this procedure may result in electric shock.
- Selecting the right spare
 - Use a spare of the same type and rated current as the blown fuse.

2.1.8 Other Precautions

CAUTION

Other Precautions

- Keep front doors and back covers or doors closed except when it is necessary to open them.
- Before starting electrical work, secure moving parts by fastening the door or any objects that could move the switchboard cover.
- Do not remove protective plates or protective covers. If they must be removed, be sure to return them to their proper positions.
- Do not leave any tools or work materials on or around the switchboard or starter panel after work is completed.
- Always discharge capacitors before working on capacitor circuits.

2.2 Electrical shock prevention

2. SAFETY PRECAUTIONS

2.2.1 General Information on Electric Shock

- **The Danger of Electricity**

- Receiving an electric shock is extremely dangerous.
Even a relatively small amount of current can be fatal if it passes through the head, lungs, or other vital organs.
- 220 V AC is more dangerous than commonly assumed.
- At 220 V AC, 60/50 Hz, even 50 milliamperes (mA) is dangerous and 50 – 100 mA can cause a fatal electric shock.

- **The Symptoms of Electric Shock**

The symptoms described below must be treated immediately with artificial respiration or Cardiopulmonary Resuscitation (CPR) until the victim recovers. These are symptoms of electric shock and should not be confused with death. It is common for a person suffering from these symptoms to recover even after several hours of artificial respiration or cardiopulmonary resuscitation (CPR).

The symptoms are listed in order from mild to most serious cases.

- Breathing stops.
- Normal breathing can usually be restored after continuing artificial respiration for a short while.
- Breathing stops, face is pallid, and pulse is very weak or undetectable.
- Totally unconscious.

In the worst case, the victim's body may become rigid within two or three minutes after the shock.

2.2.2 Prevention of Electric Shock

Anyone operating or performing maintenance or repairs on electrical equipment, or supervising such work, should take the following measures to prevent electric shock accidents.



Prevention of Electric Shock

- Never estimate the voltage applied to a circuit until the voltage has been confirmed (measured).
- Always cut off the power supply and confirm that no voltage is present in the circuit before performing any electrical work. Most accidents occur because the power is mistakenly assumed to be off.
- Always use rubber gloves, rubber boots, and an insulation mat when performing electrical work.
- Tag the power supply switch when performing electrical work.
(e.g., "Do Not Turn on Power: Maintenance Work")
- Turning on the power during maintenance may cause a serious accident.
- Operate switches with the dominant hand while keeping the other hand back and away from the body.
- The site manager should be present near the switchboard installation area to cut off the power immediately if an accident occurs.

RECEIVING, HANDLING AND STORING

3. RECEIVING, HANDLING AND STORAGE

Before the switchboard is shipped, it is assembled to the maximum extent possible and then dispatched to the port.

Hardware, small parts, and brackets are boxed and shipped with the switchboard assemblies. Breakers, batteries, and other major components are usually shipped in their own cartons. Cartons, crates, and boxes are tagged to facilitate receiving and assembly.

3.1 Receiving

Once the switchboard arrives, inspect the equipment for any damage. If there is any shipping damage, a claim should be filed with the shipping company. Notify a manufacturer representative as soon as possible.

Carefully check the packing list to ensure that all parts have arrived. Note that small items may be packed with larger ones; this will be indicated on the shipping documentation.

3.2 Handling



WARNING

Make sure the rope or chain is strong enough to bear the weight of the panel. Comply with the relevant regulations for hoisting equipment.



WARNING

When lowering the panels, make sure that the supporting platform is sufficiently stable and even.



WARNING

Risk of accident. Pay attention to openings in the floor.

Before handling, refer to the drawings for the approximate weight of shipping sections. Care should be taken to avoid damaging the switchboard during handling operations. Use only properly rated equipment for lifting the specified weights, and employ trained personnel experienced in handling large electrical equipment.

Prior to uncrating, the equipment may be moved by a crane using slings placed beneath the crate. Rollers placed under crate skids are also an acceptable method of moving the switchboard section.

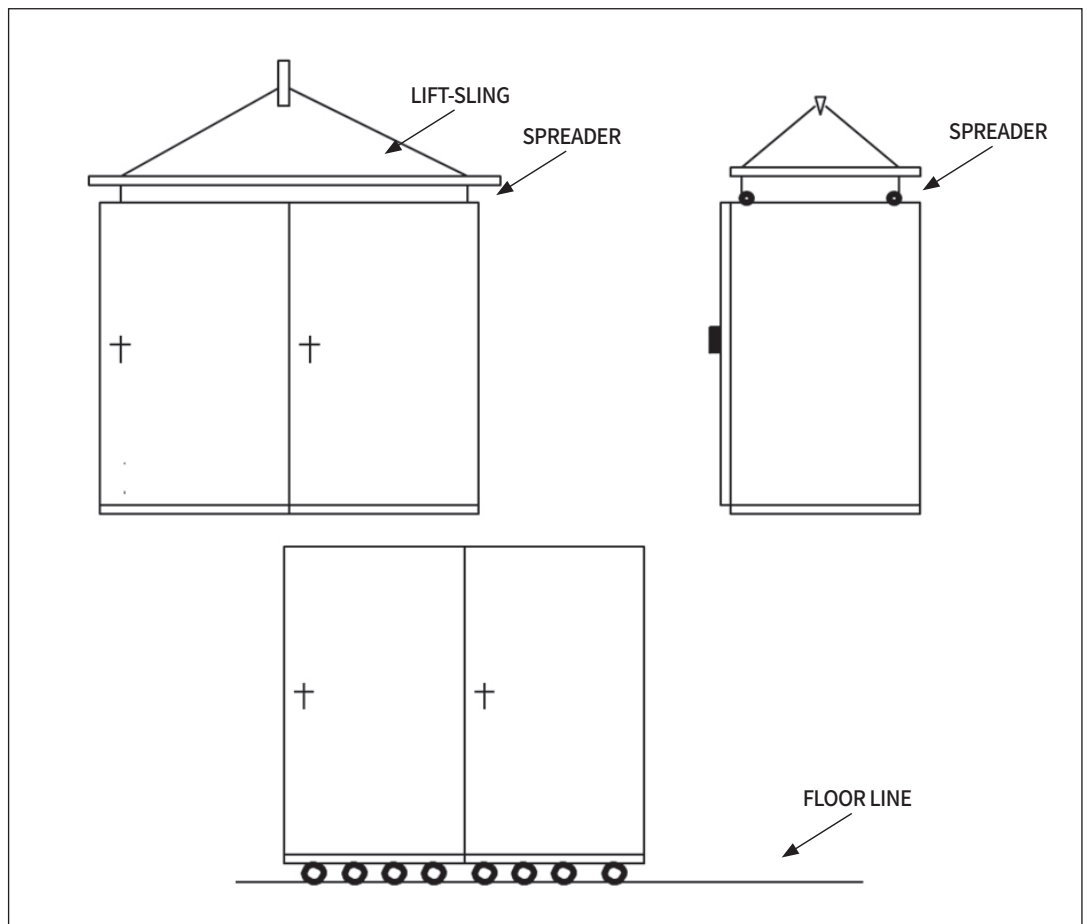
3. RECEIVING, HANDLING AND STORAGE

3.2 Handling

After uncrating, the switchboard shipping sections should be moved by cranes using chains and spreader bars. Breakers are generally equipped with their own lifting eyes.

Dragging or skidding the switchboard along the ground may damage the base and cause deformation or functional failure.

Improper lifting or failure to use spreader bars may damage the enclosure by applying excessive lateral force. Using improperly rated lifting equipment or untrained personnel may result in the switchboard being dropped, causing breakage, warpage, or misalignment.



< Fig. 1 Transporting indoor equipment >

For movement in this direction only, use rollers.
(Each roller must support the front, middle, and rear floor channels.)

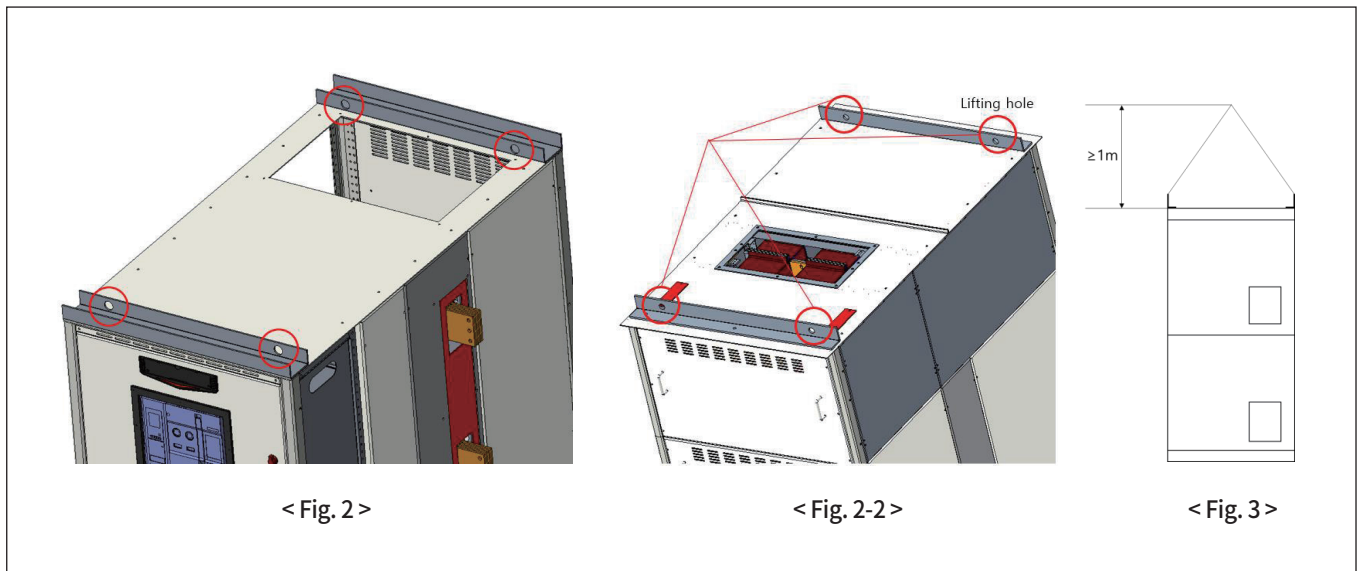
RECEIVING, HANDLING AND STORING

3. RECEIVING, HANDLING AND STORAGE

3.2 Handling

Transportation the panel by crane

- Attach the crane slings to the lifting points at the top of the panel (Fig. 2).
Make sure to maintain a minimum height of 1 m (Fig. 3).
- Carefully lift the panel and place it at the designated location.



NO	DESCRIPTION	MARK	POSITION
1	THIS WAY UP		SIDE
2	FRAGILE		-
3	KEEP DRY		-
4	DO NOT USE HOOK, DO NOT PUNCTURE		FRONT
5	SLING HERE		-
6	DO NOT TUMBLE, DO NOT DROP		-
7	CENTER OF GRAVITY		-

3. RECEIVING, HANDLING AND STORAGE

3.3 Storage

3.3.1 Storage method

If the equipment will be stored for an extended period, it should be prepared for storage and stored under the following conditions. DO NOT uncrate the wooden box of the switchgear.

Choose a clean, dry location free from harmful vapors. The switchboard should be stored on a flat floor to prevent bending or structural twisting. Do not store directly on the dirt or mud; place a protective covering on the floor under the switchboard. Cover the switchboard with heavy tarps to prevent dust and dirt from settling. Allow adequate ventilation to remove condensation.

If dampness or condensation is encountered, heaters should be used to prevent damage. Remove any plastic, paper, cardboard, or fabric from the vicinity of the heaters. Never use heaters near flammable liquids or gases.

If in the event of severe weather conditions (e.g., heavy snow, rain, or strong wind), the switchboard should be stored indoors.

If the equipment must be stored for more than three months from the shipment date, it should be placed in a dry, clean, well-ventilated, and heated indoor environment. After 12 months from the shipment date, it is recommended to uncrate the equipment for a visual inspection under the manufacturer's supervision, and then repack it.

Batteries and breakers should be stored according to the requirements of their respective instruction manuals. In general, these requirements are more stringent than the switchboard requirements.

3.3.2 Checkpoint for storage

- Wooden condition
- Vacuum bag condition
- Humidity in vacuum bag
- SWBD condition

3.4 Storage guarantee

The quality guarantee for the panels is valid for 2 weeks after unpacking when stored indoors in a well-ventilated area. The storage area should have a well-drained, paved floor, and the temperature should be above 60 °F with air humidity not exceeding 60 %. After the guarantee period expires, the panels shall be repacked by the responsible manager.

INSTALLATION

4. INSTALLATION

4.1 Location

Find the designated area on the building floor plan where the switchboard will be installed. The location chosen for installation should provide working clearances complying with Section 110-26 of the National Electrical Code® (NEC®) or Section 2-308 of the Canadian Electrical Code (CEC) Part 1.

Switchboards that require rear access for installation, field connections, or maintenance (such as filter replacement), require 30 in. (762 mm) of working space per NEC 110-26.

For installation at the site, the switch room must be fully set up. Lights, power supplies, locking devices, and ventilation systems should be installed and operational.

The electric room should be well-ventilated, avoiding high temperatures and humidity. Even when humidity is relatively low condensation can occur if there is significant temperature change. An air conditioner or dehumidifier should be present at the site if this occurs.

It is recommended to install LSB Series products in areas where salt, explosives, or toxic gases are not present. The location should be free from risk of flooding or water drips. Special care should be taken to prevent accidents caused by water leakage from the ceiling. Do not install pipes carrying combustible gases, water, or fuel in the power substation.

Power cables and control cables for connection to the switchboard should be prepared in advance. For switchboard panels with top-mounted structures for earthing switches or instrument transformers, ensure that ceiling height is sufficient to open the access plates.

4.2 Foundations

Before setting the switchgear down, the foundation must be settled. The mounting area of the switchgear should be within 0 – 2 mm. Adjustments can be made by using steel plate or by installing steel plates under the corners and center of cubicles if needed.

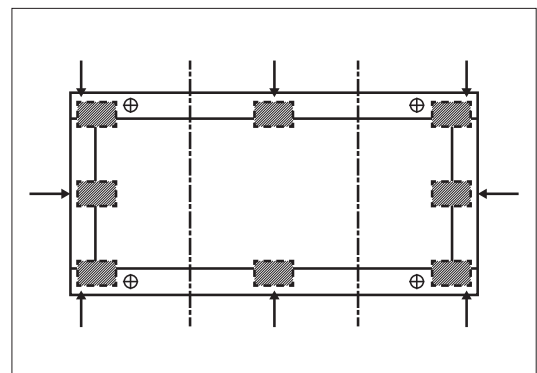
The floor or foundation must be strong enough to support the weight of the switchboard without sagging. The surrounding floor area should gently slope toward a drain.

An unlevelled foundation may cause improper operation of doors. Weatherproof seals may not align correctly. Breakers may not rack in and out properly. Section alignment and busbar connections will be more difficult. Unlevelled areas in front of indoor sections may interfere with door opening and racking in/out of the ACB.

For switchboard installation, nothing should protrude (e.g., conduits, wiring and ground connectors). This prevents problems when the switchboard is set in place.

All concrete preparation work should be completed prior to setting the switchboard in place. This includes leveling, drilling holes, and finishing.

In addition to the physical issues caused by performing concrete work after setting the switchboard, such work generates dust, which can be harmful to the switchboard.



4. INSTALLATION

4.3 Installation

Remove all dirt and debris from the foundation and surrounding area before moving the switchboard into final position.

Prior to placing the switchboard on the foundation, remove all packing and crating material. If the switchboard consists of more than two sections, the center section should be placed first. Switchboard sections shall be positioned before the aisle section.

Maneuver each shipping section into the desired position by following the procedures described in “Handling” on pages 15-18.

Align the first section of the switchboard carefully, as all remaining sections must be exactly aligned with it. Lower each section slowly over the conduit stubs to align with the “available conduit area” shown in the bottom view of the equipment drawings. Otherwise, there may not be sufficient cable bending space.

Remove all temporary bracing and shipping supports. These components are painted in different colors to facilitate easy identification.

After the switchboard is placed, check for flatness and vertical alignment. When the switchboard is out of level, insert shims at the fastening points to secure it to the foundation.

Install the remaining sections outward from the center section, ensuring each section is properly aligned when placed. After each section is installed, make the through-bus splice connection to the preceding section before installing the next section.

HAZARD OF INCREASED STRESS ON BUSBARS

- Level and align adjacent shipping sections with one another. Ensure proper alignment of the horizontal main through busbar and correct splicing of bus connections.
- Failure to follow these instructions can result in equipment damage.

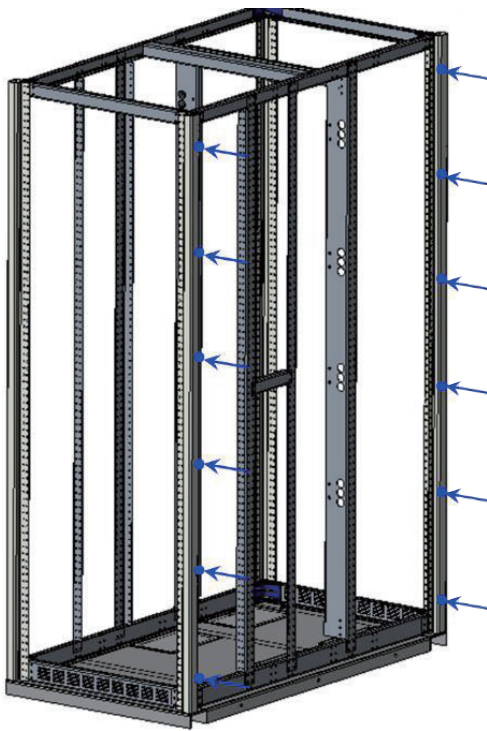
INSTALLATION

4. INSTALLATION

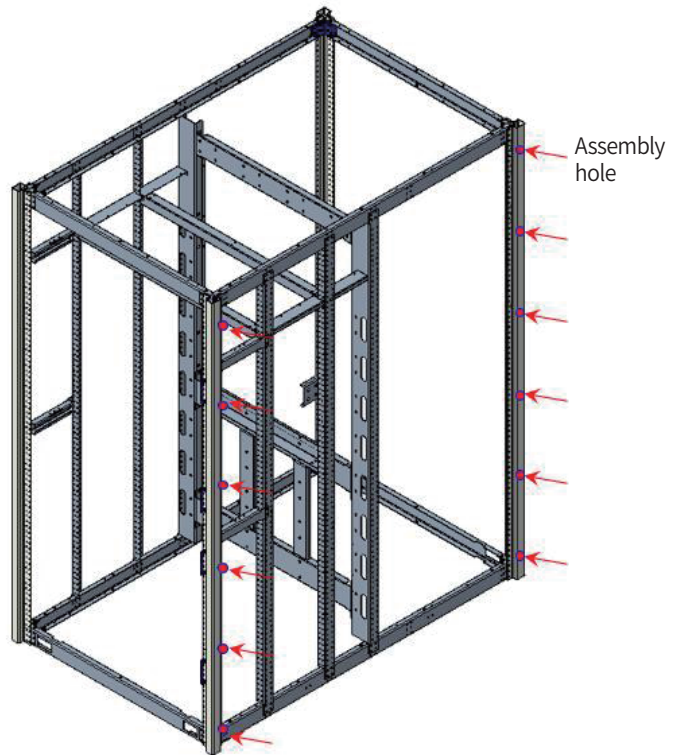
4.3 Installation

4.3.1 Joining shipping sections

- 1) Position each adjacent section, carefully leveling and aligning it with the previous section.
- 2) Open or remove the front doors and rear covers to provide access for bolting adjacent shipping sections together.
- 3) 12 bolts (M8×20 mm) are provided. Place the bolts through the existing holes in the front and rear vertical corner channels to join adjacent sections. See Figure 4.
- 4) Make the through-bus splice connections to the preceding section.
- 5) Close or secure all front doors and rear covers removed in the previous step 2.



< Fig. 4 >



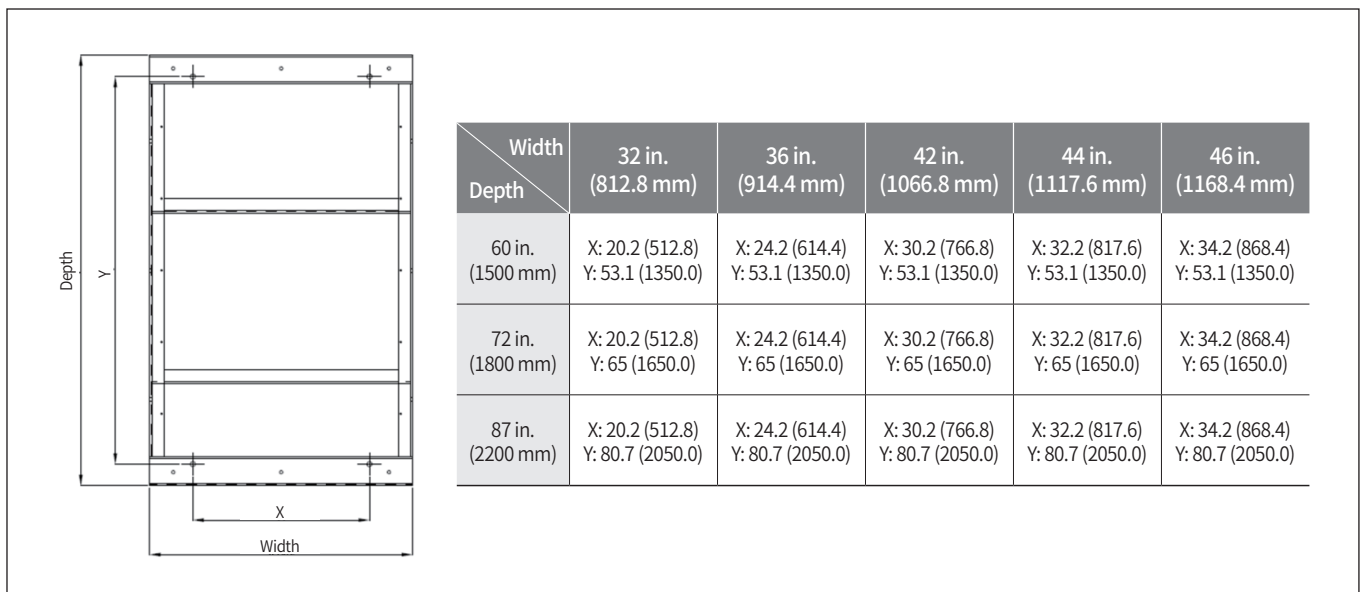
< Fig. 4-2 >

4. INSTALLATION

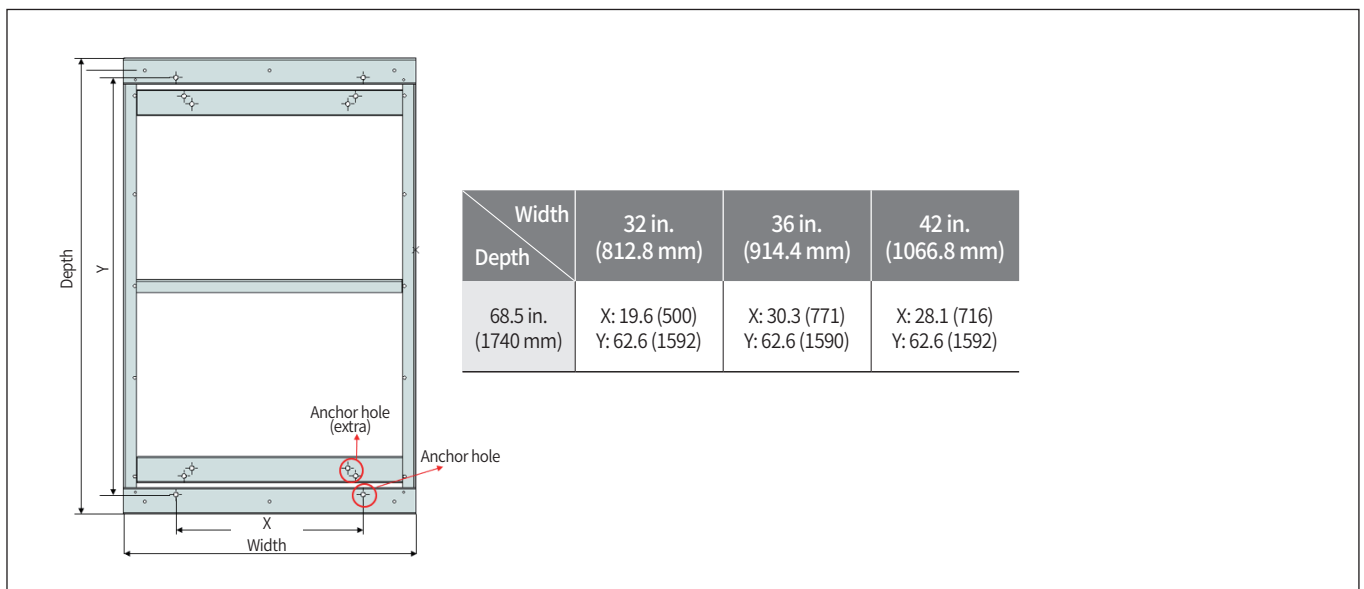
4.3 Installation

4.3.2 Base anchoring

- 1) To anchor the switchboard to the floor properly, use all designated 18 mm diameter mounting hole locations shown in Figure 5.
- 2) There are 4 anchor holes, 2 at the front and 2 at the back.
(If an anchor bolt interferes with reinforcement steel, an additional hole may be used for installation.)



< Fig. 5 >



< Fig. 5-2 >

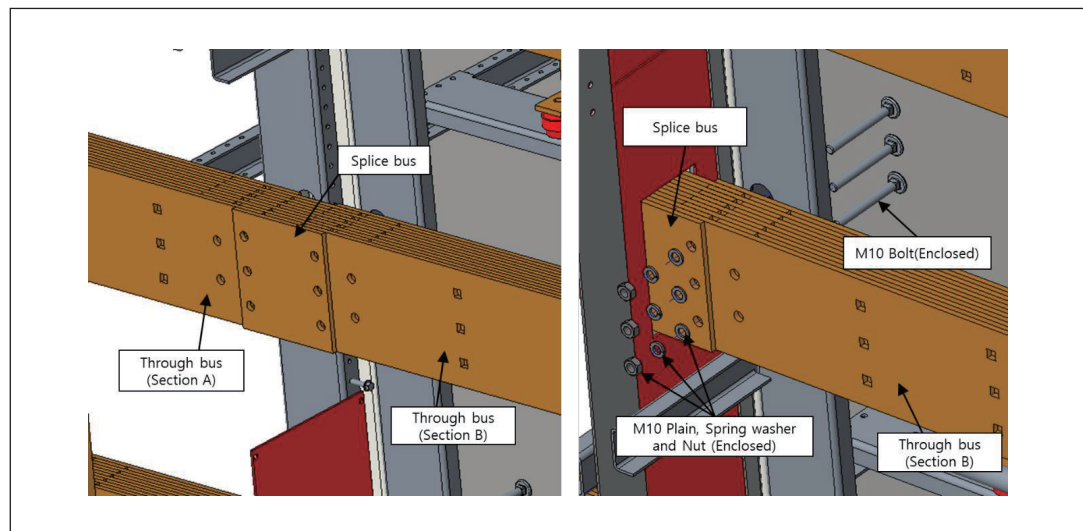
INSTALLATION

4. INSTALLATION

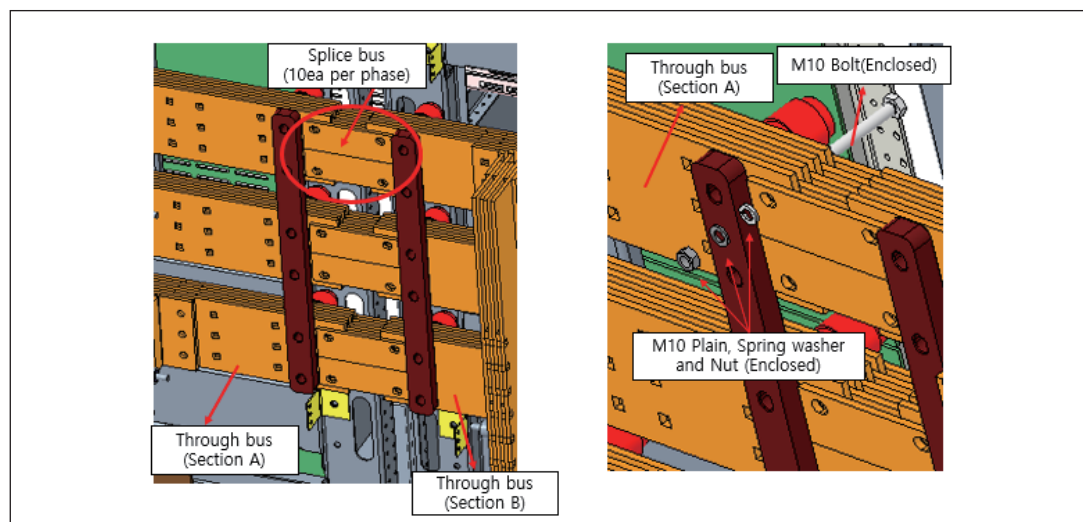
4.3 Installation

4.3.3 Connections of through bus splice

- 1) Splice bus and connecting bolts are enclosed inside the panel.
- 2) Clean the contact surfaces with a non-flammable, non-harmful cleaning solution, and wipe them clean using a non-abrasive cloth.
- 3) Through-bus connections are made between sections by bolting each through bus. When the bus is aligned with the bus bars in adjacent cubicles, they are joined directly to each other using M10 bolts.
- 4) Connect the splice bus as shown in Figure 6. Refer to Section 4.4 for assembly torque.
- 5) Complete the assembly.



< Fig. 6 >



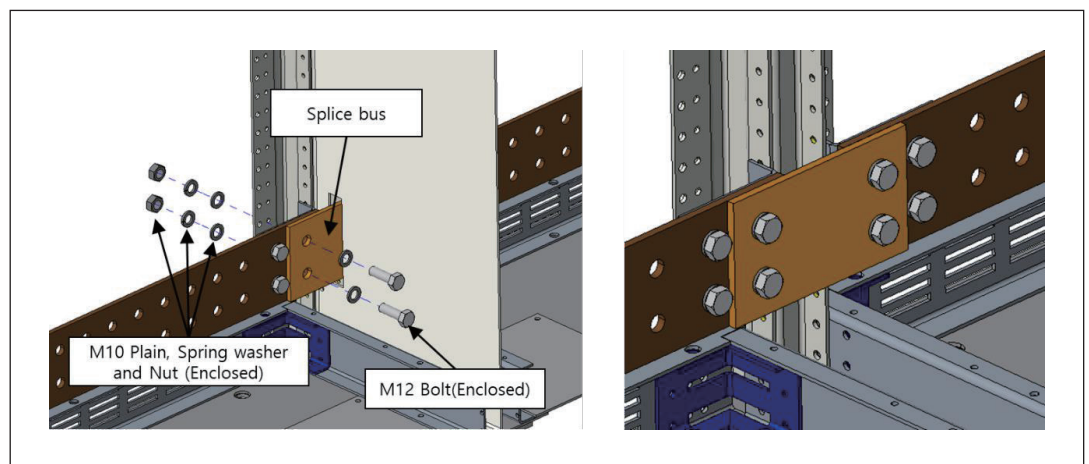
< Fig. 6-2 >

4. INSTALLATION

4.3 Installation

4.3.4 Connections of ground bus splice

- 1) Remove the rear cover.
- 2) The ground bus splice is enclosed inside the panel.
- 3) Clean the contact surfaces with a non-flammable, non-harmful cleaning solution, and wipe them clean with a non-abrasive cloth.
- 4) Ground bus connections are made between sections by bolting each through-bus. When the bus bars in adjacent cubicles are aligned, join them directly using M12 bolts.
- 5) Connect the splice bus as shown in Figure 7. Refer to Section 4.4 for assembly torque.
- 6) After assembly is complete, reattach the removed rear cover.



< Fig. 7 >

INSTALLATION

4. INSTALLATION

4.3 Installation

4.3.5 Grounding and Bonding

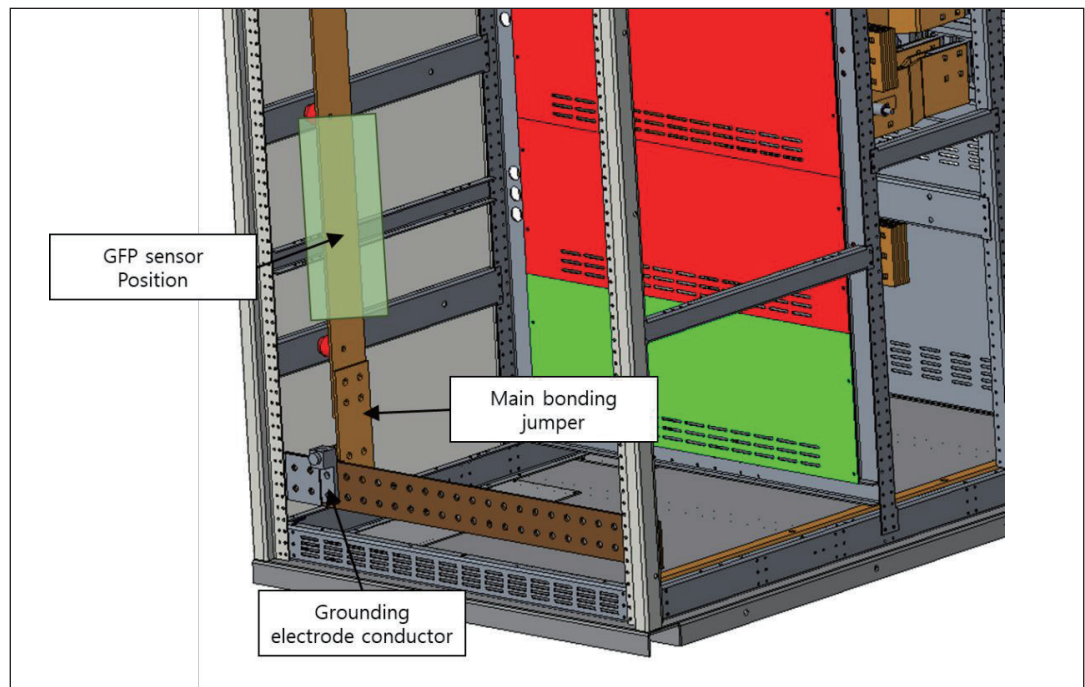
4.3.5.1 Service equipment - Grounded system

※ **Note:**

A system is considered “grounded” if it is connected to ground at any point along the system, regardless of whether the grounded conductor (neutral) is carried through the loads.

For solidly grounded systems used as either service equipment or as a main switchboard on a separately derived system:

- 1) The ground conductor hole configuration is based on NEMA CC1. Run a grounding electrode conductor from the grounding electrode at the installation site to the grounding electrode conductor connector (optional ground lug) located on the switchboard ground bus (Figure 8). Select the material and size of the grounding electrode conductor to comply with Sections 250-62 and 250-66 of the NEC or Sections 10-204 and 10-206 of the 1998 CEC, and install it as specified in Section 250-64 of the NEC or Section 10-908 of the 1998 CEC.
- 2) Install the main bonding jumper between the neutral bus and the ground bus (Figure 8).
- 3) For torque values, refer to “Section 4.4— Torque values for switchboard hardware”.



< Fig. 8 >

4. INSTALLATION

4.3 Installation

4.3.5.2 Service Equipment - Ungrounded System

For ungrounded systems used as either service equipment or as a main switchboard on a separately derived system:

- 1) Run a grounding electrode conductor from the grounding electrode at the installation site to the grounding electrode conductor connector (optional ground lug) located on the switchboard ground bus (Figure 8).
- 2) Select the material and size of the grounding electrode conductor to comply with Sections 250-62 and 250-66 of the NEC or Sections 10-700 and 10-702 of the 1998 CEC, and install it as specified in Section 250-64 of the NEC or Section 10-204 of the 1998 CEC.

4.3.5.3 Not Service equipment

For either grounded or ungrounded systems, when a switchboard is not used as service equipment or as a main switchboard on a separately derived system:

Use equipment grounding conductors sized according to Section 250-122 of the NEC or Section 10-206 of the 1998 CEC to connect the switchboard frame and ground bus to the service ground.

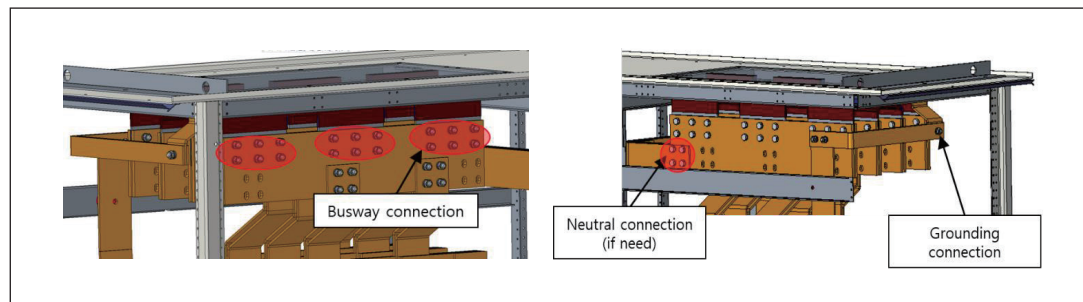
INSTALLATION

4. INSTALLATION

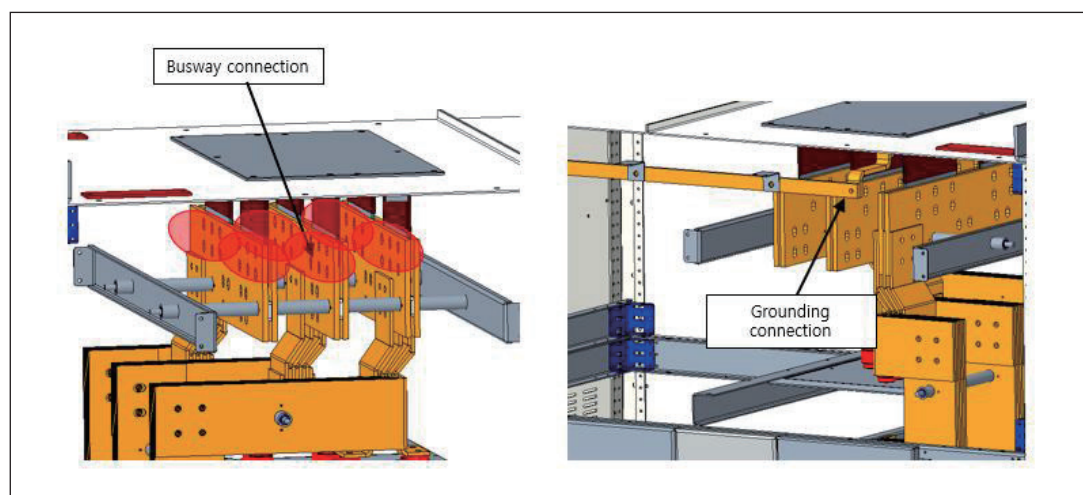
4.3 Installation

4.3.6 Busway connections

- 1) Remove the bolts used to connect where the busway and keep them for reuse.
- 2) Install the busway flanged end to the switchboard bus connectors provided in the switchboard (Figure 9). Insert the flanges between the switchboard bus connectors so that the mounting holes in the flanged end align with the pre-drilled holes in the switchboard enclosure.
- 3) Line up the holes in the bus bar flanges and reinstall the M12 bolts with plain washers, spring washers, and nuts.
- 4) Torque the bolts inserted in step 3 as indicated in "Section 4.4 -- Torque values for switchboard hardware".
- 5) Assemble the busway collar to the switchboard enclosure using the provided screws.
- 6) Ensure that the busway integral ground is connected to the switchboard ground bus.
- 7) Confirm the busway phase sequence before energizing.



< Fig. 9 >



< Fig. 9-2 >

4. INSTALLATION

4.3 Installation

4.3.7 Conduit Area

- 1) The conduit area is marked on the drawings provided. Prepare the conduit according to the specified size.
- 2) Install the conduit properly. Use hubs, locknuts, and bushings to protect the cables and prevent condensation from entering the switchboard.
- 3) Bond all conduit hubs to the switchboard enclosure using approved electrical connections.

4.3.8 Cable Connections (for ACB)

The switchboards are constructed according to customer specifications for the cable entrance arrangement. Switchboard components are arranged to provide proper cable clearance and bending space for cables entering or exiting the switchboard, as specified on the equipment drawing.

- 1) Use only cable sizes suitable for a proper fit with the corresponding lugs.
- 2) Pull the required number of line-side and load-side cables according to the load served and the NEC or CEC.
- 3) Position the cables inside the switchboard to prevent physical damage.
- 4) Maintain the largest possible bending radii and proper clearance to bus bars and grounded parts. If any cables are resting on or bearing against structural members, support them or place suitable protective material at the bearing point to protect the cable insulation.
- 5) Ensure that all phase conductors, including the neutral, pass through the same opening where cables enter or exit the switchboard, or through any metal with magnetic properties. Failure to do so may result in overheating. See Section 300-20(a) of NEC.
- 6) When instructed, brace or cable-lace the conductors.

INSTALLATION

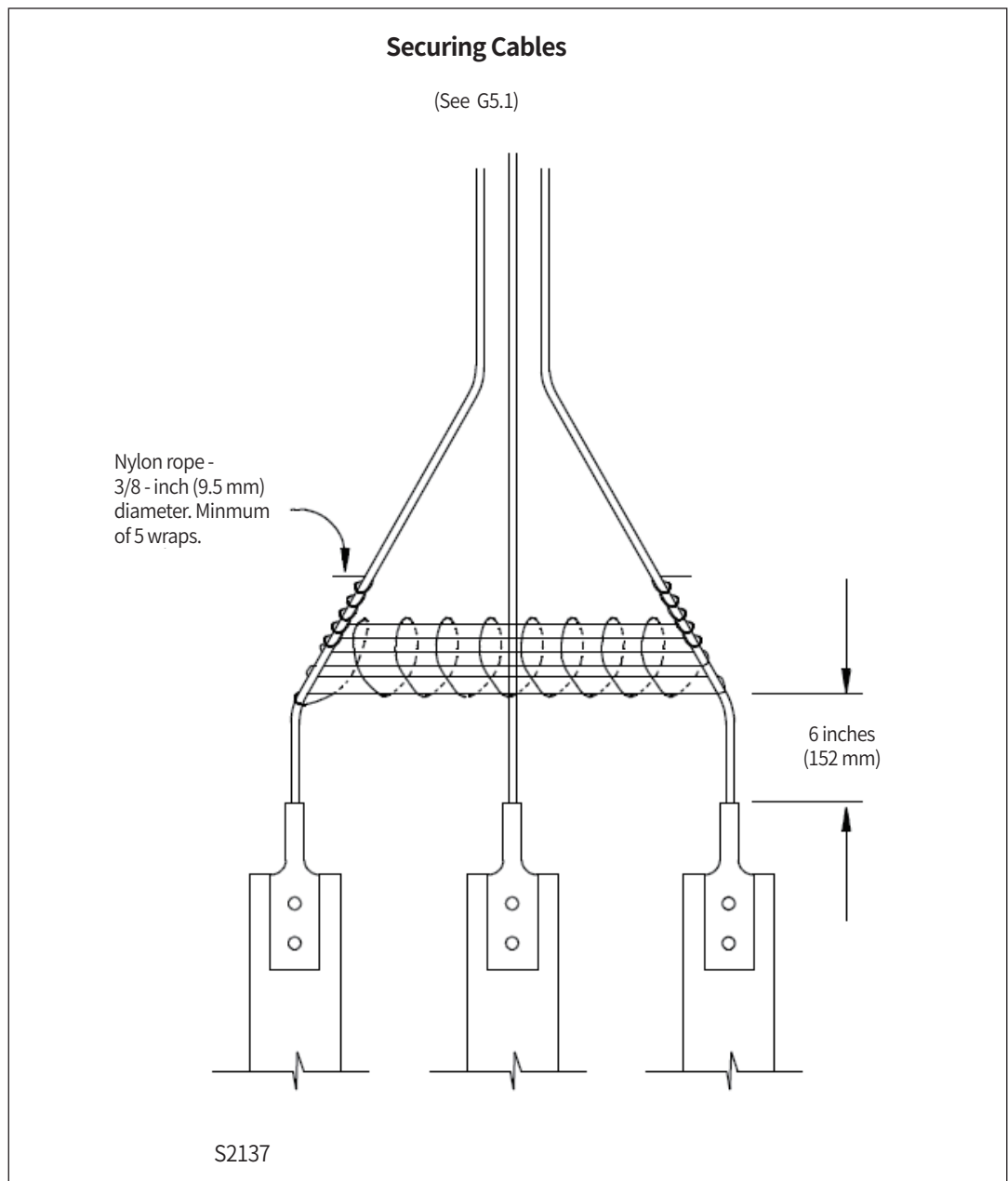
4. INSTALLATION

4.3 Installation

Cable Restraint for Short-Circuit Current Rating

Wrap line cables together and, if provided, tie them with nominal 9.5 mm (3/8 inch) nylon rope or rope with a minimum tensile strength of 8896 N (2000 pounds) as follows:

- (1) At 152 mm (6 inches) and 305 mm (12 inches) from the line terminals, make five wraps.
- (2) Every additional 152 mm (6 inches), make five wraps; or every 25.4 mm (1 inch), make one wrap.



< Fig. 10 >

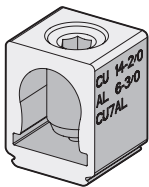
4. INSTALLATION

4.3 Installation

4.3.8 Cable Connections (for MCCBs)

The switchboards are constructed according to customer specifications for the cable entrance arrangement. Switchboard components are arranged to provide proper cable clearance and bending space for cables entering or exiting the switchboard, as specified on the equipment drawing.

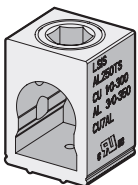
- 1) Use only cable sizes suitable for proper fit with the corresponding lugs.
- 2) Pull the required number of line-side and load-side cables according to the load served and the NEC or CEC.
- 3) Position the cables inside the switchboard to prevent physical damage.
- 4) Maintain the largest possible bending radii and proper clearance from bus bars and grounded parts. If any cables rest on structural members, support them or place suitable protective material at the bearing points to protect the cable insulation.
- 5) Ensure that all phase conductors, including the neutral, pass through the same opening where cables enter or exit the switchboard, or through any metal with magnetic properties. Failure to do so may result in overheating. See Section 300-20(a) of NEC.
- 6) When instructed, brace or cable-lace the conductors.
- 7) Refer to the assembly torque values provided below.



AL150TS
1.6 – 150 A LUG

Lug type	Terminal body material	Breaker AMP range	Wire type	Applicable wire (AWG)	Torque N-n (lb-in)
AL150TS	Aluminum	1.6 – 15 A	Cu	14	4.1 (36.2)
		20 – 30 A	Cu	12 – 10	5.4 (47.8)
		40 – 175 A	Cu	8 – 2/0	15.1 (133.6)
		50 – 70 A	Al	6 – 3	5.4 (47.8)
		90 – 150 A	Al	2 – 3/0	15.7 (138.6)

Mechanical Lug Kits for UTS250 Circuit Breakers



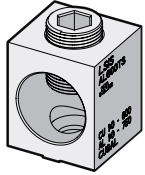
AL250TS
150 – 250 A LUG

Lug type	Terminal body material	Breaker AMP range	Wire type	Applicable wire (AWG)	Torque N-n (lb-in)
AL250TS	Aluminum	150 – 175 A	Cu	1/0 – 2/0 AWG	32 (283.2)
		150 – 175 A (Al) 200 – 225 A (Cu)	Cu/Al	3/0 – 4/0 AWG	
		200 – 225 A (Al) 250 A (Cu)	Cu/Al	250 – 300 kcmil	44 (389.4)
		250 A	Al	350 kcmil	

INSTALLATION

4. INSTALLATION

Mechanical Lug Kits for UTS400 Circuit Breakers

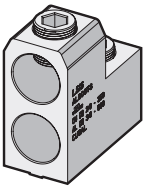


AL400TS
250 – 400 A LUG

Lug type	Terminal body material	Breaker AMP range	Wire type	Applicable wire (AWG)	Torque N-n (lb-in)
AL400TS	Aluminum	250 A 300 A 350 A 400 A	Cu/Al	1/0 AWG – 300 kcmil	40.5 (358.5)
			Cu/Al	350 – 600 kcmil	54 (478)
			Al *	700 – 750 kcmil	54 (478)

* Compact wire only (700 – 750 kcmil)

Mechanical Lug Kits for UTS600 Circuit Breakers

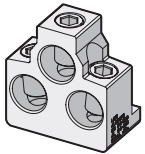


AL600TS
500 – 600 A LUG

Lug type	Terminal body material	Breaker AMP range	Wire type	Applicable wire (AWG)	Torque N-n (lb-in)
AL600TS	Aluminum	500 A 600 A	Cu	2/0 AWG – 350 kcmil	40.5 (358.5)
			Al *	3/0 AWG – 500 kcmil	40.5 (358.5)

* Compact wire only (400 – 500 kcmil)

Mechanical Lug Kits for UTS800 Circuit Breakers

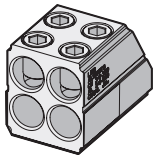


AL800TS
400 – 800 A LUG

Lug type	Terminal body material	Breaker AMP range	Wire type	Applicable wire (AWG)	Torque N-n (lb-in)
AL800TS	Aluminum	400 A 600 A 630 A 800 A	Cu	3/0 AWG – 300 kcmil	45 (398.3)
			Al *	3/0 AWG – 400 kcmil	45 (398.3)

* Compact wire only (350 – 400 kcmil)

Mechanical Lug Kits for UTS1200 Circuit Breakers



AL1200TS
800 – 1200 A LUG

Lug type	Terminal body material	Breaker AMP range	Wire type	Applicable wire (AWG)	Torque N-n (lb-in)
AL1200TS	Aluminum	800 A 1000 A 1200 A	Cu	3/0 AWG – 350 kcmil	45 (398.3)
			Al *	3/0 AWG – 500 kcmil	45 (398.3)

* Compact wire only (400 – 500 kcmil)

4. INSTALLATION

4.4 Torque values for switchboard hardware

Table A. Torque values for Switchboard hardware

Category	Torque (kg · f · cm)
Bolted bus connections	M6: 70 – 100 M M8: 200 – 245 M M10: 350 – 490 M M12: 600 – 850 M M16: 1500 – 2040 M
Power cable connections	M6: 70 – 100 M M8: 200 – 245 M M10: 350 – 490 M M12: 600 – 850 M M16: 1500 – 2040 M
Insulators	M8: 160 – 200 M M10: 300 – 360 M M12: 400 – 460 M
CT case (Plastic)	M8: 100 – 120 M
CT 2nd terminal	M5: 30 – 40 M

PRE-ENERGIZING CHECKOUT PROCEDURE

5. PRE-ENERGIZING CHECKOUT PROCEDURE

Conduct a complete inspection before energizing the switchboard to ensure that all components function and operate properly. Complete every step of the checkout procedure listed prior to energizing the switchboard.

1. Check all field-installed bus bar connections. Torque values are listed in "Section 4.4 -- Torque values for switchboard hardware".
2. Check all accessible connections for tightness.
3. Check all factory- and field-installed lug terminations for tightness.
4. Check the rigidity of all bus bar supports.
5. Inspect the switchboard enclosure for dents or other damage that could reduce electrical clearances inside the switchboard.
6. Remove all foam blocks or other temporary cushioning or retaining materials from the electrical devices.
7. Manually open and close all switches, circuit breakers, and other operating mechanisms, checking for correct alignment and free operation.
8. Operate all electrically operated switches, circuit breakers, and other devices equipped with remote operators (not under load). An auxiliary source of control power may be required to accomplish this.
9. Check all relays, meters, and instrumentation to verify that all field-installed wiring connections are correct and that the devices function properly.
10. Current transformers (CTs) supplied for customer use require connection to a metering device load before energizing. Verify that the metering device load is properly connected, including main switchboard connections to remote equipment.
11. Verify that all grounding connections are correctly made. If the switchboard is used as a service entrance, double-check that the main bonding jumper is connected (Figure 8).

HAZARD OF OVERVOLTAGE TO CONTROL AND PROTECTION COMPONENTS

- Remove the long-time rating plug before performing electrical insulation testing on a circuit breaker labeled "Warning: Disconnect Plug Before Dielectric Test."
- Open all control and metering disconnects on the control circuits.

Failure to follow these instructions may result in personal injury or equipment damage.

5. PRE-ENERGIZING CHECKOUT PROCEDURE

12. Conduct an electrical insulation resistance (Megger®) test to ensure that the switchboard is free from short circuits and unintended grounds.
 - a. Open all control power and metering disconnects or remove the fuses from the control circuits.
 - b. Disconnect the neutral connection at any surge protective device or other electronic device before performing the electrical insulation resistance test; reconnect after the test.
 - c. With the neutral isolated from the ground and all power switches and circuit breakers open, conduct electrical insulation tests from phase-to-phase, phase-to-ground, phase-to-neutral, and neutral-to-ground.
 - d. If the resistance reads less than one megohm while testing with branch circuit devices in the open position, the system may be unsafe and should be investigated.
13. After completing the electrical insulation resistance test, replace all removed control power fuses and close any opened power disconnects.
14. Check all field-installed wiring. Ensure it is clear of all live parts, and when instructed, secured to withstand fault currents.
15. Verify that all control wiring between sections is properly connected.
16. Vacuum to remove any dust, scrap wire, or other debris.

CONTAMINATION HAZARD

Do not use an air hose to blow out the switchboard. Dust can settle inside relays and overcurrent devices, causing overheating and improper operation. **Failure to follow these instructions can result in equipment damage.**

17. Replace all covers and barriers: check for any pinched wires, and close all doors. Ensure that all enclosure parts are properly aligned and securely fastened.

ENERGIZING THE SWITCHBOARD




6. ENERGIZING THE SWITCHBOARD

1. Ensure no load is present on the switchboard before it is energized. Turn off all downstream loads.
2. Energize the switchboard in the following sequence:
 - a. Turn on all control power disconnects before energizing the switchboard. Refer to the record drawings supplied with the equipment to verify whether control power disconnects are supplied.
 - b. Close any open doors and covers.
 - c. Close all main devices.
 - d. Close each branch circuit breaker or branch fusible switch.
 - e. Proceed to each panelboard and other downstream loads.
3. After all overcurrent protective devices are closed, turn on all loads (e.g., lighting circuits, contactors, heaters, and motors).

7. MAINTENANCE

7.1 General

Maintenance serves to preserve trouble-free operation and achieve the longest possible service life of the switchboard. It comprises the following closely related activities:

	Inspection	Determination of the actual condition
	Servicing	Measures to preserve the specified condition
	Repair	Measures to restore the specified condition

※ **Note:**

When carrying out all maintenance work, the regulations of the country of installation must be strictly followed.

Maintenance work may only be performed carefully by trained personnel who are familiar with the characteristics of the individual switchboard, in accordance with all relevant ANSI safety regulations and other applicable technical standards, as well as any overriding instructions. It is recommended that LS ELECTRIC service personnel be called in to perform the servicing and repair work detailed below.

The inspection and service intervals for some of the equipment/components (e.g., parts subject to wear) are determined by fixed criteria, such as switching frequency, length of service, and number of short-circuit breaking operations. For other components, however, the length of the intervals may depend on factors such as different modes of operation in individual cases, the degree of loading, and environmental influences (including pollution and corrosive atmospheres).

7.2 Classification of periodic inspection

- Where necessary, the working area must be isolated and secured from connection in accordance with the safety regulations specified by ANSI and other applicable national standards before inspection.
- The correct condition of the switchboard should be monitored through regular inspections.
- Under normal operating conditions, inspections should be carried out once every four years by specially trained professional electricians.
- Under abnormal operating conditions (including adverse climatic conditions) and/or special environmental stresses (such as heavy pollution and corrosive atmospheres), inspections may be required at shorter intervals.

MAINTENANCE

7. MAINTENANCE

7.2 Classification of periodic inspection

- Periodic inspection is primarily a visual check for grime, corrosion, and moisture, including:
 - Effects of high temperature on the main circuits.
 - Traces of partial discharge on insulating material components.
 - Traces of leakage current on insulating material components.
 - Surfaces of the contact systems.
- However, inspection must also include verification of the correct mechanical and electrical operation of the following parts: switching devices, actuating, interlocking, protection, and signaling devices.



CAUTION

Instrument transformer circuit

- With regard to the switching devices, their separate instruction manual should be followed.
- Check all switchboard accessories and auxiliary devices (e.g., storage batteries).
- Partial discharge must not occur on the surfaces of equipment at operating voltage. It can be detected by noise, a distinct smell of ozone, or visible glow in the dark.
- Visually check the contact system. It is recommended to operate the contact system alternately to clean the inner contact points.
The contact points should be cleaned if any signs of overheating (such as a discolored surface) are visible.
- If any irregular conditions are detected, then appropriate repair measures must be taken.

< Table B > For inspection, restricted conditions are necessary as follows:

Classification of inspection	Restricted Condition	Opening and closing of door	Separation of cover	Un-interruption of power	Circuit power failure	Interruption of main bus power	Inspection period
Visual inspection		○	-	○	-	-	Once /Month
Monthly inspection		○ Note 2	-	○	-	-	Once /Month
Annual inspection		○	○	-	○	○ Note 3	Once /Year
Temporary inspection		○	○	-	○	○	-

7. MAINTENANCE

7.2 Classification of periodic inspection

※ Notes:

1. Choose the inspection period by referring to Table B.
2. During a power failure, check whether the MCC door can be opened. It is also recommended to verify that the door is opened at least once a month.
3. Although a power outage is uncommon, inspection during a power outage should be performed every two years.

7.2.1 Visual inspection

Check for any damage to devices installed on the door, such as meters, lamps, switches and other components.

7.2.2 Planned inspections

These inspections are considered planned examinations that require verification that system components are functioning properly. The inspections should be scheduled at regular intervals, taking into account operating requirements, environmental conditions, and other relevant factors, with clear work instructions and systematic checks.

7.2.3 Planned inspection routine

This includes periodic inspections on a monthly and annual basis.

7.2.4 Monthly inspections

These involve visual inspections that may require opening the doors, where such actions are permitted without interrupting the power supply and when necessary.

- Replace indicator lamp as necessary
- Correct any observed abnormal conditions

7.2.5 Annual inspections

These require a full operational test to ensure that all equipment is operating properly and efficiently.

All equipment and components shall be inspected in accordance with manufacturer's data.

Where equipment must remain energized, caution shall be exercised during inspection.

If a full inspection cannot be performed due to the need to maintain energization, a visual inspection shall be conducted, and the full operational inspection rescheduled for a more suitable time in the near future.

MAINTENANCE

7. MAINTENANCE

7.3 Maintenance and repair of equipment

Restrictions imposed by the equipment should be highlighted where applicable.

7.3.1 Isolating procedure of the main bus bar for SWBD

- Open the main circuit breaker to de-energize the main circuit.
- If necessary, check the de-energized status using a voltage test meter.
- Discharge the remaining current from the capacitor to ground a few minutes after isolation for safety.
- To prevent improper operation, lock out the disconnected breaker in the “OFF” position and attach a warning sign: “MEN AT WORK”.



CAUTION

Without interrupting power from the distribution transformer secondary side, do not remove the insulation cover surrounding the main incoming bus bars.

7.3.2 General safety procedures

It is mandatory to ensure the cooperation of all related personnel for the safety of both personnel and equipment. Therefore, individuals working in the plant area must follow the safety regulations outlined in this procedure.

Before commencing any testing, commissioning, or operational activities, the following general conditions shall be observed.

Operators must have a clear understanding of the equipment construction and operating methods to ensure safety.

- The working area shall be kept clean and free of debris or leftover materials.
- Access to all working areas and equipment shall be unobstructed.
- The ventilation system shall be checked to ensure it is functioning properly.
- Appropriate danger and warning signs shall be posted in visible locations.
- Entry to the working/operating area shall be restricted to authorized personnel only.
- Firefighting equipment shall be readily available where applicable.
- Ensure clear and accurate communication with all related departments.
- Ensure equipment is de-energized (electrically isolated).

The circuit diagram shall be checked to confirm whether the primary power is live.

Check the grounding of the test equipment, then verify the de-energized status using a test meter. To ensure maximum safety, all energized zones shall remain locked, and the key shall be kept under the control of the responsible person designated in this document.

7. MAINTENANCE

7.4 Repair of surface damage

Repair of surface damage:

- Carry out repair work immediately after a defect has been discovered.
- Completely remove all rust from damaged paintwork areas on steel sheets and other steel parts by mechanical means (for example: with a wire brush).
- Lightly grind the surrounding paint coat and carefully degrease the entire area. Then apply an anti-rust primer immediately, and allow it to harden. Finally, apply the top coat. Only use suitable and compatible paint products.
- Apply the top coat in standard RAL 7032 color or the relevant special color.

7.5 Table of scheduled maintenance

Items to be checked	Check Contents and Interval (1 time)				
	Visual	Operating (Adjusting)	Measuring (Megger)	Replace	Notes
Switch Board	2 months				
Vacuum Circuit Breaker	2 months	1 year	2 year	According to its instruction manual	
Voltage Transformer	2 months		2 year	Depends on megger value	
Current Transformer	2 months		2 year	Depends on megger value	
Push Button Switch	2 months	1 year		250,000 times	
Fuses	2 months				
Fluorescent Lamp	2 months	1 year			
Instrumentation Parts	2 months	1 year			

MAINTENANCE

7. MAINTENANCE

7.6 Preventive maintenance procedures of various equipment

7.6.1 Switchboard

No.	Items	Interval (1 time)	Inspection Method	Notes
1	Rust or Damage	2 months	1) Is there any rust or damage on metal parts? 2) Is there any rust or damage on metal fixtures? 3) Is there any damage to the viewing hole, waterproof rubber, etc.?	1) Clean any damaged parts, and perform repairs if metal parts are damaged. 2) Remove rust from hinges, handles, etc., as this can cause malfunctions. 3) Clean both the inside and outside of the viewing hole.
2	Potential Malfunction	As needed	Is there any fault in the door, handle, latch, hinge, etc.?	Repair the damaged parts.
3	Display	As needed	Are there any missing lamps, or is the display unclear?	
4	Lock Device	As needed	Is the lock device functioning properly?	Check the function of the locking device and related components, and confirm proper key storage.

7.6.2 Air Circuit Breaker and Electromagnetic Contactor

※ **Note:**

See the Manufacturer's Operation and Maintenance Manual for details

7. MAINTENANCE

7.6 Preventive maintenance procedures of various equipment

No.	Items	Interval (1 time)	Inspection Method	Notes
1	Switch Operation	1 year	<p>Operate the switch several times and check the following points:</p> <ol style="list-style-type: none"> 1) Is there any fault with the on/off timing? Any variation? 2) Is there any abnormal noise? 3) Is there any abnormal vibration? 4) Is the ON control voltage and pressure normal for power operation? 5) Is the trip circuit functioning normally? 	<ol style="list-style-type: none"> 1) Listen to the sound as the breaker operates on and off. If there is any abnormality, perform a detailed inspection. 2) Perform a detailed inspection for any faults, excluding the characteristic noise and vibration of the breaker. 3) Pay attention to sparking caused by loose terminals and vibration due to an unsecured breaker, etc. 4) Measure the control voltage and adjust the power supply voltage (battery, etc.), checking that it does not deviate by more than $\pm 5\%$ of the rated value. 5) Perform an automatic trip test using the protection relay contact circuit. It is acceptable if it trips.
2	Display Unit Check	2 months	<p>Does the circuit breaker display lamp correspond to the main circuit operation?</p>	<p>Clean the gaps between the contacts of the auxiliary switch, as they easily become dirty. Ensure that the components are operating normally after cleaning the display lamp. Check the display, auxiliary switch, circuit contacts, and related components.</p>
3	Loose Parts	As needed	<ol style="list-style-type: none"> 1) Are there any loose terminals in the main circuit? 2) Is there any looseness in the auxiliary switch, control circuit terminals, control circuit components, or their fittings? 3) Is there any looseness, bending, or other issues in the circuit breaker bolts, nuts, etc.? 	<p>Make sure all parts are tightened properly.</p>

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7. MAINTENANCE

7.6 Preventive maintenance procedures of various equipment

No.	Items	Interval (1 time)	Inspection Method	Notes
4	Deformation	2 months	Is there any deformation of the bus bars or main circuit conductors due to electromagnetic forces during a high-current cutoff?	<p>Check for internal deformation that may occur during a short circuit.</p> <p>Replace parts and perform a detailed examination depending on the degree of deformation.</p> <p>The circuit breaker may need to be replaced.</p>
5	Damage	As needed	<p>1) Does the abrasion between the main contactor and housing exceed the allowable limit?</p> <p>2) Is there any damage or deformation on the contactor spring?</p>	<p>1) Check the abrasion limit between the main contactor and housing using the cut-off current and cut-off circuit. Refer to the manufacturer's instruction manual, perform repairs or replacements as needed, and conduct a detailed examination.</p> <p>2) If there is any damage or deformation on the contacts or spring, replace the affected components and perform a detailed examination.</p>
6	Insulation Resistance	2 years	<p>Use an insulation resistance meter (megger) after cleaning the insulators and insulation materials with a dry cloth.</p> <p>* High voltage circuit: 1000 V or more</p> <p>* Low voltage circuit: 500 V</p>	<p>Use the following as a guide for insulation resistance between the main circuit and ground:</p> <ul style="list-style-type: none"> - Between the contacts of the same phase of the main circuit (100 M ohm) - Between the main circuits of different phases - Between the control unit conductor and ground (1 M ohm)

7. MAINTENANCE

7.6 Preventive maintenance procedures of various equipment

7.6.3 Current Transformer (CT)

No.	Items	Interval (1 time)	Inspection Method	Notes
1	External Deformation	2 months	<ol style="list-style-type: none"> 1) Is there any internal abnormality, swelling, or cracking in rubber, compound, resin, etc., caused by excessive heat at the primary terminals? 2) Are there any traces of electrical discharge caused by dirt, moisture, salt, gas, or other contaminants? 	<ol style="list-style-type: none"> 1) Do not reuse equipment that is severely damaged by external shock or internal malfunction. After replacing it, remove the causes of the issue, such as load, wiring, etc., before operating. 2) Replace deformed equipment that shows signs of electric discharge. Carefully check the surrounding conditions to ensure that it does not happen again.
2	Dirty or Damage	As needed	<ol style="list-style-type: none"> 1) Is there any dirt, damage, or other issues? 2) Is the fuse functioning properly? 3) Is there anything sticking to the conductors, core fittings, bolts, nuts, or other components? Are there any damaged, cracked, or missing parts? 	<ol style="list-style-type: none"> 1) Clean the components, as dirt may cause electric discharge. Check for cracks while cleaning and replace any damaged parts. 2) Be cautious of poor fuse contacts in high-voltage circuits, as they may cause phase-to-phase flashover accompanied by electric discharge.
3	Heat Discoloration	As needed	Is there any discoloration of the conductors due to excessive heat?	Perform a detailed examination when there is heat discoloration on the conductor.
4	Rust	As needed	Is there any rust on the conductors?	Clean the conductors, core, and structure when there is rust, and repair any damaged painted parts.
5	Loose Components	As needed	<ol style="list-style-type: none"> 1) Are there any loose primary or secondary terminal fittings? 2) Are there any loose mounting bolts? 	Be careful, as loose primary or secondary terminals may cause accidents. Tighten the mounting bolts and other fasteners as needed.
6	Insulation Resistance	2 years	<ol style="list-style-type: none"> 3) Are there any loose fuse mountings? Test with an insulation resistance meter (megger) at over 1000 V after cleaning the insulation materials with a dry cloth. 	<p>Use the following guide for insulation resistance:</p> <p>Between the primary line and secondary line (30 Megger ohm)</p> <p>Between the secondary line and the outer enclosure (2 Megger ohm)</p>

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7. MAINTENANCE

7.6 Preventive maintenance procedures of various equipment

7.6.4 Switch and Contactor

No.	Items	Interval (1 time)	Inspection Method	Notes
1	Switch Operation Check	1 year	Are there any abnormalities when operating the device several times?	Check the condition of the contactors and mechanism in response to manual operation.
2	Heat Discoloration	2 months	Is there any discoloration of the contacts?	Replace the switch and contacts if there is any discoloration.
3	Abnormal Smell	As needed	Is there any rust on the conductors, metal fittings, or mounting fixtures?	If there is an abnormal smell, check the built-in coil bushing, insulation materials, and other internal components.
4	Rust	As needed	Is there any rust on the conductors, metal fittings, or mounting fixtures?	Aluminum, copper, and other metals can easily rust or corrode when exposed to moisture or gases. Cleaning is required during inspection.
5	Contact	As needed	1) Is there any fault in contact pressure due to spring fatigue, copper plating wear, or other factors? 2) Is there any abnormality caused by wear at the contact points or by contact deformation?	1) For a self-contacting type, lightly tap the conductor to check for any loss of elasticity, comparing the sound with that of a contact in good condition. 2) Replace any worn contacts.
6	Loose Components	As needed	Are there any loose bolts, nuts, or other fasteners in moving parts, conductor connections, or related components?	Securely tighten any loose components or connections.

7. MAINTENANCE

7.6 Preventive maintenance procedures of various equipment

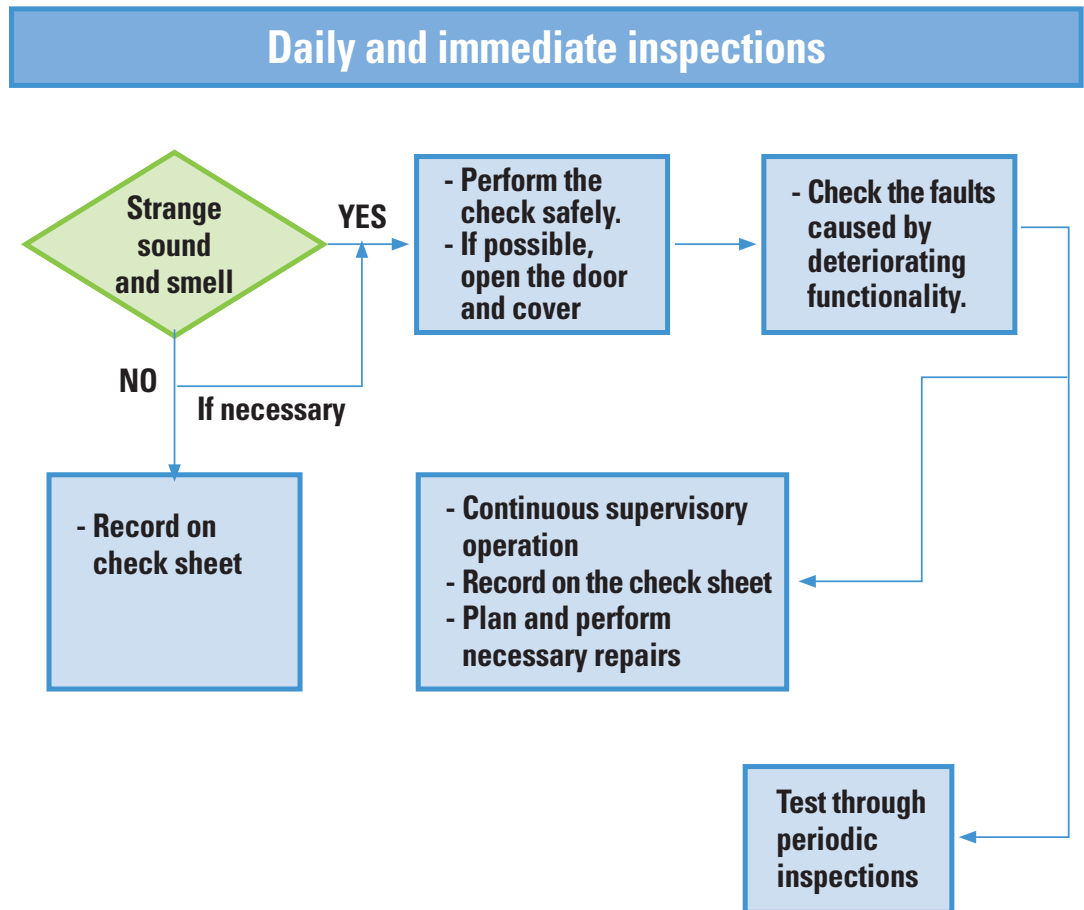
7.6.5 Busbar

No.	Items	Interval (1 time)	Inspection Method	Notes
1	Heat Discoloration	2 months	Is there any discoloration on the auxiliary busbar or the insulated busbar?	If there is discoloration on the busbar, check whether the load current exceeds the current-carrying capacity of the busbar.
2	Dust and Debris	As needed	Is there any dust or foreign matter on all busbars?	The busbar must be kept in a clean environment, and it should be cleaned only when de-energized.
3	Loose Contacts	As needed	Are there any loose contacts on clamps, mounting bolts, or other fasteners?	Loose busbar contacts can cause accidents, such as fusing due to excessive busbar current. Ensure inspection is performed only when deenergized.

TREATMENT


8. TREATMENT

8.1 daily and Immediate treatment



8. TREATMENT

8.2 Periodic treatment

No.	Treatment	Contents and Attention
1	Cleaning	<p>1) It is recommended to use a vacuum device that draws air and to avoid blowers or other devices that push air.</p> <p>※ Be aware of humidity and air pressure.</p> <p>2) Before opening the door and cover, clean dust and debris.</p> <p>3) Clean the insulation material in a crosswise direction between live parts.</p> <p>4) It is recommended to use neutral cleaning materials.</p>
2	Bolt Joint (Busbar and Construction)	<p>A. SECURING BUSBAR CONNECTIONS</p> <p>1) Method</p> <p>a) Connect using a proper torque wrench with the specified torque.</p> <p>b) Tighten the nut securely, not the bolt.</p> <p>c) Be careful not to tighten only one side when using more than two bolts.</p> <p>B. CHECKING BOLT CONNECTIONS</p> <p>It is necessary to check whether the bolt is secured with the specified torque, as unsecured bolt connections may cause accidents. Therefore, bolts and nuts must be marked in red after securing the connections.</p> <p>※ Bolt torque shall comply with Table A.</p>  <p>The diagram shows a top-down view of a bolt and nut assembly on a busbar. A red check mark is drawn on the busbar surface next to the nut. A line points from the text 'Check Mark' to this red mark.</p>

TREATMENT

8. TREATMENT

8.2 Periodic treatment

No.	Treatment	Contents and Attention																																
3	Repair of Insulation Materials	<p>1) When the porcelain insulator is contaminated with dust, clean it by referring to the Treatment above.</p> <p>2) If looseness occurs due to worn resin or wooden materials, replace the part by referring to Treatment 5.</p> <p>3) Damaged, cracked, or degraded insulation materials require replacement.</p> <p>4) Dropping of insulation resistance requires checking the table below. Compare and check with previous data, and treat adequately.</p> <p>5) The insulation resistance value may be affected by temperature, humidity, and surface condition. Refer to the following values:</p> <p>a) Panel</p> <ul style="list-style-type: none"> - Condition: 68 °F (20 °C) 65 % RH - High-voltage circuit: More 5 M ohm - Low voltage circuit: <table border="1"> <thead> <tr> <th colspan="2">Voltage class</th> <th>Insulation resistance value</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Below 300 V</td> <td>Voltage to earth below 150 V</td> <td>0.1 M ohm</td> </tr> <tr> <td>Others</td> <td>0.2 M ohm</td> </tr> <tr> <td colspan="2">330 V - 600 V</td> <td>0.4 M ohm</td> </tr> </tbody> </table> <p>b) Main circuit breaker and isolator</p> <table border="1"> <thead> <tr> <th></th> <th>Insulation resistance value</th> <th>Tester</th> </tr> </thead> <tbody> <tr> <td>Main circuit</td> <td>More 500 M ohm</td> <td>1000 V</td> </tr> <tr> <td>Control circuit</td> <td>More 2 M ohm</td> <td>500 V</td> </tr> </tbody> </table> <p>c) Measuring instrument</p> <table border="1"> <thead> <tr> <th>Base temp</th> <th>20 °C</th> <th>30 °C</th> <th>40 °C</th> </tr> </thead> <tbody> <tr> <td>- Enclosure - Between primary and secondary winding</td> <td>500 M ohm</td> <td>250 M ohm</td> <td>130 M ohm</td> </tr> <tr> <td>- Between enclosure and secondary winding</td> <td colspan="3">2 M ohm</td> </tr> </tbody> </table>	Voltage class		Insulation resistance value	Below 300 V	Voltage to earth below 150 V	0.1 M ohm	Others	0.2 M ohm	330 V - 600 V		0.4 M ohm		Insulation resistance value	Tester	Main circuit	More 500 M ohm	1000 V	Control circuit	More 2 M ohm	500 V	Base temp	20 °C	30 °C	40 °C	- Enclosure - Between primary and secondary winding	500 M ohm	250 M ohm	130 M ohm	- Between enclosure and secondary winding	2 M ohm		
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8. TREATMENT

8.2 Periodic treatment

No.	Treatment	Contents and Attention			
4		- Mold Type -			
		Base temp	20 °C	30 °C	40 °C
		- Enclosure - Between primary and secondary windings	200 M ohm	100 M ohm	50 M ohm
		- Between enclosure and secondary 2M ohm windings	2 M ohm		
5	Replace Parts	1) Check the type and function. 2) When replacing parts, avoid improper connections and tighten bolts with the specified torque. 3) If adjustment is necessary, set the value correctly after replacing the part. 4) Only skilled personnel should perform welding, if required.			

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