META
POWER SOLUTIONS

SWITCHBOARD MANUAL

Meta-Power Solutions ®

Product information

Introduction

This instruction manual will help guide competent technicians in installing, operating, and maintaining Switchboards.

This manual was made after anticipating most normal installation, operation, and servicing problems. However, the instructions do not cover all possible scenarios where equipment or application conditions may vary. In such cases, additional information can be obtained by contacting a factory representative at:

Meta Power Solutions (MPS)
500 S Australian Ave Suite 600, West Palm Beach, FL 33401

Read this manual first!

It is important that a technician reads this manual, understands its contents, and follows all locally approved practices and safety procedures before connecting or operating a switchboard.

Additional information

This instruction manual cannot cover every detail or variation in the equipment, process, or procedure described, nor can it provide directions for meeting all possible contingencies during the equipment installation, operation, or maintenance. Contact your Meta Power Solutions representative for additional information if the need arises.

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Introduction

1.0 - Introduction

The aim of this manual is to assist the user to develop safe and efficient procedures for installing, maintaining, and operating switchboard equipment. For additional information, refer to NEMA Standards Publication PB2.1, "General Instructions for Proper Handling, Installation, Operation, and Maintenance of Dead Front Distribution Switchboards rated 600 volts or less", which is available on the NEMA web site (www.nema.org).

MPS warrants that all the goods manufactured by MPS strictly conform to accepted industrial standards regarding materials and workmanship, which are verified until the day of product shipment from the MPS factory. However, if any non-conformity is observed in the manufactured goods by the purchaser within the first twelve months from the date of shipment and promptly notifies MPS in writing, MPS will rectify the identified defect through adjustment, repair, or replacement of the item and any affected part of the goods. Purchasers may refer to "Standard Terms and Conditions of Sale" for the complete warranty terms and contact the MPS representative if additional information is required.

1.1 - Qualified Person

The instructions in this manual are not meant to be used as substitutes for proper training and experience in safely operating the described equipment. Only "Qualified Person" should be allowed to install, operate, and service the equipment. In the context 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 should have the following qualifications:

- They are thoroughly familiar with the instructions given here.
- They are properly trained in industry-accepted low-voltage and high-voltage safe operating procedures and practices.
- They are adequately trained and fully authorized to energize, de-energize, ground, and clear power distribution equipment.
- They possess knowledge of NEC requirements and other relevant codes, laws, and standards.
- They are properly trained in the care and use of protective equipment such as rubber gloves, face shields, safety glasses, hard hats, clamp-sticks, arc flash clothing, hot-stick, etc.

1.2 - Signal Words

Switchboard installation, operation, and maintenance procedures can give rise to various hazardous situations. Signal words like "**Danger**" "**Warning**" and "**Caution**" are used to indicate the degree of danger associated with these different hazards that the user may encounter. These signal words are defined as follows:

DANGER:

indicates an imminently hazardous situation that will result in serious injury or even death.

WARNING:

indicates a potentially hazardous situation that could result in serious injury or even death.

CAUTION:

indicates a potentially hazardous situation that may result in minor or moderate injury but not death.

1.3 - Dangerous Procedures

In addition to the specific precautions that must be followed to ensure safety against various hazards and dangers associated with switchboard installation, operation, and maintenance procedures, user personnel must also always adhere to the following warnings:

DANGER:

Hazardous voltage. Contact with hazardous voltage can cause severe injuries and even death. Personnel working around low-voltage and high-voltage lines and equipment should follow all locally approved safety procedures and practices, and only Qualified personnel should be allowed to work on or near high-voltage equipment.

WARNING:

Ensure the switchboard equipment is completely de-energized and disconnected from the rest of the system to prevent accidental re-energization. Otherwise, possible shocks from an energized switchboard component could lead to equipment damage, severe physical injuries, and even death.

CAUTION:

Always allow the interlock device or safety mechanism to function completely without forcing the device.

CAUTION:

Hydrocarbon compounds and spray propellants can cause the degradation of certain types of plastics used within the switchboard equipment. Contact MPS representatives before applying these products for cleaning and lubricating switchboard components.

1.4 - Field Service

MPS provides its customers with the following support services for switchboards:

- Start-up Commissioning of Switchboard Equipment.
- Switchboard Component and System Testing.
- Switchboard Maintenance (Preventative and Scheduled).
- Switchboard Component Repair and Refurbishing.
- On-Site Operational Training for Switchboard Technicians.

Contact MPS to obtain additional information about the aforementioned services and to schedule an appointment.

1.5 - General Description

MPS switchboards are designed and manufactured to perform efficiently within standard operating conditions. The instructions provided in this manual aim to assist purchasers in deriving prolonged and economical switchboard functionality. This manual and its guidelines should be shared with operators and engineers associated with the owner/purchaser to ensure that the switchboards are operated and maintained in the best possible conditions. This manual covers the standard construction details of MPS switchboard assemblies, as defined in NFPA70 (NEC), UL891, and NEMA PB2, including the necessary accessories and auxiliary equipment. Any special or additional equipment furnished with the standard product, in accordance with the purchaser's order requirements, is covered separately in supplementary instruction books. All switchboard parts, conductors, and insulation materials are designed and constructed to meet the voltage class requirements of the system. Additionally, all switchboard components are enclosed within a grounded metal enclosure for added protection.

MPS designs switchboard equipment to cater to the specifications provided by the purchaser at the time of purchase. The final product, therefore, has the circuit capacity to meet the operating conditions of the purchaser's specified power system. However, the momentary rating of the switchboard and the interrupting capacity of the switchboard protective devices must be rechecked when installing the switchboard equipment in a different system or when the short-circuit capacity of the target system is increased. If the service is changed, the equipment's short circuit capacity, amperage, and voltage class should be checked to ensure they meet or exceed the new system's requirements.

Switchboards are free-standing units rated at 1000 volts AC or less and 4000 amperes or less. A typical switchboard contains distribution sections with branch devices and service entrance sections with main devices.

These sections contain auxiliary equipment, protective devices, disconnect devices, and current transformers for control, metering, or ground fault protection.

Safety Precautions and Switchboard Preparation

Switchboards are constructed in various sizes and mounting arrangements, depending on the purchaser's unique requirements. Outdoor switchboards are typically made by enclosing the equipment inside a weatherproof housing and fixing a door over the inner front panels.

2.0 - Safety Precautions

DANGER:

Care should be taken when energizing a switchboard for the first time after initial installation or maintenance due to the potential danger posed by any undetected exposed parts. Contact with hazardous voltage through these parts can cause severe injuries and even death. The following safety precautions must be strictly followed while working on switchboard preparation:

- Only qualified persons familiar with the operation and construction of the switchboard equipment should be allowed to perform the procedures described in this set of instructions.
- Qualified persons should be allowed to work on the switchboard equipment only after reading this complete set of instructions.
- The qualified persons should ensure they strictly follow the safety-related work practices, as described in NFPA 70E.
- Switchboard inspection and maintenance should only be performed after cutting off, disconnecting, and electrically isolating the switchboard so it cannot be accidentally re-energized.
- Some electrical equipment can introduce harmonics in the electrical system and cause it to overheat. This condition should be considered when determining the switchboard loading. The equipment rating may need to be derated in case of excessive heating.

3.0 - Switchboard Preparation

3.1 - Receiving

MPS inspects each switchboard before being shipped to the purchaser-designated site to ensure that the electrical and structural construction of the switchboard equipment complies with the applicable specifications, codes, and standards.

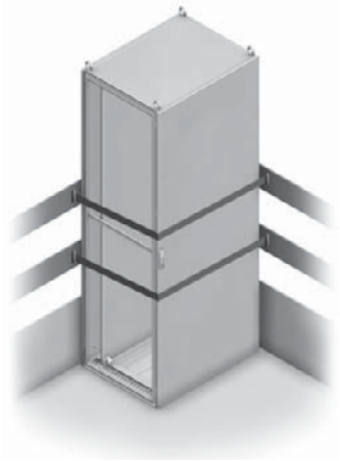


Figure 3-1 Secured Transportation of Switchboard.

Depending on the number of sections and the size of each section, the switchboard may be divided into one or more vertical pieces and placed onto wooden skids for easy shipping. Each piece is packaged, securely blocked, and braced for shipment.

Regardless of the shipping method, every precaution is taken to minimize the possibility of damage to the equipment and to ensure its safe arrival. The packages are carefully loaded to prevent damage to the relatively delicate instruments or devices, and similar care must be exercised upon arrival at the required site. The enclosure is secured against tilting before the transportation, assembling and configuration of the switchboard. In the case of plinth systems, the switchboard must be raised and lowered during transport by applying load at the plinth corner pieces, i.e., the load must never be applied to the plinth trim panels.

Once the switchboard equipment arrives at the required destination, the marking tag(s) or packing list(s) should be checked very carefully by the purchasing party against the equipment received to ensure the correct and complete list of equipment has been shipped. In case of any shortages or deficiencies, the purchasing party must claim in writing within the first 30 days of receipt of shipment. Failure to give such a notice would constitute an unqualified acceptance of the shipped goods and a waiver of any future claims.

Marking tags are attached to every shipped package or crate for identification on shipments with more than one shipping group. In lieu of the marking tags, the section marking can be found on the rating label on each section, and the location of each unit within the group lineup can be found on the general arrangement drawing.

3.2 - Inspection

The equipment should be inspected as soon as possible after the arrival of the shipment for any damage that may have occurred in transit. The packing of the switchboard components should be carefully removed to allow for inspections for possible damage. However, the packing material must not be discarded in the process, as the material itself can be used to store the equipment at the designated site until installation or to repackage the equipment for a return shipment if necessary.

When moving or handling the switchboard, it should be kept upright and secured to the shipping skid to prevent distortion or damage to the bottom frame.

3.3 - Shipping Damage Claims

If the goods get lost or damaged in transit, the purchaser must handle all claims directly with the carrier. The carrier must be notified about any concealed damage within 15 days after receipt of goods. The following procedures must be followed to ensure that the goods are received in accordance with the purchase order.

- Upon arrival of the shipment, the purchasing party should note:

  The blocking condition of the equipment.
  The condition of the equipment upon arrival and whether it was properly protected from environmental factors like humidity, heat, wind, etc.
  The trailer number on which the equipment arrived.
  Whether the equipment count during unloading agrees with the delivery receipt.

- An inspection should be made to detect any visible damage to the equipment as soon as possible upon arrival of the goods. If possible, such inspection should be finished on the shipping vehicle before the unloading process. However, if it is impossible, a close inspection of the goods should be maintained during the unloading process, and any signs of visible damage should be noted. Pictures may also be taken for evidence if possible.

- Any visible damage on the equipment must be noted on the delivery receipt and signed by the driver to acknowledge the detected deformity. A detailed description of the damage should be added whenever possible, and the notation “Possible internal damage, subject to inspection” should be included on the delivery receipt. If the driver does not provide acknowledgment through a sign on the delivery receipt, the shipment should not be signed for or received by the consignee or their approved agent.

- Any detected damage should be reported to the MPS Sales Office immediately.

- If any damage is observed on the shipped equipment, the consignee or their agent must arrange a carrier inspection immediately. The equipment must not be removed from the place it was set by the carrier when unloading. This location should be properly protected to ensure further damage does not occur before an inspection from the carrier. This eliminates loss to the consignee arising from carrier claims that the equipment was damaged, or the damage aggravated on-site after unloading.

- The equipment should be covered properly to protect it from any further damage after unloading. The equipment should be stored in a dry, clean place at a uniform temperature to prevent condensation and damage.

- If practical, further equipment inspections for possible concealed damage should be done in the presence of the carrier inspector. If not possible while the carrier is on-site, the consignee or an affiliated party must inspect the equipment within 15 days of receipt. If the concealed damage is found, the consignee party must notify the carrier and a carrier inspection must be made before any corrective action or repair to remove the observed defects is made. Notify the MPS Sales Office immediately of any detected signs of damage.
- After the carrier inspection, the consignee party must obtain the original carrier inspection report and send it to the MPS Sales Office along with a copy of the noted delivery receipt. Upon receiving these two documents, MPS shall obtain approval from the carrier to initiate the repair work on the equipment.

3.4 - Handling

CAUTION:

First, verify the weight of each switchboard shipping section by contacting the MPS Sales Office. Then, check the lifting capacity of all available hoisting and lifting equipment, and only use the cranes and forklifts if their load capacity exceeds the weight of each section. Do not use damaged hooks, slings, or cables. Only lift the switchboard from the provided lifting provisions, like lifting points and lifting bars, on the equipment. The sections can be moved by attaching the lifting bars at the top of the switchboard to a crane with at least four lift cables. If crane facilities are unavailable due to space or budget constraints, rollers can be fitted beneath the skids to facilitate movement. Take care when lifting the unit and removing it from the truck so it does not get damaged.

A. Lifting By Means of an Overhead Crane

All MPS sections are equipped for lifting using an overhead crane. The eyebolts on the top of an individual section and combination angles in the case of bayed sections can be utilized to lift the entire weight of the assemblies, as depicted in Figures 3-3 and 3-4, respectively.

Regardless of the lifting method, the cable pull angle between the crane's hoisting cable and the section's roof must be a minimum of 45 degrees. Ideally, it should be maintained at 60 degrees to ensure an equal distribution of the section weight along the cable length.

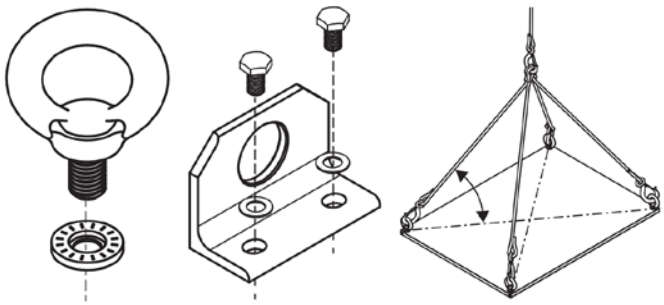


Figure 3-2 Lifting Provisions. (Left) Eyebolts, (Middle) Combination angles. (Right) Cable Pull Distribution.

NOTE:

Spreaders may be employed with the lifting cables to prevent the brackets from twisting.

Figure 3-3 Single Section Lifting

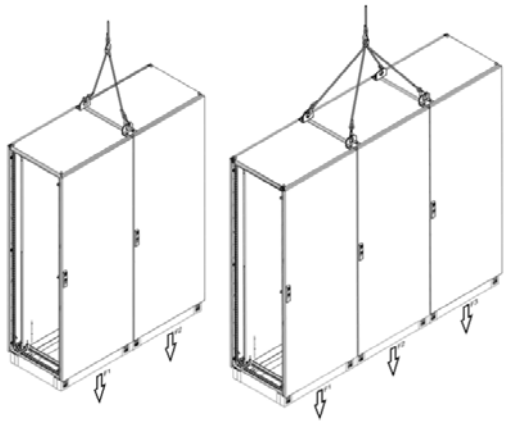


Figure 3-4 Multi-Section or Bayed Sections Lifting

B. Lifting by Means of a Forklift

Forklift trucks can easily lift and move switchboard equipment in an upright position over short distances. However, they must be used with a lot of care, as any improper lift points can cause damage to the equipment. Balance the load carefully and use safety straps when handling the switchboard equipment with a forklift. The path to the installation place should be level and free of debris and obstructions. **Figure 3-5** shows the standard procedure for lifting switchboards using a forklift. In the case of bayed switchboards, internal baying blocks, internal baying brackets and external baying connectors may be used to facilitate the lifting process.

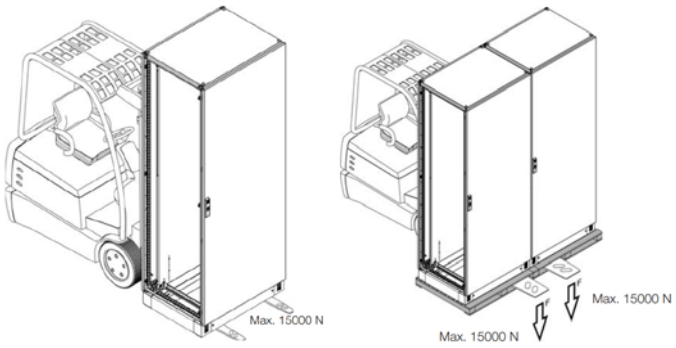


Figure 3-5 Lifting by Means of a Forklift.

C. Lifting by Means of Castors

Castors can be used to move sections with base/plinth systems. They allow for the rolling of the sections into the required places. Multiple rollers may be employed to ensure the unit's weight is distributed uniformly throughout the moving process. The path to the installation place should be level and free of debris and obstructions.

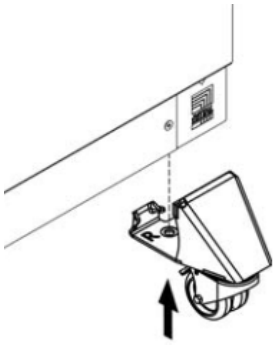


Figure 3-6 Attaching a Castor Roller to the Base of a Switchboard.

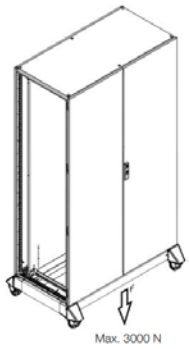


Figure 3-7 Lifting by Means of a Castor Rollers.

Please refer to the NEMA Standards Publication PB 2.1 for information on alternate handling means.

3.5 - Storage

A. Indoor Switchboards

If the equipment must be stored for some time prior to installation, the equipment should be stored in a dry, clean place with a uniform temperature and adequate air circulation to prevent condensation and damage. When storing a switchboard for prolonged periods, it should be kept upright to avoid distortion or damage to the bottom frame. The packing of the switchboard components should be carefully removed when performing inspections for possible damage so that the packing material can be used to store the equipment until installation. If the packing material is damaged, an appropriate cover should be placed over the switchboard to protect it from moisture, dust, and debris.

Unlike outdoor switchboards, indoor switchboards are not expected to suffer extreme outdoor weather conditions and are, therefore, not equipped with similar weatherproof or drip-proof protections. If possible, indoor switchboards should only be stored indoors where the building walls and roof can provide the required insulation from harmful weather conditions.

If there is a lack of indoor space for storage, the indoor switchboard can be stored outdoors if given adequate protection against humidity, heat, weather, dirt, and other weather conditions. Indoor switchboards are not equipped with space heaters, so heat sources of approximately 250 watts output must be placed within each vertical switchboard section to prevent condensation and damage. However, the heat source should only be energized after ensuring no loose packaging or flammable materials are inside the switchboard. If the equipment must be stored for an extensive period, all moving parts, such as shutters, hinges, etc., must be adequately lubricated to prevent rusting.

B. Outdoor Switchboards

Outdoor switchboards must be stored exactly in the same manner as described above for indoor switchboards. If possible, the switchboard must be stored indoors for added protection. However, if there is a lack of indoor space for storage, the outdoor switchboard can be stored outdoors by keeping it dry and clean. The outdoor switchboards are equipped to handle outdoor conditions, but additional protection should be provided, if possible, to extend their service life. If self-contained space heaters are provided with a switchboard unit, they must be energized to prevent condensation and damage. The vents and louvers on the switchboard must be uncovered to allow air to circulate, and the shipping splits must be covered to protect them from outdoor environmental elements like humidity and dust. Refer to the wiring drawing to find the connections needed for the space heater circuit. If the equipment must be stored for an extensive period, all moving parts, such as shutters, hinges, etc., must be adequately lubricated to prevent rusting.

Installation

4.0 - Installation

The proper installation method depends on whether the switchboard units are shipped as a single complete group (84.0" or less) or in two or more shipping sections. The MPS factory that manufactures a product for the consignee also ships a general arrangement drawing to indicate the shipping groups and the location of each unit within the group lineup. The general arrangement drawing also provides instructions for assembling the switchboard units after receiving all sections/ shipping group components at the installation site.

4.1 - Location

The switchboard installation area should be designated on the building plan prior to the arrival of the unit. The chosen location must provide working clearances in accordance with NEC.

The equipment drawings provide the means to identify whether the switchboard is front-accessible or rear-accessible. If it is front-accessible, then adequate spacing must be provided on the front side of the installation site to allow access to field connections, e.g., the mains, ground, branches, and neutral connections. If the switchboard is rear accessible, the same spacing must be provided but on the rear side of the installation site.

4.2 - Foundation Requirements

It is pivotal to ensure that the switchboard equipment is placed on a strong and sturdy foundation that can adequately support the switchboard weight in an upright position so that neither the foundation nor the equipment is damaged or deformed. The general arrangement drawing provides the exact spacing and location information needed to install the required anchor bolts and grouted sills (or bed plates) to the support and fix the switchboard on top of the foundation or floor. These drawings also provide information for designating an area for conduits, the associated limitations, and other general instructions. According to NEC, conduit couplings should be stubbed below or level with the finished horizontal floor. After lowering the equipment and setting it in place on top of the prepared foundation, the conduit extension sleeves may be screwed into these couplings.

The foundation and grouted sills (or bed plates) should be properly aligned and have a smooth horizontal level throughout their lengths so that the floor and sills are on the same plane at each point of contact with the switchboard equipment. The foundation surface must not protrude above the grouted sills or bed plates at any point.

Usually, outdoor equipment is installed on a concrete pad with a flat and even surface. The outdoor equipment must be supported at each section if assembled on formed base plates. While preparing the foundation, it must be ensured that adjacent units at each shipping split are supported by a single support.

4.3 - Positioning of Sections

Adequate space should be provided in the front and rear of the installation site to allow for door opening, installation, and removal of breakers, as well as inspection and maintenance activities. The service entrance equipment should be positioned near the incoming service of the building. The process of positioning and connecting the switchboard sections at the installation site should follow the below instructions:

- Before the process can begin, the mounting surface should be thoroughly cleaned of any dirt or debris.
- Refer to this manual's "Handling" section for instructions on maneuvering the switchboard sections into the desired positions. Start this process from the left-end shipping group and proceed in sequence until the right-end group is also in position. Exercise caution when moving the switchboard sections over conduit areas, as protruding conduits can obstruct the sliding movement of the section in either direction.
- Connections must be made across shipping splits before the final placement of the equipment. Remove the bus joints and supports using the front, rear, and side access options as necessary. Take note of the mounting orientation and position. Save the hardware for use in reinstallation.
- After removing the shipping skid, stand the switchboard section upright. Remove all packing material and any present bottom floor plates inside or near the section. To safeguard the bottom channel, carefully apply a sliding force across the bottom 4 inches (100mm) of the side to distribute the sliding force evenly.
- All shipping sections must be leveled and aligned to each other to maintain proper alignment of the horizontal main through bus and splice bus connections. Bolt all section frames together and connect all through the bus and ground bus at shipping breaks using the supplied splice plate bus and hardware. Tighten the bolted connections in accordance with the torque specifications indicated on the instruction label supplied.

4.4 - Anchoring

The vertical sections of the indoor switchboard shipping groups are held together using bolts. The entire shipping group must be leveled and anchored as a single structure without loose hardware. The supporting surfaces for the switchboard at each anchoring bolt location must be level and aligned within the same plane as one another. No projections above this plane must be allowed within the area covered by the switchboard cubicles. If the floor or ground sill channels do not meet this requirement, shims may be required to elevate the cubicle and mitigate the impact of protrusions.

All anchor bolt locations of a cubicle must rest freely over and in firm contact with the mounting support surface. There must be no projections or obstructions in other areas that could potentially distort the cubicle. Do not force a cubicle into firm contact by drastically tightening the anchoring bolts because such over-torquing would distort the cubicle. Instead, 4" (100mm) square shims may be added adjacent to anchor bolts until firm contact is achieved. Verify the location of each anchor bolt, as illustrated in **Figures 4-1(a)** and **4-1(b)**. The following steps must be implemented to complete the successful anchoring and leveling of the equipment:

- First, all side-mounted lifting bars on a shipping section must be removed unless the shipping sections also include top-mounted lifting brackets, in which case the removal becomes optional.
- Tighten the anchor bolts or weld them to the sills.
- If the lineup comprises multiple groups, place two groups into position, with the rear of one group aligned and tight against the adjacent group. The groups must not be bolted together at this stage. Ensure that the cubicles are in firm contact with the foundation at each corner and anchor point and that the bolt holes are aligned. If required, square shims may be added before the anchor bolts are tightened. Finally, bolt the groups together as outlined in this manual's "Joining Shipping Sections" section.
- Repeat the above step for the secure installation of all shipping groups in the correct order per the front elevation drawing supplied by the MPS factory.

NOTE:

For seismic installations, see the installation instructions furnished with the purchased equipment.

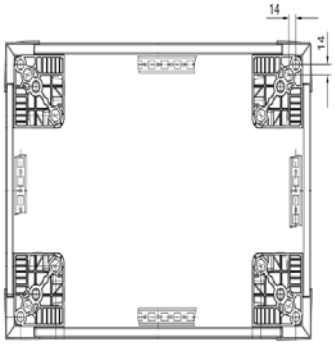


Figure 4-1 (a) Bolt-Down Hole Provision Locations on the Bottom of the Cubicles.

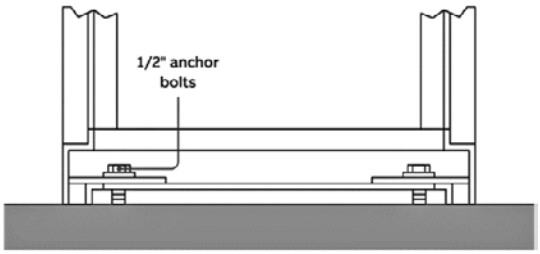


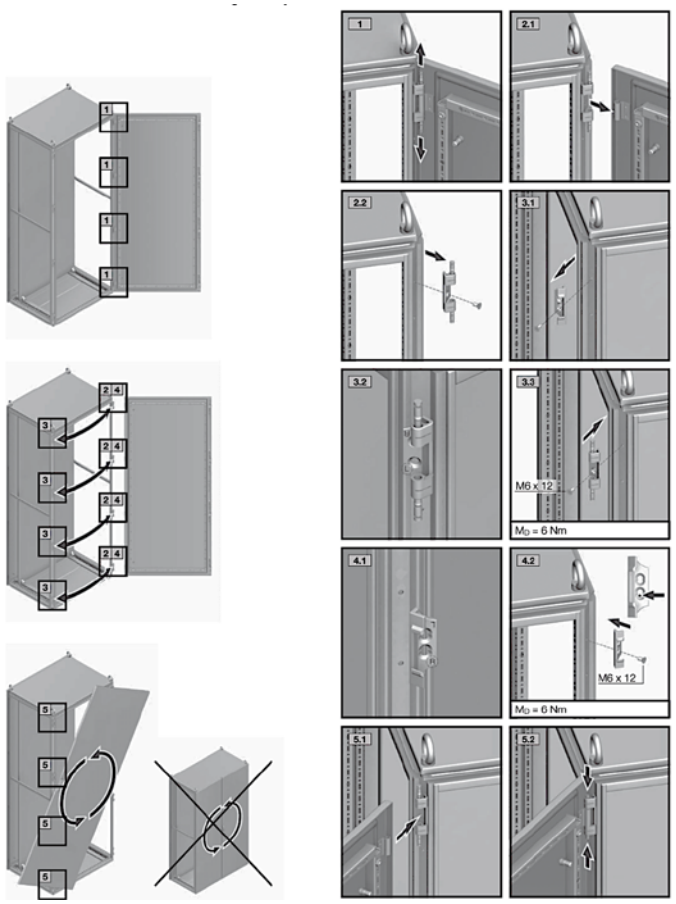
Figure 4-1 (b) Switchboard Section Installed on a Foundation.

4.5 - Assembling

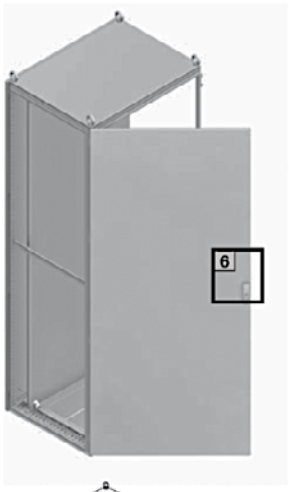
The switchboard enclosure comprises various components that require thorough examination before installation. This section outlines the assessment and potential replacement procedures for each of these components. The required procedures are listed for each component below as steps A to Q.

A. Remove the Enclosure Door

Each step must be executed based on the designated tag number on the corresponding figure. If there are multiple areas marked with the same number, the steps are to be repeated accordingly. The process for each section starts with the corresponding tag number and proceeds based on the provided indications.



B. Switching The Door Hinges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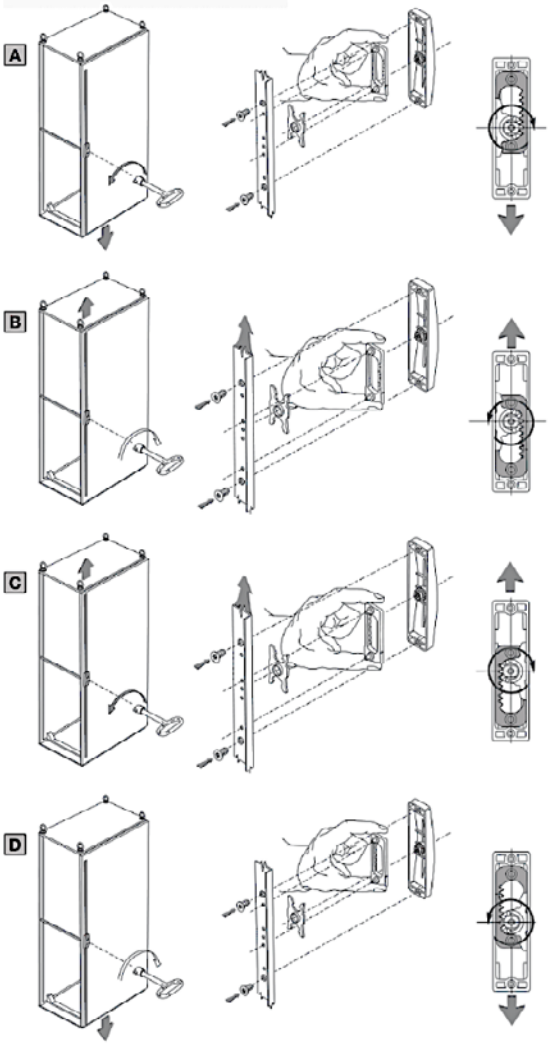
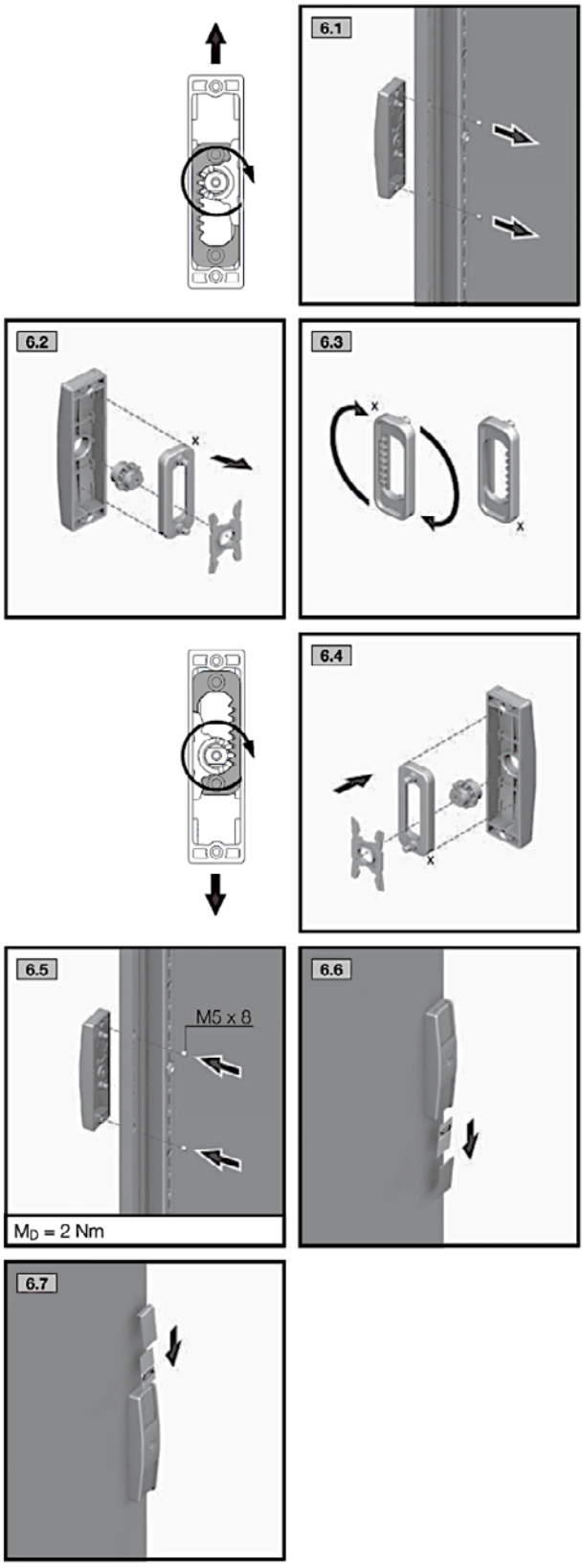

A
B
C
D


6.1
6.2
6.3
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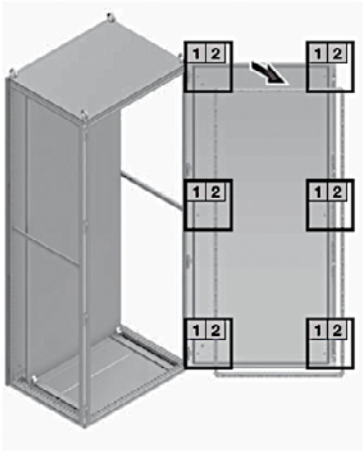
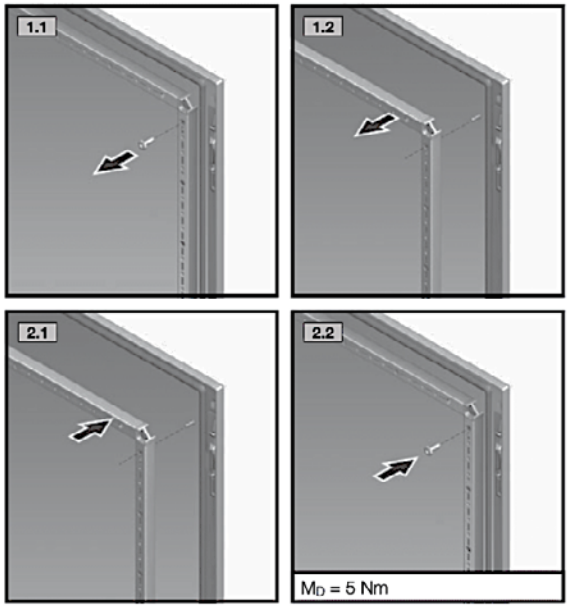
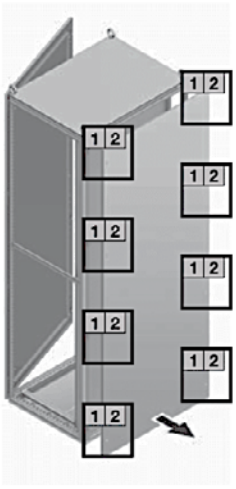
MD = 2 Nm
6.6
6.7

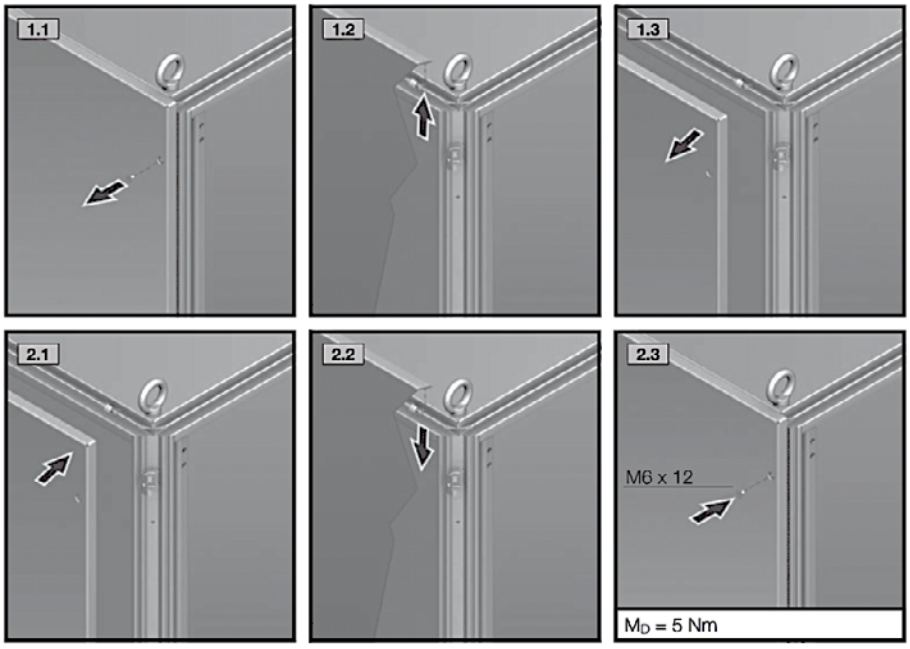
C. Removing The Tubular Door Frame



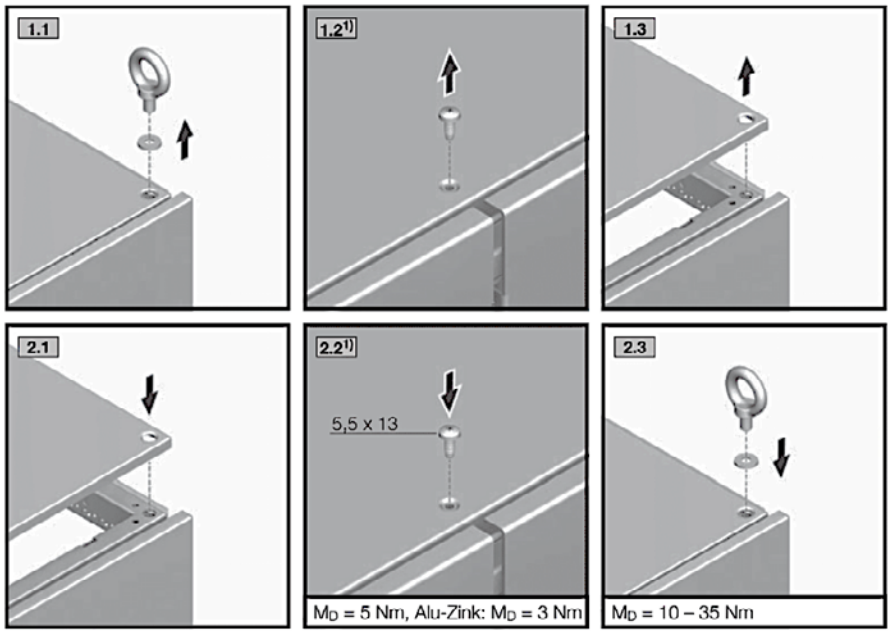


D. Removing The Rear Panel



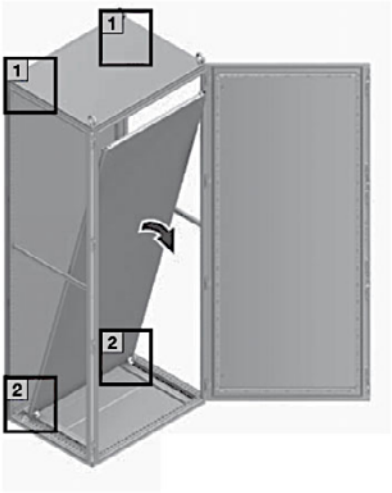


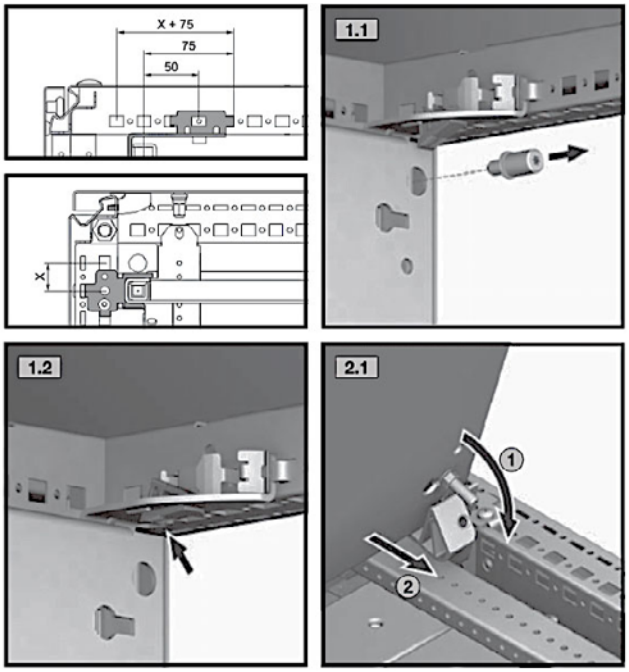
E. Removing The Roof Plate

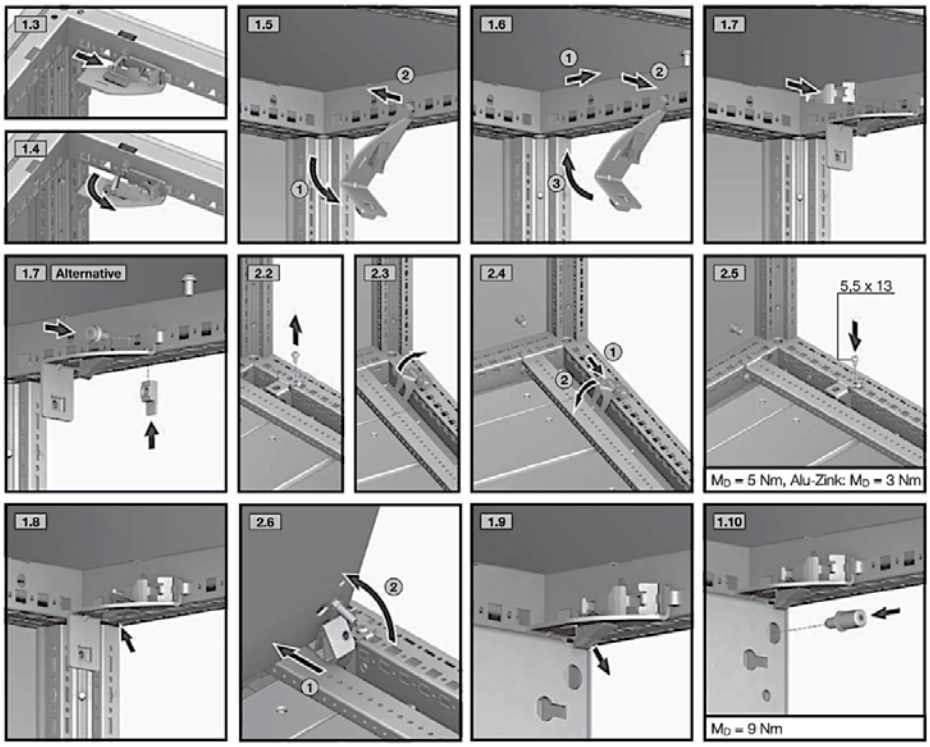


¹) Additionally for width 1000/1200

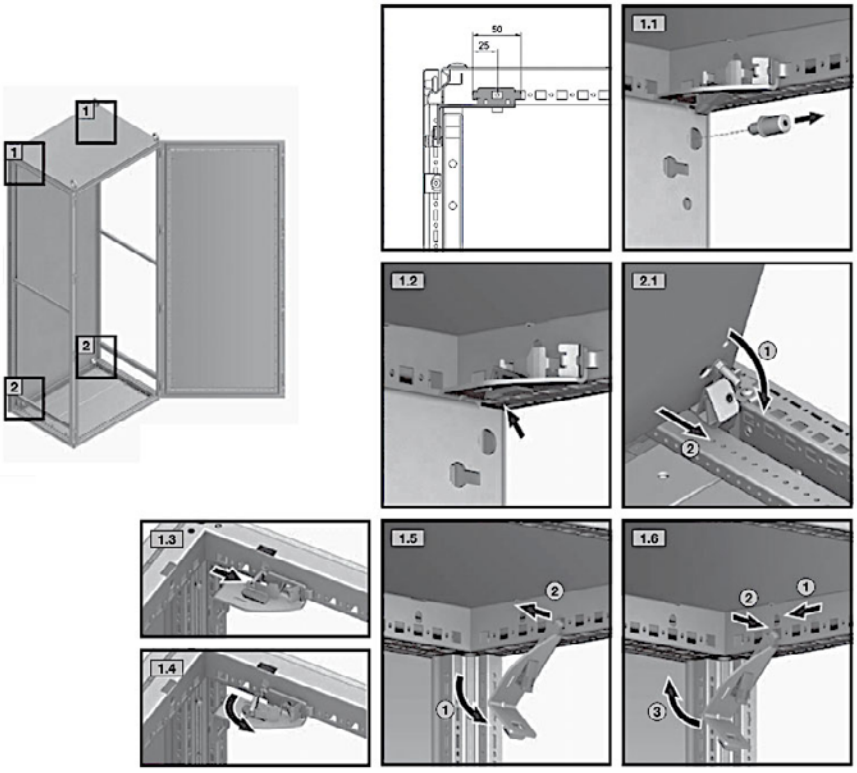
F. Moving The Mounting Plate

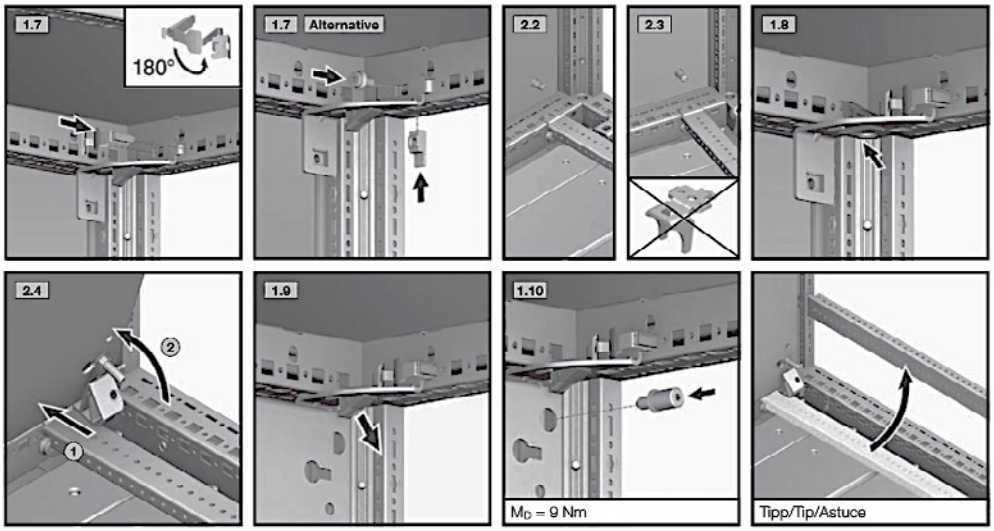






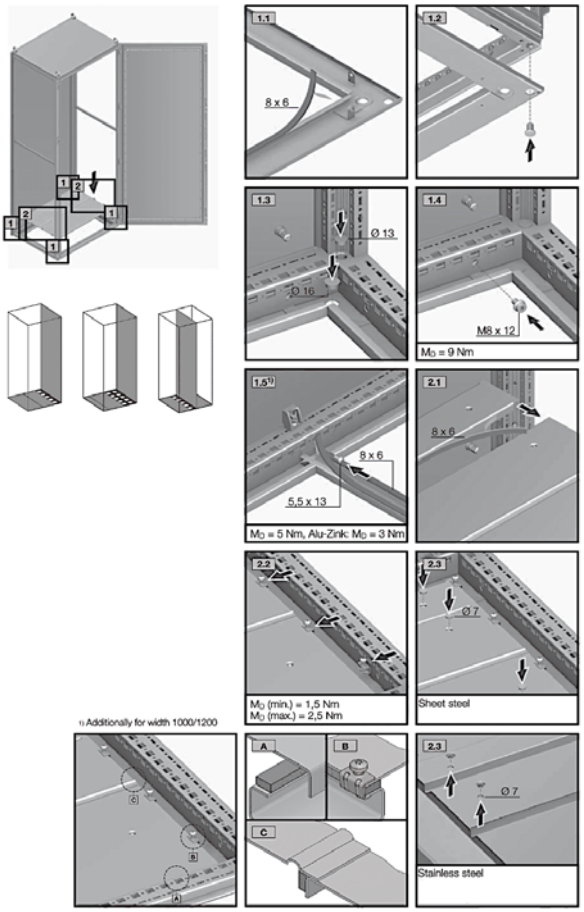
G. Fitting The Mounting Plate In The Rearmost Position



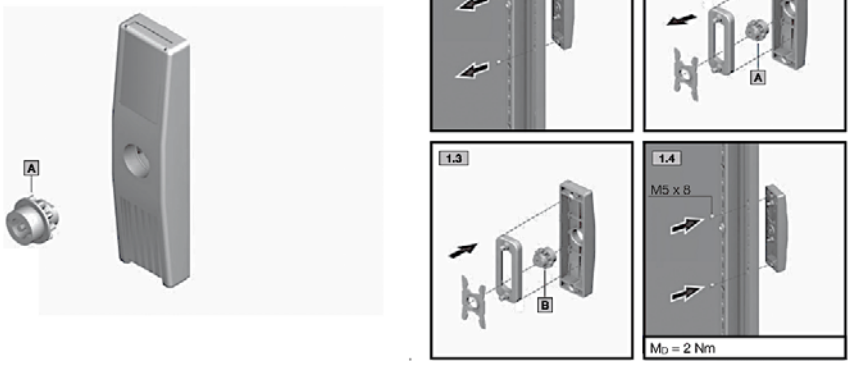


H. Fitting The Gland Plates

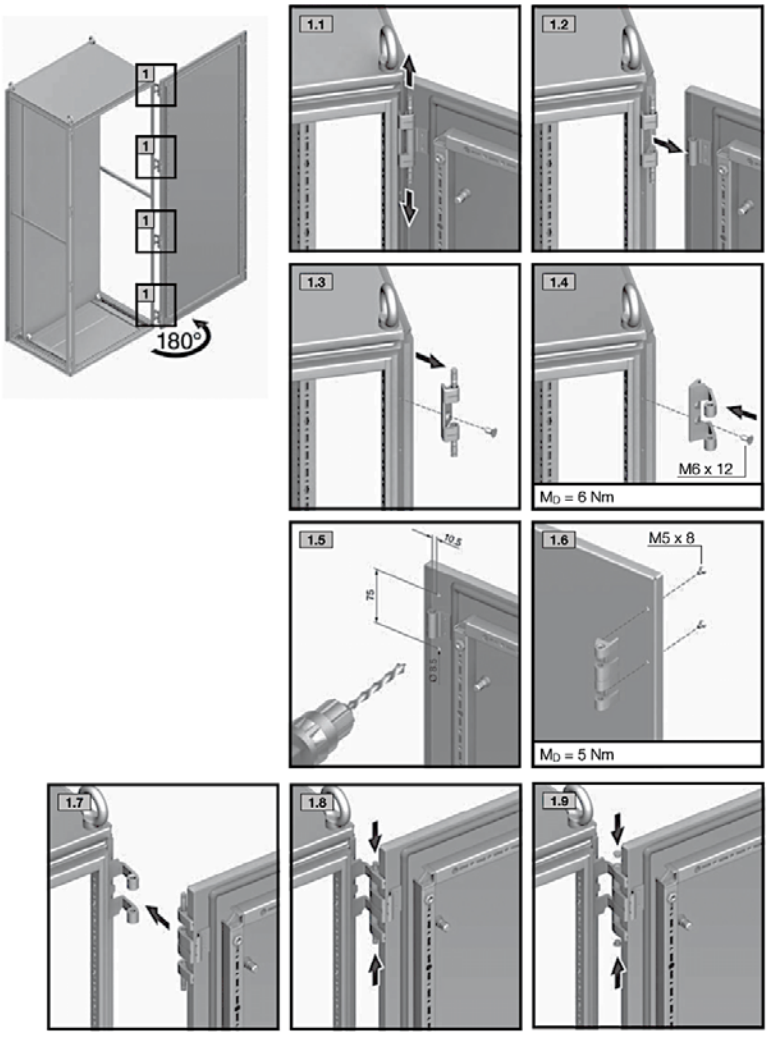
The illustrations below show three instances of installing cable entry plates instead of the standard three-part gland plates of the enclosure. This allows for flexible positioning aligned with the mounting plate. The symmetrical enclosure design enables the installation of cable entry plates on either the right or left side, similar to the gland plates. Variation in the enclosure depth is also achievable with appropriate sizes.



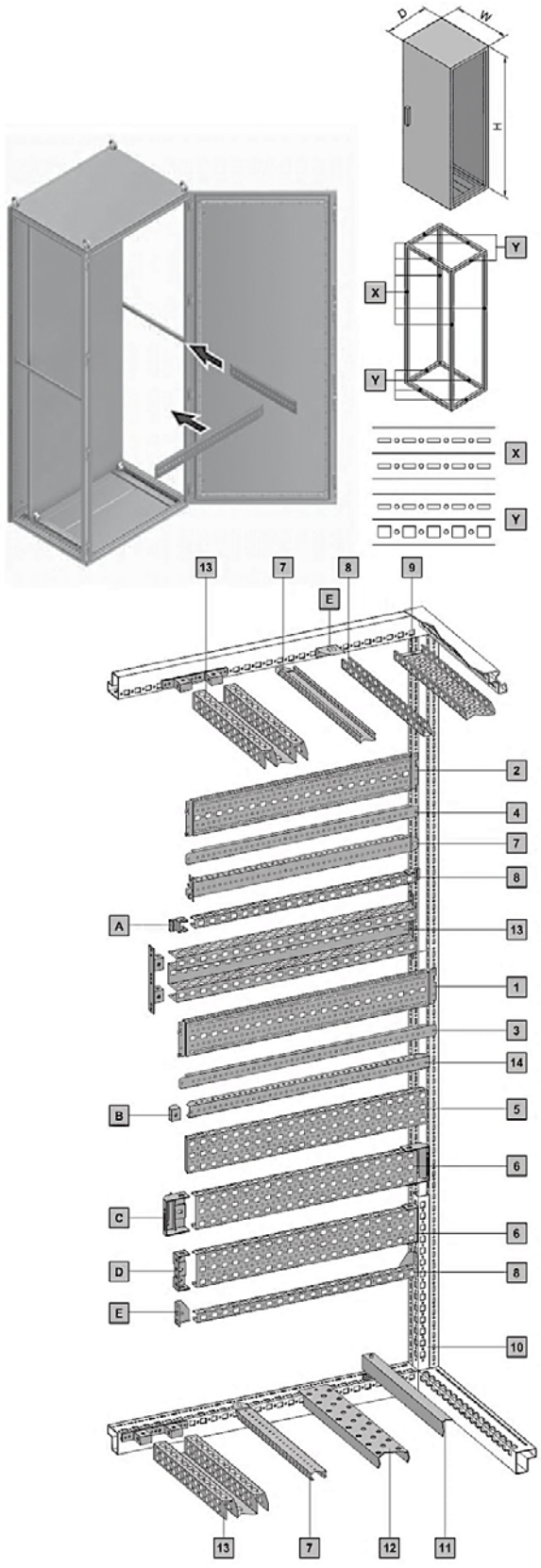
I. Changing The Lock Insert



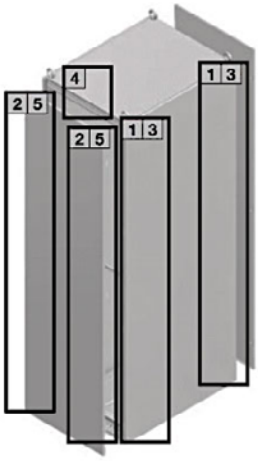
J. Fitting The 180° Hinges

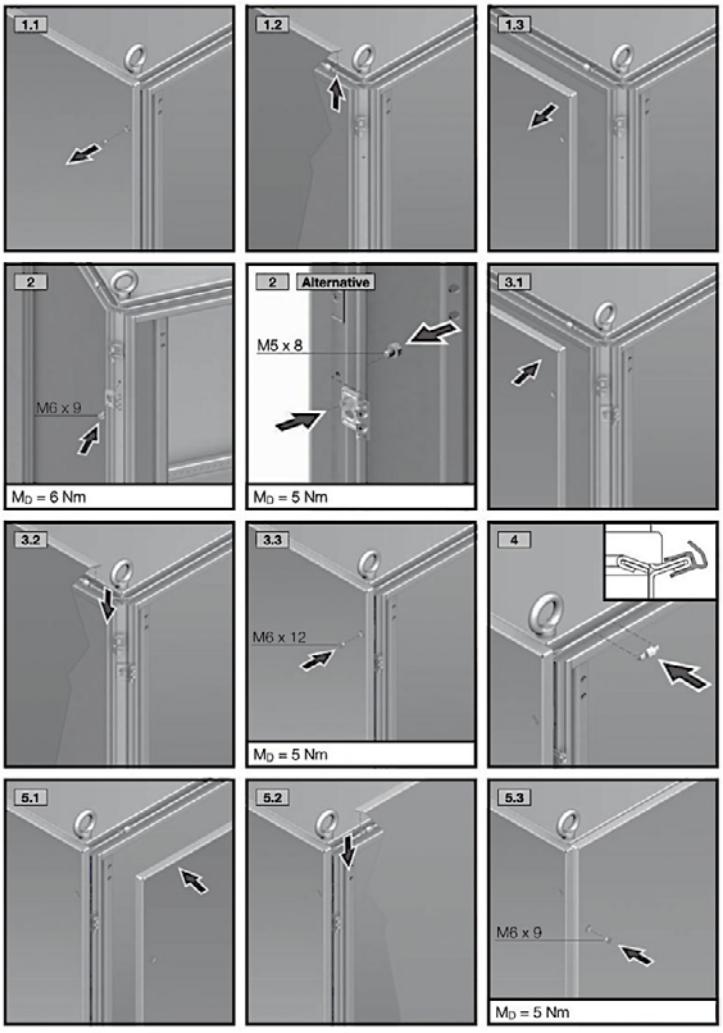


K. Installing Mounting Angle Systems



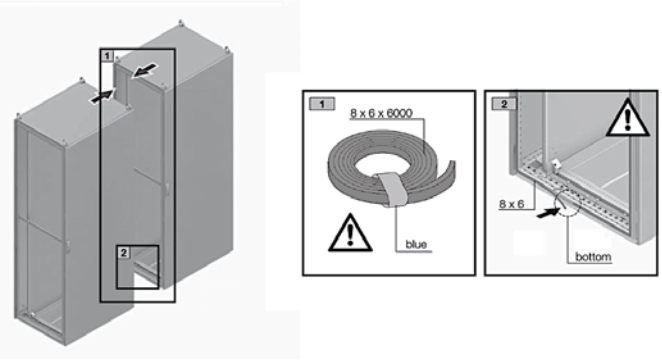
L. Fitting The Side Panels

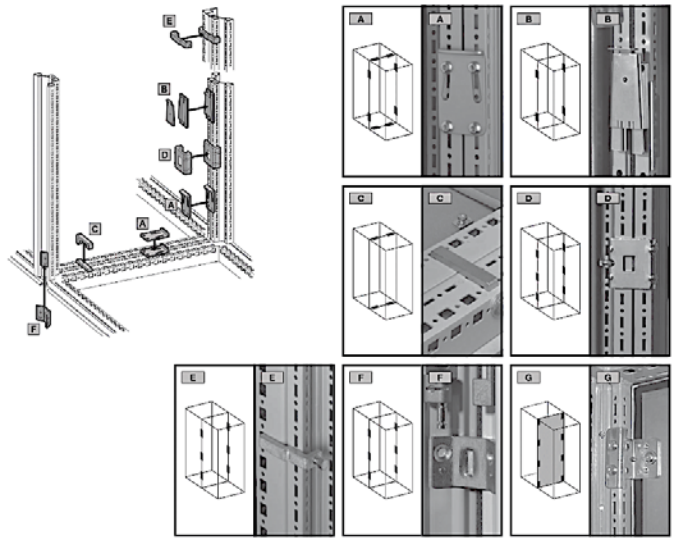




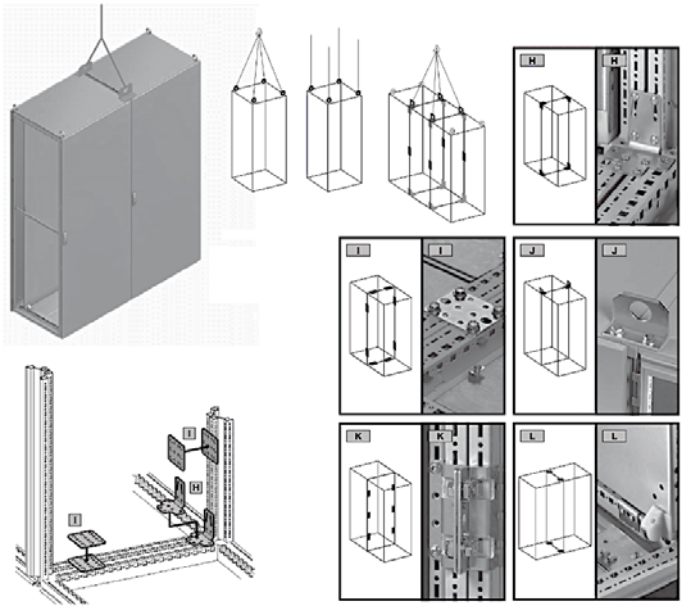
M. Baying

The process of joining two switchboard sections involves several steps. Begin by removing the front panels and, if applicable, the back plates. This allows for the secure bolting of adjacent shipping section frames. Next, insert appropriate steel bolts through the holes in each front and rear corner post, following the configuration illustrated in the figures below. Finally, apply sufficient torque to tighten the bolts, ensuring a secure connection.



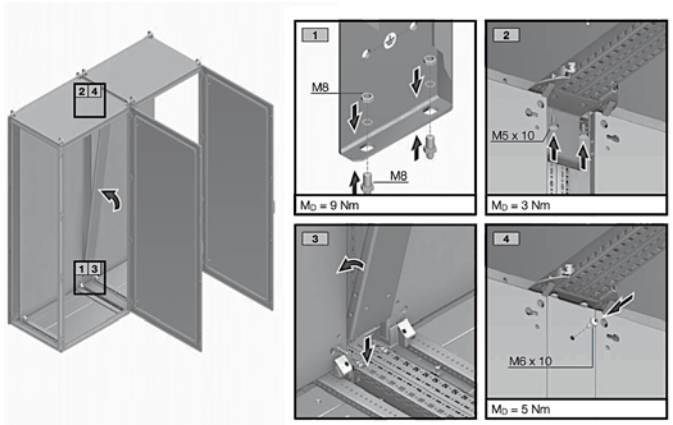


Indicator	Component
A	Quick-fit baying clamp, one-piece
B	Quick-fit baying clamp, three-piece
C	Baying clamp, horizontal
D	Baying clamp, vertical for TS/TS enclosures
E	Baying clamp, vertical for TS/PS enclosures
F	Baying connector, external
G	Baying attachment, vertical, for TS/TS with divider panel enclosures

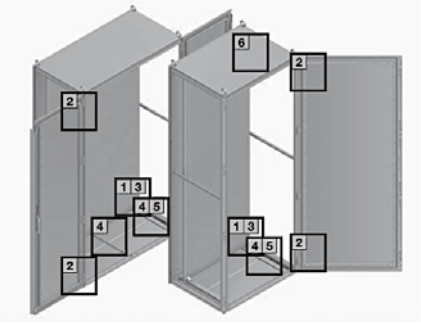


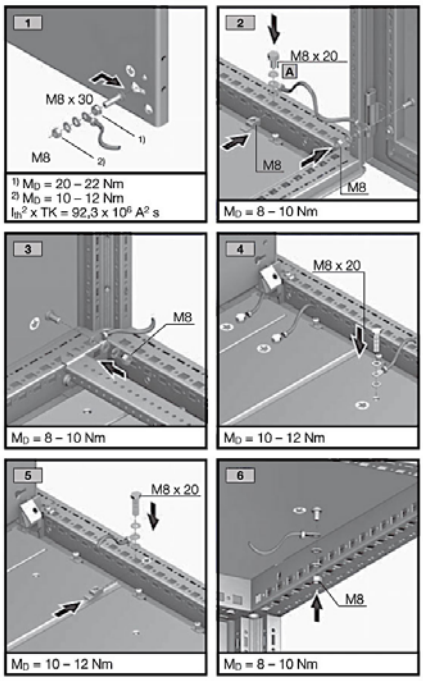
Indicator	Component
H	Angular baying bracket for TS/TS enclosures
I	Baying bracket for TS/TS and TS/PS enclosures
J	Combination angles
K	Baying attachment, vertical, for TS/TS enclosures
L	Baying clamp, for back-to-back mounting

N. Fitting The Mounting Plate Infill



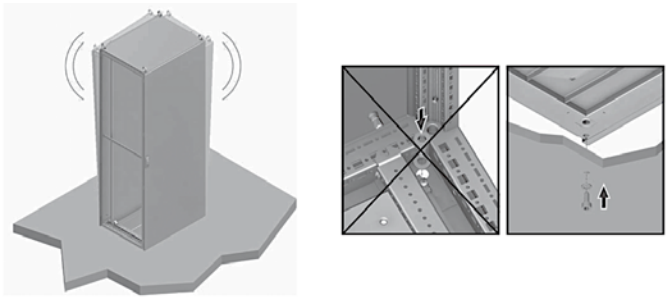
O. Earthing And Potential Equalisation



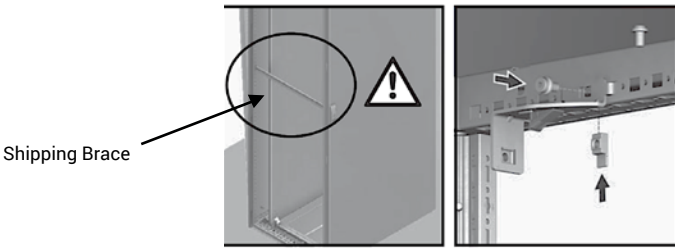


		1	2	3	4	5	6
	M8 x 30	1	-	-	-	-	-
	M8 x 20	-	-	-	4/8	1	-
	Ø 8,2	-	-	-	4/8	1	-
	M8	1	1/2	1	-	-	1
	M8	1	-	-	-	-	-
	M8	-	-	-	-	1	-
	A 8,4	1	1/2	1	4/8	1	1
	A8	1	1/2	1	-	-	1
		1	1/2	1	4/8	1	1

P. Securing In Case Of Dynamic Load



Q. Securing Of Mounting Plate In Case Of Dynamic Load on Installation Site



4.6 - Electrical Connections

All electrical connections within switchboards are made using cables or bus bars. Bus bars are furnished for connecting the main bus, pads for cable terminations, and circuit breakers fusible devices. MPS Switchboards are designed to comply with accepted industrial standards for electrical clearances between energized components. However, some cable and bus connections must be made in the field, and in such cases, the technicians making the connections must ensure that all minimum clearances are maintained according to the provisions provided in **Table 4-1**.

Table 4-1 Minimum Clearances Between Energized Components

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 - Busbar Connections

When the switchboard group is divided into parts for shipping purposes, different connections must be established in the field during the equipment installation process. Bus bar connections are made by combining busbar systems and connection systems.

The busbar system comprises conductors and components responsible for conducting electrical energy within the switchboard. MPS switchboards come equipped with busbar systems, illustrated in **Figure 4-2**.

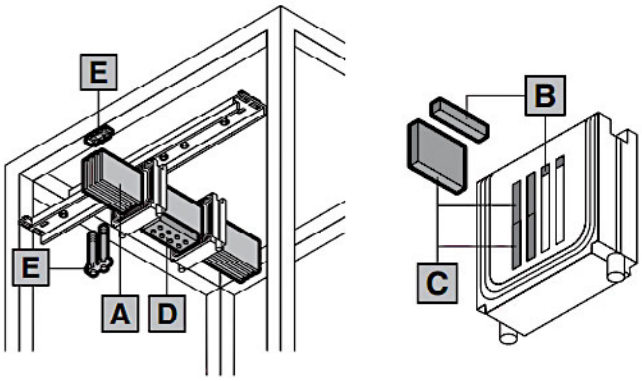


Figure 4-2 Busbar System.

The components of the busbar system, as illustrated in the above figures, include:

Indicator	Component
A	**Busbars E-Cu** These are the physical copper conductors/bars used for collecting and distributing electrical energy to various switchboard components, as well as transferring energy from the input terminals to the output terminals of the switchboard. A single bar can extend up to 2400mm in length.
B	**Spacer** The busbar spacers are non-conductive elements within the busbar system designed to isolate a busbar from others, ensuring a minimum distance between them. Usually crafted from fiberglass, these spacers exhibit excellent insulating properties and increased mechanical strength.
C	**Filler Pieces** Busbar filler pieces serve the purpose of occupying empty busbar slots within switchboards when not all slots are in use for conduction. These components play a crucial role in safeguarding the switchboard against any stray voltages and currents in the unused slots.
D	**Longitudinal Connectors E-Cu** Busbar longitudinal connectors, smaller copper bars in comparison to the actual busbars, are used to connect the main busbars of different enclosures. The configuration of longitudinal connectors may vary based on the number of strands per busbar conductor. These connectors do not require any drilling.
E	**Busbar Claws** Busbar claws are mechanical supports made from stainless steel, serving to stabilize flat copper busbar stacks and securely hold connection brackets in place. These claws are generally designed for use with 10mm bars.

The connection system comprises all the fasteners and components essential for securing the busbar system in place. Refer to **Figure 4-3** for a visual representation of the connection system.

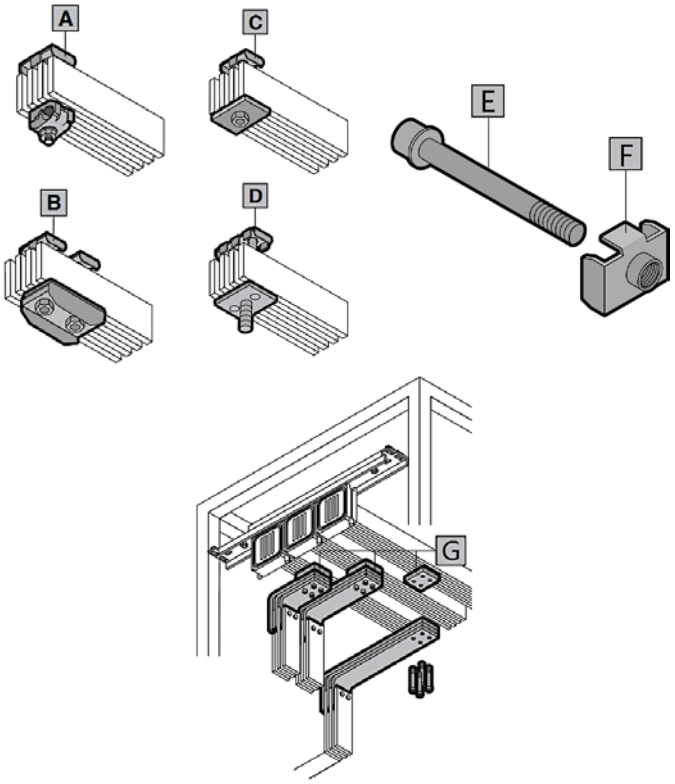


Figure 4-3 Connection System

The components of the connection system, as illustrated in the above figures, include:

Indicator	Component
A	**Direct Connection Terminals for Round Conductors** Direct Connection Terminals consist of two components: busbar claws and tin-plated connection clamps, crafted from stainless steel and brass, respectively. These terminals are specifically used for connecting round conductors to a busbar distributor system composed of flat copper.
B	**Connection Plates for Laminated Copper Bars** Comprising three elements – connection plates made from copper, along with a thrust piece and busbar claw made of stainless steel – these plates are specifically used to connect laminated copper bars to a busbar distributor system composed of flat copper.
C	**Connection Plates for Ring Terminals with M10 Screws** Comprising two elements – connection plates made from copper and a busbar claw made of stainless steel – these plates are specifically used to connect ring terminals to a busbar distributor system composed of flat copper. These connection plates use M10 screws designed to accommodate 10 mm bars.
D	**Connection Plates for Ring Terminals with M12 Screws** Connection plates for ring terminals are also available with M12 screws, suitable for connections that require lengths exceeding 30mm. Other properties remain consistent with connection plates using M10 screws.
E	**Screw Connections** Stainless steel screws in various designs and sizes, ranging from M10x60 to M10x190, are available to facilitate essential mechanical connections within the switchboard device.
F	**Claws with Threaded Inserts** Claws are used for mounting NH slimline fuse-switch disconnectors size 00 on bar systems with 185 mm center-to-center spacing.
G	**Contact Makers E-Cu** They are made of copper and used for connecting the connection brackets to busbars.

Follow the provided instructions for making the necessary bolted connections:

- The main bus can be made accessible from the cable termination area by removing the main bus compartment barrier, which separates the main bus from the cable area. Depending on the arrangement, it may be necessary to remove additional items between the main bus barriers and the rear of the unit to gain full access. Upon the completion of bus assembly and installation, these items should be reassembled in reverse sequence.
- Ensure that all surfaces are free of dust, dirt, or any other foreign material. Avoid the use of abrasive cleaners on plated contact surfaces. Cleaning is unnecessary and should only be done if parts are significantly tarnished. If necessary, cleaning should be done using a mild cleaner to thoroughly remove all residue. The cleaning agent must be kept away from the insulation.
- Before assembling a bus bar joint, confirm that the bar is correctly inserted through bus supports whenever required.
- Assemble all joints while keeping the parts in a dry state. Do not apply grease or “no-oxide” products.

4.8 - Ground Bus Connections

The installation of the Ground bus involves two steps. Initially, a combination angle is secured onto the top of the frame’s bottom/base. Subsequently, the ground bus is rotated into position and mounted on the two combination angles located on opposite sides of the switchboard frame. This process is illustrated in **Figure 4-11**.

NOTE:

Proper installation of ground bus connection is critical for safe ground fault protection system operations.

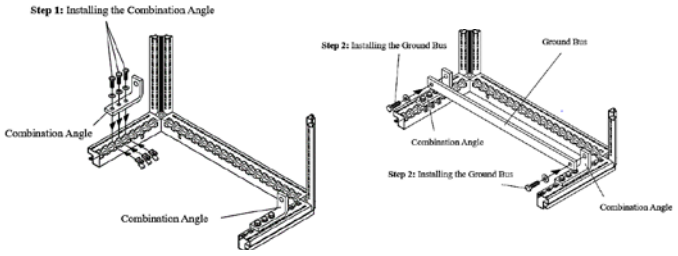


Figure 4-11 Ground Bus Connections, (Left) Installation of Combination Angle, (Right) Installation of Ground Bus.

4.9 - Grounding and Bonding

- Implement the following guidelines for grounded systems employed as service equipment or as the main switchboard on a separately derived system:

- A grounding electrode conductor must be run between the grounding electrode conductor terminal of the switchboard and the global grounding electrode at the installation site. The appropriate material and size for the grounding conductor must be chosen in accordance with provisions in the NEC. The NEC provides the guidelines for installing the grounding electrode conductor. It is crucial to note that no ground conductors must be permitted on the load side of the neutral disconnect link or ground fault sensor.
- The main bonding jumper between the neutral and ground buses may be installed at the factory if necessary. The bonding jumper must be properly placed inside the equipment and properly labeled.
- It is crucial to note that no ground conductors must be permitted on the load side of the neutral disconnect link or ground fault sensor.
- Refer to the switchboard front elevation drawing for properly grounding and handling dual-fed (double-ended) systems with ground fault protections.

- Run a grounding electrode as described above for ungrounded systems employed as service equipment or as the main switchboard on a separately derived system.
- If the system is grounded at a point ahead of the switchboard, the grounded conductor must run from that point and connect to the ground bus as specified in the NEC. This conductor must be provided even if the switchboard supplies only phase-to-phase loads.
- If a switchboard is not utilized as the main switchboard on a separately derived system or as service equipment, equipment grounding conductors sized according to the NEC must be used to ground the ground bus and switchboard frame to the service ground, or it may be bonded to the raceway enclosing the main supply conductors in accordance with the provisions in the NEC.

4.10 - Conduit Area

All stubs and conduits must be positioned to avoid cable interference with live buses and nearby structural members. According to the NEC, conduits shall not be permitted to protrude more than 3 inches above the bottom of the enclosure.

The side-to-side frame supports on a deep switchboard frame may need to be removed to install the conduit properly. An appropriate number of hubs or sleeves and ring connectors must be used while installing a conduit to protect cables and prevent water from entering and accumulating in the switchboard. All metallic conduits and stubs should be bonded to the switchboard with electrical connections sized in accordance with the provisions given in the NEC. According to the NEC, the cable should only be pulled after verifying the cable's compliance with the required size, temperature rating, and conductor insulation, as highlighted by the switchboard markings.

NOTE:

If the switchboard comes furnished with bottom plates, the required bottom conduit entrance must be holed by the customer.

The bottom plate must be reinstalled after a sufficient hole is made. The top plate is not designed to support the weight of the conduit and will buckle if under such weight for extensive periods of time. Therefore, conduits must be supported by other, more proper, means.

4.11 - Cable Pulling

All MPS switchboards are constructed in accordance with NEMA standards for cable arrangements. The front elevation drawing, and the following instructions should be followed when entering the cables into the switchboard in the conduit area:

- Only utilize cable sizes appropriate for a secure fit with the corresponding lugs.
- Pull the proper number of line and load side cables based on the served load.
- Arrange the cables within the switchboard in a way that helps prevent physical damage.

  Maintain the maximum cable bending radii and ensure proper clearance between cables, bus bars, and grounded parts. If any cables rest on structural members, either provide a different support structure to relieve the
- stress from the current member or place the necessary protective material at the bearing point to safeguard cable insulation.

  When cables enter or exit the switchboard or pass through metals with
- magnetic properties, all phase and neutral conductors should be run through the same opening as per the guidelines in the NEC.

  Cables entering or leaving the switchboard should be in the same section
- where they are terminated unless exempted under the guidelines of the NEC. Refer to the NEC for information on the appropriate wiring methods.
- Refer to the NEC for information on the separation requirements in Class 2 and Class 3 remote control, signaling, and power-limited circuits.
- According to the NEC, conductors sized 1/0 AWG or larger can be run parallel in the same size, length, and material to ensure uniform current distribution.

4.12 - Control Wiring

The control wiring undergoes meticulous installation and verification processes at the MPS factory before shipment. Inter-group wiring at shipping splits can be easily connected by referencing wire markings. These wires are designed with sufficient length to facilitate the on-field routing to their termination points after the cubicles are securely bolted together. Terminals for these leads can be readily obtained from other sources to accommodate the available crimping tools. However, the terminal block hardware may also be included with the switchboard when required. All requisite wiring diagrams for installation are provided in advance.

Wires can be effortlessly traced on the wiring diagram furnished with the switchboard. Each device is clearly depicted, and each terminal of every device is precisely identified. The wire list is also provided adjacent to each device on the diagram to specify the device and terminal number to which each wire is connected at the subsequent connection point.

All control wiring is installed at the MPS factory. It is meticulously bundled and secured to the cubicle wiring pan or side plate. It is recommended to make all field connections in a similarly organized manner for ease of use in the future. All parts and components must be verified to clear any additional wiring installed. Furthermore, all field wiring must be routed behind the removable cable retainer, specifically designed for such installation purposes. Plastic or nylon ties may be used to secure all field-installed wires to the cubicle structure.

Pre-Energizing, Inspection, and Testing

5.0 - Pre-Energizing, Inspection and Testing

Prior to energizing the equipment, conduct a comprehensive inspection and testing. Address any deviations and reinspect the equipment before proceeding with energization. MPS provides its customers with the following support services for switchboards:

- Start-up Commissioning of Switchboard Equipment.
- Switchboard Component and System Testing.
- Switchboard Maintenance (Preventative and Scheduled).
- Switchboard Component Repair and Refurbishing.
- On-Site Operational Training for Switchboard Technicians.

Contact MPS to obtain additional information about the aforementioned services and to schedule an appointment.

5.1 - Inspection

When inspecting the switchboard equipment, check the following carefully:

- Inspect the switchboards for any visual signs of damage that could negatively affect bus bar supports and device mountings or reduce the electrical clearances within the switchboards. **Table 4-1** of this manual lists the minimum clearance values.
- Check the electrical disconnecting contacts, shutters, machine parts, etc., for operation and lubrication conditions.
- Check the supports, blockings, and other temporary ties removed from relays, instruments, breakers, etc.
- Check the applied torque on all accessible busbar connections, including the factory and field-installed connections. If the connections are inaccessible, temporarily remove the barriers to the inspection process.
- Ensure that the proper fuses are installed correctly.
- Manually operate devices like switches, circuit breakers, etc., to check their alignment and operation.
- Operate all electrically operated devices like switches, circuit breakers, relays, meters, etc., to ensure their alignment and operations. Use an auxiliary power source to provide the necessary signals and power, if needed.
- Ensure all temporary wiring jumpers are removed from the equipment.
- Check the screw position of the current transformer shorting terminal block.
- MPS configures the adjustable settings of all its switchboard protective devices and relays to their lowest possible values prior to shipping. These settings must be adjusted in the field by the end users depending on the required system coordination study. Contact MPS Technical Services to perform the system coordination study and system commissioning.
- Ensure that the equipment is properly grounded.
- Check the incoming primary and secondary connections to ensure they are properly made and free of undesired shorts and grounds.
- Ensure that the equipment removed during assembly has been replaced.
- Confirm that the interlocks perform correctly.
- Check the disconnect devices and ensure they conform to the provided instruction books.
- Confirm the condition of the filters located in the vent areas. Make sure they are clean and free of undesired foreign material.
- Make sure no tool or object is left inside the equipment.
- Confirm the covers and doors are properly installed. Close the doors and ensure no cable or conductor is nicked or pinched.

5.2 - Testing

A **megger** test must be performed to verify the insulation of all connections made in the field. According to guidelines in NEMA PB2.1, Section 7.6., the test must be performed between phase to phase, phase to neutral, phase to ground, and neutral to ground connections, with the neutral isolated overcurrent devices in the open position. A healthy switchboard should give a resistance reading of 1 Megohm or greater. If lower resistance readings are observed, the issue should be investigated, and the required corrective measures should be applied. If the issue persists, contact the MPS Sales Office for further assistance.

If possible, a dielectric test should be applied on the high-voltage and high-power circuit for one minute at the appropriate test voltage, as given in **Table 5-1**.

Table 5-1 Test voltages for Dielectric Testing

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

Various equipment like control transformers, voltage transformers, surge protective devices, surge arresters, and surge capacitors must be disconnected before performing these tests.

NOTE:

The above dielectric test voltages are provided as a reference. They can be used to verify the integrity of the connected cable installations without disconnecting them from the switchboard. During the dielectric test, the voltage should be incrementally raised to the test value in discrete steps and maintained at that level for one minute.

According to ANSI C37.20.02 Clause 5.5, Field Dielectric Tests must be performed after significant field modifications and when new units are introduced to an existing installation. These tests must not be performed on equipment stored for extended periods because such equipment accumulates a significant amount of moisture, dust, and other contaminants during the storage period and does not give accurate results. If dielectric tests must be performed on such units, the equipment must be restored to a satisfactory condition through comprehensive cleaning and maintenance. This precaution is crucial to ensure the reliability and accuracy of the field dielectric tests.

5.3 - Ground Fault Protection System

The NEC mandates the inclusion of ground fault protection on all service disconnects in the switchboard rated 1000 amperes or greater, particularly when fed by a solidly grounded Wye system with more than 150 V line-to-ground voltage. To ensure compliance with relevant standards, all ground fault protection equipment for the switchboard is thoroughly tested before shipment from the factory. When provided, the ground fault protection system must undergo testing upon its initial installation, adhering to the specifications outlined in the NEC. However, there are exceptions to this rule, and ground fault protection is not obligatory for fire pumps or continuous industrial loads where a non-orderly shutdown could pose an additional hazard.

The NEC outlines the specific requirements for installing the mandated additional levels of ground fault protection inside healthcare facilities, such as hospitals.

The NEC requires that ground fault protection be provided on devices, switches, and breakers rated 1000 amp or greater and applied in a system as described above unless the necessary ground fault protection is already provided upstream. Utilities commonly use grounded Wye secondary transformers and connect the grounded mid-point to the service section ground bar. In such cases, the switchboard equipment must be provided with the necessary ground fault protection.

Ground Fault Inspection and Testing

6.0 - Ground Fault Inspection and Testing

For a 480-volt, 1000-ampere (or larger), three-phase, three-wire service section, an inquiry should be made to determine whether the utility uses a three-wire delta secondary transformer. If confirmed to be the case, ground fault protection is not required for the switchboard equipment.

WARNING:

The above dielectric test voltages are provided as a reference. They can be used to verify the integrity of the connected cable installations without disconnecting them from the switchboard. During the dielectric test, the voltage should be incrementally raised to the test value in discrete steps and maintained at that level for one minute.

According to ANSI C37.20.02 Clause 5.5, Field Dielectric Tests must be performed after significant field modifications and when new units are introduced to an existing installation. These tests must not be performed on equipment stored for extended periods because such equipment accumulates a significant amount of moisture, dust, and other contaminants during the storage period and does not give accurate results. If dielectric tests must be performed on such units, the equipment must be restored to a satisfactory condition through comprehensive cleaning and maintenance. This precaution is crucial to ensure the reliability and accuracy of the field dielectric tests.

6.1 - External Ground Fault

- Disconnect the main power source to ensure a secure work environment.
- Remove the neutral disconnect link and confirm that the neutral is grounded exclusively by the main bonding jumper. Ensure the main bonding jumper is positioned on the line side of the sensor.
- Close all branch devices to facilitate the measurement process.
- Use a “megger” type meter to measure the resistance of the load phase and neutral to ground. This step is essential to verify the absence of any ground connections in the system.
- A healthy insulated system should give a resistance reading of 1 Megohm or greater.
- Reinstall the neutral disconnect link once the resistance measurements have been obtained.

- Open all devices.
- Reconnect the main power source, ensuring a controlled and gradual restoration of power to the system.

Follow the below instructions to test the entire system, including the disconnect device:

- Check for control power and ensure that the LED is illuminated, indicating the presence of power.
- Press and hold the “shunt trip bypass” switch on the relay.
- Observe the trip indicator, which should move to the “trip” position, causing the disconnect device to open.
- Release the “push to test” switch on the relay.
- Reset the relay and the disconnect device to return the system to its normal state.

Figure 5-1 Ground Fault Relay

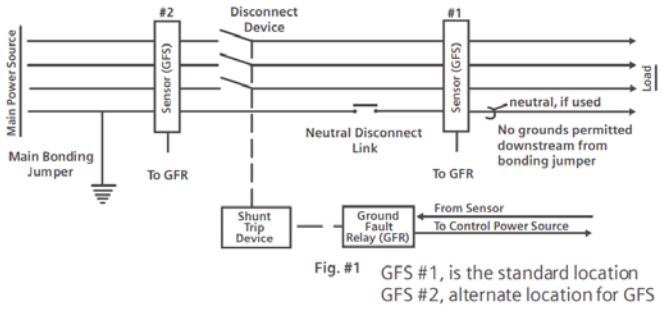


Figure 5-2 Ground Fault Configuration

Follow the below instructions to test the ground fault relay and sensor only:

- Check for control power, ensuring that the “LED” is illuminated, indicating the presence of power.
- Press and hold the “shunt trip bypass” switch on the relay.
- While holding the “shunt trip bypass” switch, press the “push to test” switch. This action should cause the ground fault relay to trip.
- Reset the relay, and then release the “shunt trip bypass” switch to restore the system to its normal state.

NOTE:

Make sure to document the results of the ground fault field testing. This record-keeping is valuable for maintaining an organized and comprehensive log of ground fault field testing activities.

Energizing and Operation

7.0 - Energizing and Operation

WARMING:

Care should be taken when energizing a switchboard for the first time after initial installation or maintenance due to the potential danger posed by any undetected exposed parts. Contact with hazardous voltage through these parts can cause severe injuries and even death.

7.1 - Placing Equipment into Service

Only qualified persons familiar with the operation and construction of the switchboard equipment should be allowed to perform the procedures described in this set of instructions. Additionally, the qualified person should be allowed to work on the switchboard equipment only after reading this complete set of instructions.

- Verify the status of all interrupting devices and set them to the open position. Check and open all control circuits.
- Energize the primary incoming power source to the equipment, ensuring that the source’s voltage does not exceed the normal rating of the equipment.
- Close the control circuit to check all instruments, meters, relays, etc. during this phase. It’s essential to note that there must be no load on the switchboard when it is initially energized.
- Gradually energize the equipment in sequence, starting at the source and working towards the load. Close the main device first, followed by feeder devices, and then the branch devices to finally connect the source to the load. Observe instruments as the smallest branch load is added, allowing several minutes before connecting additional loads.
- Gradually increase the loads connected to the equipment while observing instruments and allowing several minutes before adding each additional load. Repeat the process but add more and more loads until the full load is connected to the equipment.

- After all mains and branch devices are closed, downstream loads such as lighting, heaters, contactors, and motors may be turned on.
- Regularly check the primary and secondary circuits for signs of overheating. Additionally, monitor all instruments during the first week of operation to ensure proper functioning.

Switchboard Loading and Maintenance

8.0 - Switchboard Loading

8.1 - Main Lug Switchboards Without Mains

The total continuous load current flowing through the supply bus should not exceed the current rating of the switchboard.

8.2 - Single Main Switchboards

For single main switchboards, maximum continuous loads must never exceed 80% of the overcurrent protective device rating, except in motor circuit applications or when the overcurrent protective devices are explicitly marked as suitable for continuous operation at a 100% rating. The same principle applies to each main in a multi-main switchboard. The feeders and branch circuits should also adhere to the 80 percent rule for the load applied to feeder and branch circuits, respectively.

8.3 - Harmonics Considerations

Some electrical equipment can introduce harmonics in the electrical system and cause overheating. This condition should be considered when determining the switchboard loading. The equipment rating may need to be derated in case of excessive heating.

Maintenance

9.0 - Maintenance

DANGER:

Failure to properly maintain equipment can result in equipment failure, serious physical injuries, and even death.

The instructions contained in this section should be reviewed, understood, and followed regularly when performing maintenance work on switchboard equipment.

9.1 - Inspection and Maintenance Intervals

Periodic inspections and maintenance are crucial in ensuring equipment's safe and reliable operation. When the equipment is operated under "Usual Service Conditions", it is recommended to perform maintenance and lubrication at least once every year. Generally, "Usual Service Conditions" refer to an environment where the equipment is not exposed to excessive acid fumes, dust, salt air, damaging chemicals, vibrations, rapid or frequent changes in temperature, and high humidity. More frequent maintenance would be required if the equipment were exposed to such conditions.

To prioritize the safety of maintenance personnel and others exposed to potential hazards during maintenance activities, it is essential to adhere to safety-related work practices outlined in NFPA 70E and other notable safety practice guidelines. Maintenance personnel should receive training in safety practices, procedures, and job-specific requirements. This manual should be reviewed thoroughly and kept in a readily accessible location for reference during equipment maintenance activities.

The user is responsible for establishing a periodic maintenance program to ensure safe and reliable equipment operations. The frequency of inspections, periodic cleaning, and preventative maintenance depends on specific operating conditions. NFPA Publication 70B, "Electrical Equipment Maintenance," can serve as a guide for establishing such a program.

It is crucial to note that a preventative maintenance program is not intended to cover reconditioning or major repairs. Instead, it should be designed to identify the need to perform such actions in a timely manner to prevent malfunctions during operation.

9.2 - Recommended Maintenance

Routine maintenance of switchboards involves cleaning, lubricating, and exercising its different components. The frequency of maintenance checks depends on the extent of switchboard usage and the environmental conditions of the installation site. However, the interval between two inspection checks should not exceed one year. All the tests detailed in the "Maintenance Tasks" section of this manual must be performed at the date of the inspection check.

A comprehensive and permanent record of all maintenance work should be maintained. This record should include a list of periodic checks and tests conducted, the date of their execution, the equipment's condition, and details of any repairs or adjustments made.

9.3 - Maintenance Tasks

Before conducting maintenance on a switchboard that has been energized for a minimum of three hours, a simple hand test should be performed just before the inspection. This test involves putting a hand on the front and side of the equipment enclosure and the dead-front surfaces of interior trims, switches, circuit breakers, and doors for at least three seconds.

If maintaining contact with these surfaces is challenging due to extreme temperatures, it could signal a potential issue in the equipment, thus necessitating immediate investigation.

DANGER:

Switchboards contain hazardous voltages. Contact with these hazardous voltages can cause severe injuries, property damage, and even death. Only qualified persons must be allowed to perform maintenance work on switchboard equipment, and they should follow all safety procedures and practices of working near switchboards and associated equipment. These practices include powering off, disconnecting, electrically isolating, and grounding the switchboard to prevent accidental energization while personnel work around the equipment. The workers should not come into contact with energized parts of the equipment during the inspection and maintenance procedures unless specified otherwise. Before starting any maintenance work on the equipment, complete the following steps on any component that affects the area of the work:

- Disable the automatic transfer schemes and remote control.
- Turn off the power from all direct and back-feed power and control sources, test, and ground.
- Disconnect all voltage and control power transformers.

The following steps should be performed during a switchboard maintenance procedure:

- Assess the overall condition of the switchboard installation.
- Inspect the interior of the switchboard for signs of accumulation of dust, dirt, or any foreign material. If any are found, vacuum the interior to remove the accumulated dust or dirt deposits; avoid using an air hose for the cleaning, as it can blow the dust into critical electrical contact areas.
- Carefully examine the interior of the switchboard for signs of moisture, condensation buildup, and prior wetness. Inspect conduit entrances and cracks. Seal off any leaks to eliminate moisture. Use a mild household detergent to wash and clean the air filters.
- Examine the condition of the indicating lamps and replace them if required.
- Inspect the connections on the terminal block contacts for looseness.
- Check the control and instrument switches and the condition of their contacts. Ensure the instrument transformers are in proper condition. Check both primary and secondary connections. Replace any burned-out fuses, if present.
- Examine the de-energized insulators for signs of dust accumulation and clean any observed buildup.
- Inspect the condition of bus bars and connections. If bus bars have overheating issues, check the bus bar connections and loading conditions to find the cause.
- Inspect the fuse clip contact pressure and contact means. If any signs of looseness or overheating are observed, contact the MPS Sales Office for replacements.
- Inspect and replace deteriorated insulated material where the sealing compound has melted.
- Inspect the condition of all safety interlocks to ensure they function properly.
- Carefully examine all devices inside the switchboard for worn, broken, or missing parts. Manually operate all devices several times to ensure proper functionality. Follow the maintenance procedures for interrupting devices outlined in the device instruction manual. Avoid opening sealed breakers or trip units, as such actions may disrupt their calibrations. Contact the MPS factory for any necessary replacements. Refer to NEMA AB4 for further guidance.
- Make sure the space heaters and thermostat (if equipped) operate properly.
- Maintain other auxiliary equipment according to the requirements in their respective instruction books.
- Lubricate contacts, mechanisms, and other moving components, excluding parts of molded case circuit breakers.
- Inspect painted surfaces of the switchboard and perform touch-ups as required.
- Check the interior of the switchboard for signs of insect or rodent nesting.
- Replace, re-insulate, reassemble, and return all switchboard items to their proper operating condition. Remove grounds before energization.
- Ensure the instruments and relays operate satisfactorily in accordance with the requirements outlined in the separately furnished instruction books. Avoid leaving the device covers off for an extended period. If a cover is damaged, temporarily cover the device and promptly replace the broken glass.
- Verify the functionality of the ground fault protection system (if provided).
- Perform the electrical insulation resistance test on the switchboard to verify that it is free of short circuits and grounds.

This checklist is not a comprehensive examination of all the maintenance steps needed to guarantee the safe and reliable operations of the equipment. Specific applications might demand additional procedures. If further procedures are needed or if specific issues arise that are not adequately addressed for the purchaser's requirements, consult the MPS Sales Office for guidance.

9.4 - Cleaning Insulation

The majority of plastics and synthetic materials utilized in insulation systems are susceptible to damage from solvents containing aromatics or halogenated hydrocarbons. Exposure to such solvents can lead to crazing and deformation of the material, thereby diminishing its dielectric strength. Isopropyl alcohol is the only solvent cleaner recommended for use with MPS insulation systems.

Adverse Conditions and Informational Charts

10.0 - Adverse Conditions

10.1 - Ambient Temperatures

Switchboards are typically designed for installation in areas where the average ambient temperature never exceeds 40ºC (104ºF). In installations at higher temperatures, the switchboard operation may need to be derated. Contact the nearest MPS representative for assistance before relocating a purchased switchboard unit.

10.2 - Short Circuits

Overcurrent protective devices effectively limit the damage to the precise location where the short circuit or fault occurs. However, the short circuit currents can generate intense mechanical stresses in the system that can travel physically (rather than electrically) and potentially inflict harm on nearby conductors, insulation, and other switchboard equipment despite the function of protective devices. Therefore, a comprehensive inspection of the entire system must be made after the occurrence of any fault to confirm the absence of damage to all conductors, insulations, and equipment.

Furthermore, the overcurrent protective device(s) should also undergo inspection for potential arcing damage to contacts, arc chutes, and insulation. However, sealed devices and breaker trip units should not be opened, as doing so would result in a loss of functionality and require replacement. A hi-pot test should be conducted on the equipment to detect any traces of current leakages. For the necessary inspection and correction procedures, consult this manual's inspection and maintenance sections. If a device is damaged, it should be promptly replaced.

10.3 - Arcing Damage

In the event of a fault, the intense heat from an electrical arc can cause certain organic insulation materials to lose some of their insulation properties due to carbonization.

Therefore, any signs of carbon deposits or tracking should be removed using a dry, lint-free cloth. Additionally, the affected material may be replaced entirely before the switchboard re-energization. Contact the MPS sales representative before undertaking any cleanup or corrective actions.

10.4 - Water Damage

The switchboard must be completely de-energized if any signs of moisture or water are observed on the equipment. Refer to the NEMA publication, "Guidelines for Handling Water Damaged Electrical Equipment" for detailed instructions for dealing with water damage and moisture issues inside switchboards and other electrical equipment. In case of extensive damage or prolonged exposure to moisture, contact the MPS sales representative for assistance.

10.5 - Corrosive Atmospheres

Special precautions must be followed when switchboards are installed and operated in corrosive environments to minimize their impact on switchboard performance. Non-insulated bus bars, disconnect switches, exposed metallic surfaces, wire ends, primary and secondary disconnecting contacts, instrument terminals, etc., must all be protected from the corrosive environment.

During each maintenance inspection, the old grease must be removed from contacts, and a new lubricant must be applied to sliding surfaces. A coat of a corrosion-resistant material, like glyptal, can be applied to secure other exposed components.

Informational charts

11.0 - Informational charts

11.1 - Torque Values

The equipment connections are inspected, tested, and properly applied prior to shipment. However, transit conditions may result in some connections becoming loose. Hence, it is advisable to recheck the tightness of all connections before energizing the equipment at its intended destination.