ANSI SWITCHGEAR

ADVANCE®

5/15 kV non-arc resistant switchgear

Installation, operations and maintenance manual

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1. IMPORTANT SAFETY NOTES & WARNINGS

Equipment operation depends on proper handling, installation, and maintenance. Neglecting fundamental requirements may lead to injury of personnel, failure of the equipment and property damage.

Safety as described in this instruction book involves two conditions:

- Personal injury.
- Product or property damage.

1.1 Safety Notations

Safety notations alert personnel to possible death, injury or property damage situations. The safety notations appear before the step in which the condition applies. The one safety notice and three hazard levels notations are:

DANGER

"Danger" indicates a hazardous situation that has a high probability of death, severe injury, and substantial property damage.

WARNING

"Warning" indicates a hazardous situation that has some probability of severe injury and substantial property damage.

CAUTION

"Caution" indicates a hazardous situation that may result in minor or moderate injury and/or property damage.

"NOTICE" Indicates a statement of company policy as it relates to the safety of personnel or protection of property

Personnel installing, operating, or maintaining this equipment must have thorough knowledge of all applicable local, regional, industry, government, and OSHA safety procedures as well as commonly accepted safe working practices. Personnel working in or around this equipment must also exhibit common sense and good judgment regarding the potential hazards for themselves and other personnel in the area. These instructions are intended for use by fully qualified personnel and are not a substitute for adequate training, experience and supervision.

Should clarification or additional information be required, refer the matter to your nearest ABB Sales office. When communicating with ABB regarding the product covered by this IOM Manual, always reference the ABB assigned Order number.

2. INTRODUCTION

2.1 General Instructions

Read these instructions carefully before installation and use as a guide during installation and initial operation.

File these instructions with other instruction books, drawings and descriptive data of the switchgear. Keep this book available for the installation, operation and maintenance of this equipment. Use of these instructions will facilitate proper maintenance of the equipment and prolong its useful life.

2.2 Scope of Instructions

The instructions are general in nature. They cover requirements for installation, setup, checkout and maintenance as applied to all ratings of ABB Advance® medium voltage, arc-resistant, switchgear. These instructions do not attempt to cover all variations and combinations of equipment and installations.

Information on particular installations appears in the following:

- Bills of Materials that list electrical devices and equipment.
- Single line drawings showing power connections.
- Floor plan, representing available space for power & control conduits.
- Section/Side Views.
- Special construction details.
- Elementary and schematic diagrams.
- Connection diagrams

3. RECEIVING, HANDLING AND STORAGE

3.1 Receiving Inspection

Before shipment, the equipment is inspected and marked with its number and position. Switchgear frames are factory- assembled and shipped with the doors closed. The factory ships circuit breakers in separate cartons, or as an option, inside the switchgear frame with the breakers in disconnect position.

Upon receipt of the equipment, examine the shipment for damage or missing components. Check the contents against the packing list before discarding any packing material. Check the consignment for completeness and lack of any damage (e.g. moisture and its detrimental effects). In case of doubt, the packing must be opened and then properly resealed, putting in new drying agent bags, when used.

If any quantities are short, or defects or transport damage are noted, these must be documented on the respective shipping document. Notify ABB and the carrier at once of any discrepancies. If there is damage from improper handling, file a claim for damages at once with the carrier and notify ABB.

Note: Always take photographs to document any damage.

Note: Unless otherwise noted in the project contract documents, ABB standard shipments are "CPT- Carriage Paid To." ABB is not responsible for damage, after delivery of the equipment to the carrier.

3.2 Handling the Equipment

Transport panels upright. Take the high center of gravity into account. Carry out loading operations only when it has been ensured that all precautionary measures to protect personnel and materials have been taken into consideration.

For structural integrity, all doors and panels must be in place and securely fastened before moving the equipment.

3.3 Storing the Equipment

Leave the equipment on the shipping base.

Store all equipment indoors in a well- ventilated area.

The storage building should have a well- drained paved floor. The temperature should be above 60°F. The air should be dry (60% maximum humidity).

The shipping sections are wrapped in plastic for protection during shipment only. Remove the plastic wrap after placing into storage. Cover with heavy wrapping paper or other moisture barrier. Use materials that will not trap moisture inside the unit. Do not cover louvered openings.

For long term storage, durations exceeding 2 weeks, or in high-humidity areas, use heaters to keep the interior dry. Bring power for the heaters to the load terminals of the device that controls the heater circuits (see Figure 1).

Figure 1: Heater load terminals in low voltage compartment (typ.)

Note: The protective breaker in the space heater circuit must remain open when using a separate power source during storage.

For circuit breakers shipped in crates, store circuit breakers upright in their original shipping carton oriented as indicated on the shipping crates. For circuit breakers shipped in the switchgear, do not remove for storage. See documents 1VAL050503-MB and 1VAL108002-MB for details on ADVAC and AMVAC breaker storage respectively.

Before energizing the heaters, remove all the packing materials from the switchgear. Open the breaker or cutout device that controls the heaters when using a separate power source.

4. SITE PREPARATION

4.1 General

Before installing, consult all drawings furnished for the particular order. The drawings show top, front and section views of the lineup, primary and secondary connection diagrams, and Bills of Materials. Study these drawings and the following recommendations before preparing the site plan drawings. On commencement of installation on site, the switchgear room must be completely finished, provided with lighting and the electricity supply, be lockable, dry and have facilities for ventilation. All the necessary preparations, such as wall openings, ducts, etc., for positioning the power and control cables up to the switchgear must already be complete.

4.2 Location

Locate the lineup in accordance with local regulations. Clearances at the front should allow for installation and removal of the drawout equipment. A minimum of 6 feet is recommended. Provide rear access for making connections before start-up and for periodic inspections and maintenance of 4 feet minimum.

4.3 Foundation

The ABB factory supplies General Arrangement and Floor Plan drawings for each installation. Refer to these drawings for floor leveling requirements. The finished floor under and in front of the switchgear line-up should be smooth, and shall not extend upwards above the switchgear floor line. Minimum floor leveling requirements are +0.0” to -0.25” over a linear distance of 20 feet.

For installations with concrete floors, install all power and secondary (control) conduits before moving the units to the site. Available space for the conduits appears on the floor plan drawings supplied with the switchgear. Conduits should not extend more than one inch above the station floor level. Plug conduit openings before pouring concrete.

For installations with steel floors, i.e., prefabricated metal buildings, cutouts for cable entry should not extend outside the space provided in the Advance frames as shown on the floor plan drawings.

5. INDOOR INSTALLATION

5.1 General

In order to obtain an optimum installation sequence and ensure high quality standards, site installation of the switchgear should only be carried out by specially trained and skilled personnel. Ensure all safety protocols are followed before, during and after installation of the switchgear by personnel and equipment operators.

Metal-clad switchgear ships in sections. These sections ship on disposable steel shipping bases. Equipment is not to be permanently installed on the shipping bases.

Unload the units as close to the installation site as possible. Remove all drawout elements and secure all doors and panels. To move the shipping sections to their final position, one of 4 methods can be used.

Forklift – place forks through locations provided in the shipping bases (see Figure 2 and Figure 3). Make sure that forks have penetrated the entire depth of the switchgear to engage all 3 shipping channels: front, center and rear (see Figure 4).

Lift the switchgear frames slowly and tilt forks slightly rearward to balance. Move carefully into the final position taking into account the center of gravity (see Figure 5).

Figure 2: Forklift provisions in shipping channels

Figure 3: Forklift forks penetrating shipping channels

Figure 4: Complete fork penetration of all 3 shipping channels

Figure 5: Lifting of switchgear frames with forklift

Towing - use chains rated for safe handling of the shipping splits. Consult the chain manufacturer or local code requirements for proper safety factors. Attach the chains to the holes at each end of the shipping base. Secure chains to the towing equipment. Make sure that the floor height is consistent or provide heavy duty steel sheets to bridge any inconsistencies. Protect the lower edge of the switchgear from damage by the chains.

Crane - using a spreader bar and either chains or slings connected to the shipping channel extensions, part no. 921309T01 (provided upon request), and lift carefully taking into account the center of gravity. Once located, final positioning can be done with a forklift. When using either chains or wire rope slings, place a wooden 4" × 4" block between the equipment and the sling to protect the equipment from damage.

Jacks and Rollers - raise the units with jacks located at the corners of the shipping bases (see Figure 6).

Move the units on steel pipe rollers with the shipping bases attached by pushing in one direction while another person puts an additional roller under the forward end (see Figure 7). As rollers reach the rear, they can be moved to the front until the unit is in place.

For lateral moving, raise the units by jacks as described previously and place the rollers laterally with steel channels (not furnished) on the rollers (see Figures 8 and 9). Carefully push the unit onto a third roller and move a roller from the rear to the front until the unit is in place.

Figure 6: Placement of jacks at the corners with rollers under the shipping bases.

Figure 7: Movement of the frames with rollers.

Figure 8: Position rails as shown for lateral movement.

Figure 9: Lateral movement of the frames with rollers.

Use of fork lift trucks for jacking or placing the jacks other than as described may result in stress distortions and irreparable damage to the equipment.

Do not remove the shipping bases until the units are set in place. Moving the units without the shipping base will cause irreparable damage and a hazardous condition.

5.2 Removal of the Shipping Base

Once the units are in their final place, the shipping bases can be removed.

Open the equipment doors. Remove the bolts holding each of the three shipping bases to the equipment floor plates (see Figure 10). If circuit breakers were installed for shipment, the lower position breakers will need to be removed prior to this step.

Figure 10: Unbolting the shipping bases.

Close and secure all doors and panels. Raise the units to a height that allows removal of the base. Use four jacks located at each corner of the shipping split, just inside of the shipping bases for this operation. Keep the units uniformly level to prevent distortion.

Select four pieces of wood thick enough to permit removal of the jack after lowering. Place one under each corner. Slowly lower one side until it rests on the pieces of wood. Repeat this process on the other side.

Use a pry-bar to lift each corner enough to remove the four pieces of wood (see Figures 11 and 12).

Figure 11: Using jacks to lower the frames onto wood blocks.

Figure 12: Using a pry bar to remove the wood blocks.

5.3 Attaching to the Floor

Following the removal of the shipping bases, the switchgear units should be secured to the floor either by bolting or welding per the guidelines outlined on the ABB factory drawings.

5.4 Connections

DANGER

Before making primary source connections, verify that the primary cables are de-energized and the equipment is properly grounded.

Bolt the separate units together. Reconnect the main bus and control wiring at the shipping splits. Follow the connection diagram when replacing secondary and control wiring.

Bolted connections should be torqued to required levels as outlined in Appendix A.

Complete all internal connections. Make the external connections to control power sources and circuits, to secondary and potential circuits to feeders, power sources and to ground.

Ground bus connections should not penetrate any part of the switchgear not intended for cable or bus entrance.

Note: After completing all connections to secondary (control) circuits, follow these circuits and remove temporary connections from current transformer secondaries (see Figure 13).

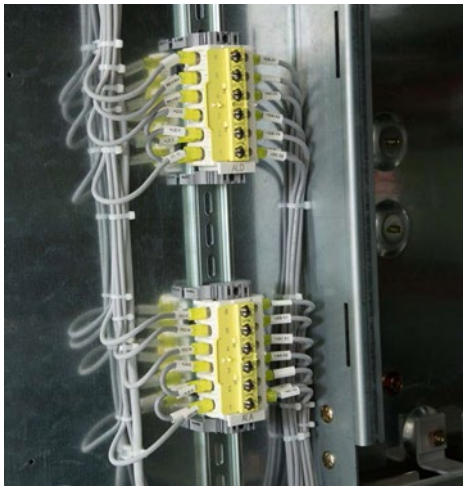

Figure 13: Current Transformer Shorting Blocks.

Temporary jumpers protect against voltages that may occur if the current transformer primaries carry currents while the secondary circuits are still not complete. With the secondary circuits connected, remove the jumpers.

Note: Failure to remove the jumpers will interfere with meters, relays, or other devices in these circuits (see Figure 13).

If shorting Terminal Blocks are used, review the Connection Diagram that was shipped with the unit, for position of shorting screws. See Step 11 of the Control Circuit Checkout in section 6.2

5.5 Connection to Ground Bus

The factory bolts the ground bus bars to each frame. Connect the ground bus bars between the shipping splits and to the station ground with a cable or bus of equal or larger gauge than the housing ground bus.

Do not run cable or bus in conduit. The cable or bus should take the most direct path to ground.

5.6 Installation of Bus Bar Connections between Shipping Splits

The factory assembles the main bus bar in each section. The splices at the shipping splits are unbolted for shipment. Refer to the General Arrangement drawings.

The contact surfaces of the bus at bolted joints are plated. Clean contact surfaces with a clean cloth and an OSHA approved solvent.

*Do not use **alcohol** or **freon**. Limit the use of solvents to removing grease and contamination from primary conductors, insulation and unpainted metallic surfaces. Use an OSHA approved, non- flammable solvent with a threshold limit of 300 PPM or higher in accordance with local regulations. Use solvents in well-ventilated areas.*

Note: Take care not to remove or tarnish plating.

Remove barriers to access the main bus compartment. Bolt the main bus together using supplied hardware. Conductivity of a bolted joint depends on the pressure or torque applied.

Note: All bolted joints must be torqued per ABB specifications – see Appendix A.

5.7 Secondary and Control Connections

The switchgear was wired in the factory in accordance with the Project specific Connection Diagrams. Refer to project specific drawings for locations of the incoming and outgoing wiring terminal blocks.

Openings in the side of the switchgear, in the low voltage/instrument compartment area, allow control connections between sections. When shipped in groups of several units each, the factory installs interconnection wiring between groups. The factory then disconnects and tags one end of each of the connections, then pulls the wire bundle back across the split within the adjacent frame. Reconnect these interconnections according to the project specific connection diagrams after the equipment shipping sections are installed in place.

WARNING

All secondary power and control wiring should be routed through the provided locations and utilize edge guards to prevent wire chafing.

5.8 Primary Cable Connections

Area for connection of primary cables is provided in the cable compartment either through the roof or floor as indicated in the General Arrangement drawings. The gland plates are made of 1/8” stainless steel. Aluminum is also offered as an option. These plates must be utilized in the final assembly. Holes for entrance of power cables or conduits must be cut in the gland plate(s) and a sealing type bushing used.

To access the 4000 A FAC cable compartments, disconnect the fan harness and unbolt the mounting ears holding fan duct assembly from the frame. After Primary cables are connected, reinstall the Fan duct using the mounting bolts and reconnect the fan harness.

5.9 Connection to Control Source

The control source wiring should be properly sized to support the requirements of the control circuit. Connect the control source leads to the terminal blocks as indicated on the project Connection Diagrams.

Note: Check the electrical phasing before connecting.

5.10 Circuit Breaker: Insertion and Removal

Before inserting a breaker into a module, remove foreign objects, tools and debris, or obstructions from inside the module.

Circuit breakers may ship separately. Remove the Plywood cover over the breaker that is securely attached to the pallet (see Figure 14). Untighten both clamp screws from the pallet (see Figure 15).

Figure 14: Breaker on the pallet (Crated)

Figure 15: Clamp screws

The factory installs blocks in the movable parts of breakers with under-voltage release. Refer to the appropriate breaker instruction manual for specific instructions on this.

All circuit breakers of like rating are interchangeable.

Circuit breakers have three positions in the housing.

1. The DISCONNECT position disengages the main disconnecting devices, and the control contacts on the breaker. They are a safe distance from the stationary part of the device located on the housings and the shutters are closed.
2. The TEST position disengages the main disconnecting devices, closes the shutters and engages the control contacts. This position allows operation of the circuit breaker for testing.
3. The CONNECTED position engages the main and control disconnecting devices on the breaker.

5.11 Insertion

5.11.1 To move breaker into the housing and DISCONNECTED position:

1. Open the breaker cell door completely
2. With the lift truck platform at ground level and the foot brake engaged (see Figure 16). Push the interlock release handles on the breaker inward and roll the breaker onto the lift truck. Roll completely onto the platform until the locking tabs engage the locking slot (see Figures 17 and 18).

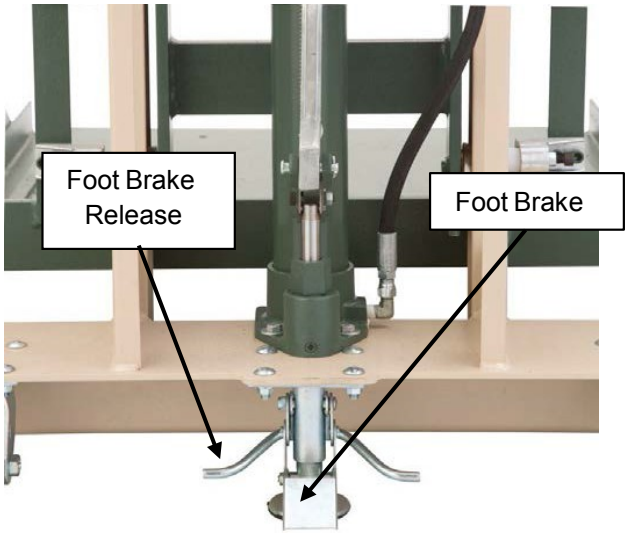

Figure 16: Lift truck foot brake

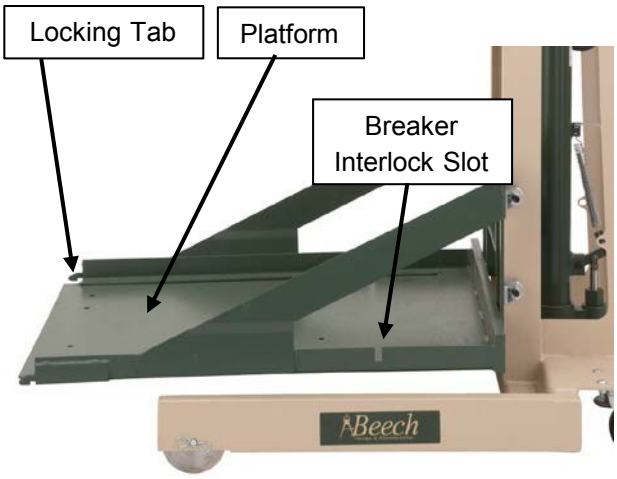

Figure 17: Lift truck

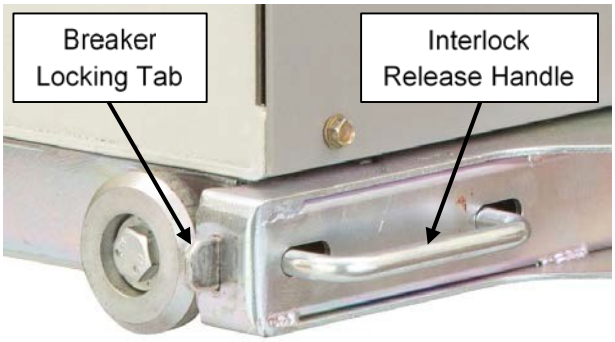

Figure 18: Breaker Truck Interlock, tabs and handles

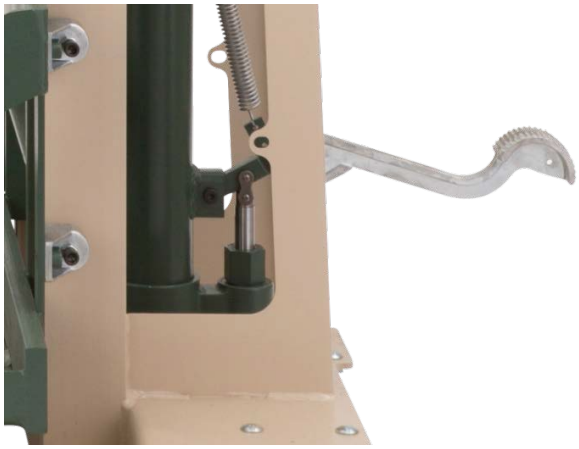

Figure 19: Lift truck foot pedal

3. Raise the lift truck platform by pumping the foot pedal (see Figure 19). Release the foot brake and push the lift truck towards the breaker cell (see Figure 24).
4. For panel screw and turn handle doors, align the locking tabs (see Figure 17) of the lift-truck with the lift truck tab slots (see Figure 21) in the front of the frame. Adjust the lift-truck to the frame to engage the locking tabs with the slots. Adjust the truck platform either by moving up using lift truck foot pedal or lowering the platform with the lift truck control valve (see Figure 22) to lock locking tabs with the lift truck holding pin. The truck platform should be horizontal and aligned with the rails in the module. Try pulling the lift truck away from the frame. The locking tabs should be set firmly in place. Set the foot brake.

Figure 20: Lift truck with breaker

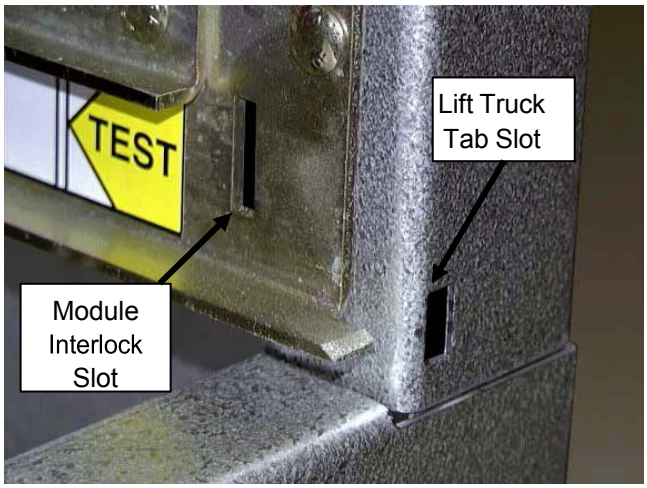

Figure 21: Module interlock slots (left hand shown)

5. Release the circuit breaker from the lift truck by pulling both module interlock release handles toward the center of the unit simultaneously.
6. Push the drawout unit straight into the module. Keep the unit level as possible. Do not raise or lift the circuit breaker.
7. Align the breaker locking tabs (see Figure 18) with the module interlock slots (see Figure 21).
8. Engage the breaker locking tabs by returning the handles to their outward position.
9. Verify that the handles are fully outward and the breaker locking tabs have engaged fully into the module interlock slots.

Note: The unit will not rack into the TEST position if the Module Interlock Tabs are not properly engaged with the frame.

WARNING

Always assure that the module interlock tabs are fully extended and locked into place with the module interlock slot to avoid injury and damage from a loose breaker falling from the frame.

Figure 22: Lift truck control valve

Figure 23: Circuit breaker in DISCONNECT position

10. Disengage the lift-truck by raising the platform via the foot pedal, release the foot brake, and move it away from the frame. The circuit breaker is now in the DISCONNECTED position (see Figure 23).

11. Close the breaker compartment door and secure the latching mechanism by pushing the door handle against the door. Ensure the door is fully seated and latched. If door is bolted design, torque all bolts to 16ft-lbs. Over-torqueing of these bolts will result in damage to the door assembly and will compromise the integrity of the equipment.

5.11.2 To rack from the DISCONNECTED position to the TEST Position:

Always rack the breaker through the door socket while the door is closed.

1. Press down on the racking release handle on the breaker compartment door (see Figure 24).

Only use hands to actuate the racking release handle as excessive force can damage the mechanism.

2. Engage the racking screw on the breaker with the racking tool and rotate clockwise (CW).
3. Release the handle and continue to rack the unit by rotating the racking tool clockwise until the racking screw stops, approximately 4 turns. The breaker is now in the TEST position.
4. Verification can be made by confirming the position indicator on the right side breaker rail shows TEST (see Figures 25 and 26a).

Figure 24: Racking release handle

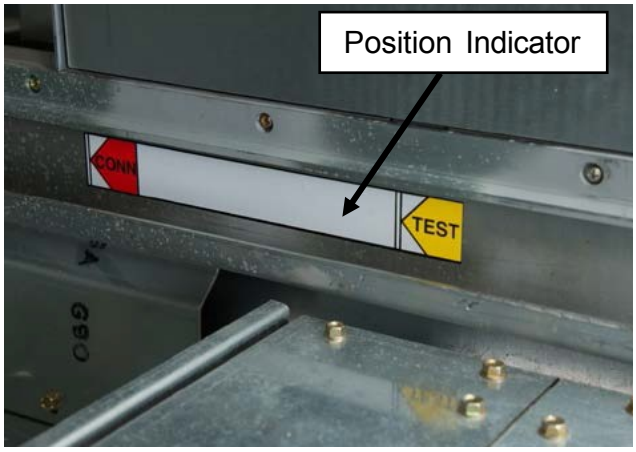

Figure 25: Circuit breaker position indicator

5.11.3 To rack from the TEST position to the CONNECTED position:

Figure 26:(a): Circuit breaker in TEST position

Figure 26:(b) Circuit breaker in CONNECTED position

1. Press down on the Racking Release Handle on the breaker compartment door.
2. Engage the racking screw with the Racking Tool and rotate clockwise (CW) approximately 21 turns.
3. Release the handle and continue to rack the unit by rotating the racking tool clockwise. A slight increase in resistance indicates that the unit is engaging the primary contacts. When the racking screw stops, the breaker is now in the CONNECTED position.
4. Verification can be made by confirming the position indicator on the right side breaker rail shows CONNECTED (see Figure 26b)

5.12 Removal

5.12.1 To rack from the CONNECT position to the TEST position:

1. Do not open the breaker compartment door. The breaker must be OPEN before proceeding to the next step.
2. Press down on the racking release handle.
3. Engage the racking screw with the racking tool and rotate counterclockwise (CCW). Release the handle and continue to rotate counterclockwise, from the CONNECTED position into the TEST position.

5.12.2 To rack from the TEST position to the DISCONNECTED position:

1. Press down on the racking release handle.
2. Engage the racking screw with the racking tool and rotate counterclockwise (CCW). Release the handle and continue rotating counterclockwise, from the TEST position into the DISCONNECTED position.

5.12.3 Removal from the DISCONNECTED position with a lift truck.

1. Open the breaker compartment door.
2. For panel screw and turn handle doors, align the locking tabs of the lift truck with the lift truck holding pin in the front of the frame. Push the lift truck to the frame to engage the locking tabs with the compartment. Lower the truck platform slightly to lock in place. The truck platform should be horizontal and aligned with the rails in the compartment. Set the lift truck foot brake.

Try pulling the lift truck away from the frame. The locking tabs should be set firmly in place and the brake set.

3. For multipoint latch doors, align slots on lift truck with locating pin in the breaker compartment floor. Adjust the lift-truck to the frame to engage the locking pins with the slots. Lift truck platform should fit between breaker truck and breaker compartment floor. Adjust the truck platform by moving up using lift truck foot pedal or lowering the platform with the lift truck control valve to lock locking pins. The truck platform should be horizontal and aligned with the rails in the module. Try pulling the lift truck away from the frame. The locking pins should be set firmly in place. The locking pins should be set firmly in place and the brake set. Set the foot brake.
4. Release the circuit breaker from the compartment by pulling the interlock release handles toward the center of the unit.
5. Pull the drawout unit straight onto the lift truck platform. Keep the unit level as possible.
6. Align the breaker interlock tabs with the lift truck slots. Engage the breaker interlock tabs by returning the handles to their outward position.
7. Verify that the handles are fully outward and the breaker interlock tabs are in the lift truck slots.
8. Raise the lift truck platform to disengage the lift truck holding pin, release the foot brake and pull the lift truck away from the frame.
9. Close and latch/bolt the circuit breaker compartment door.

The breaker interlock tabs must engage the slots in the lift truck platform before releasing the foot brake and moving the lift truck. Lower the lift truck platform before transporting drawout modules from upper positions with the lift-truck.

5.13 Auxiliary Modules

Drawout compartments are provided for Potential Transformers, Control Power Transformers and Fuses units for remote Control Power Transformers.

Before inserting a unit into a module, remove foreign objects, tools and debris, or obstructions from inside the module.

Insertion, racking and removal of Auxiliary Drawout elements is similar to racking a circuit breaker. The units do not have a TEST position and there is no racking release handle on the compartment door.

5.14 CPT/Fuse Auxiliary Modules

The Kirk Key option is an interlock device to prevent the racking of the CPT/Fuse unit from DISCONNECTED to the CONNECTED position when the Secondary Breaker is in the “ON” position. Kirk lock plungers normally extends out when the key is removed. A single interlock key must be used in these arrangements. Duplicates of the interlock are not allowed.

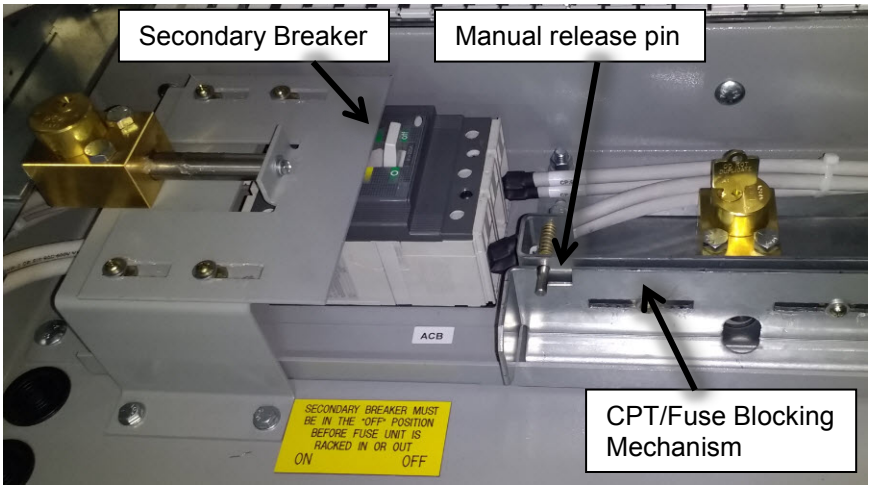

Figure 27: Secondary Breaker in ‘OFF’ position and Blocking mechanism withdrawn position using the Kirk Key.

Figure 28: Secondary breaker interlock in ‘ON’ position and Blocking mechanism withdrawn position.

5.15 Insertion

To rack the CPT/Fuse unit from the DISCONNECTED to the CONNECTED position:

1. Verify the secondary breaker, located in the low voltage compartment is in the “OFF” position and the interlock key from secondary breaker Kirk lock is removed. This will prevents the breaker from switching to “ON” position (see Figure 27).
2. Insert the key to the CPT/Fuse unit Kirk lock and turn the key to retract the Kirk lock plunger. Depress the manual release pin on the interlock slide. The spring will retract the CPT fuse unit blocking mechanism.
3. Engage the racking screw with the racking tool and rotate clockwise (CW rotation), until the racking screw stops and the unit is in the CONNECTED position, approximately 25 turns.
4. Confirm that the CPT is in CONNECTED position via the position indicator on the right side truck rail.

5. Depress the manual release pin of the CPT fuse unit interlock slide and remove the key from CPT fuse unit Kirk lock (see Figure 27). The key can be removed only when the Kirk lock plunger is completely engaged with the interlock mechanism.
6. Insert the key into the secondary breaker Kirk lock. Turning the key enables retraction of the interlock plunger. Now, the secondary breaker can be switched to the “ON” position (see Figure 28.

5.16 Removal

To rack from the CONNECTED to the DISCONNECTED position:

1. Switch the secondary breaker to the “OFF” position. Remove the interlock key from secondary breaker Kirk lock, which causes the Kirk lock plunger to extend out. The secondary breaker is now in “OFF” position and the interlock plunger prevents it from switching to “ON” position. (See Figure 27)
2. Insert the key to the CPT/Fuse unit Kirk lock and turn the key to retract the Kirk lock plunger. Depress the manual release pin on the interlock slide. The spring will retract the CPT fuse unit blocking mechanism.
3. Engage the racking screw with the racking tool and rotate counter-clockwise (CCW rotation), until the racking screw stops and the unit is in the DISCONNECTED position, approximately 25 turns.
4. Confirm that the CPT is in DISCONNECTED position via the position indicator on the right side truck rail.
5. The CPT/Fuse device can now be removed from the compartment via the lift truck.
6. Close and securely latch/bolt the CPT fuse unit door.

6. TESTING AND FINAL INSPECTION

6.1 Testing

DANGER

Disconnect the primary power source
Do not exceed the listed voltages for the voltage class of the equipment under test.
Disconnect the shunt connected coils such as potential transformers.
Do not test sensors or relays with high voltage.
Disconnect all sensors and relays before applying voltage.

With the system erected, assembled and connected, perform the following 16 step process.

1. Remove all packing and shipping materials.
2. Make sure that all internal parts are clean and dry. If moisture is present, blow dry with warm air.
3. Remove any shipping blocks from relays.
4. Check for damaged insulation by applying potential tests to the primary bus. Conduct potential tests phase-to- phase and phase to ground in accordance with “Field Test” values as shown in Table 1.

60 HZ, RMS, WITHSTAND VOLTAGES (1 minute)

Rated	Factory Test	Field Test	DC Field Test*
up to 250 volts	1500	1125	none
4160 volts	19,000	14,250	20,000
7200 volts	36,000	27,000	38,000
13,800 volts	36,000	27,000	38,000

Table 1:60HZ, RMS, Withstand Voltages

* The column headed “DC Field Test” is a reference for those using DC tests to verify the integrity of connected switchgear. It represents values believed to be appropriate and approximately equivalent to the corresponding power frequency withstand test values specified for each voltage class of switchgear. The presence of this column in no way implies any requirements for a DC withstand test on AC equipment. Also, it does not imply that a DC withstand test is an acceptable alternative to ANSI C37.20.2 for design, production, or conformance tests. When making DC tests, raise the voltage to the test value in discrete steps and hold for one (1) minute.

5. With the main circuit de-energized and grounded, check the continuity of all circuits after installing the circuit breakers. Energize the control source and operate the equipment. Indicating instruments verify the continuity of current transformer circuits and energizing of the main circuit.

6.2 Control Circuit Checkout

DANGER

The breaker or cutout device of the local control power circuit must remain open when using a separate control power source.

1. The preferred method to check the control circuit is to furnish a separate temporary source of control power of the required control voltage rating. The temporary source must have a properly coordinated backup protective device in the circuit. Set the device to clear any faults that might occur. Initially all circuit breakers should be in the DISCONNECT position and the main circuit de-energized and grounded. When AC control power is supplied from control power transformers in the switchgear, remove all fuses in the transformer circuits.
2. Rack all circuit breakers to the DISCONNECT position.
3. Open all normal control power source disconnects, if supplied.
4. Check each control switch or push- button. Make sure that it is in the OPEN position.
5. Connect a temporary control power source to the circuit load terminals in the switchgear. Energize the control circuit from the temporary control power source. Refer to the project specific electrical drawings for connections.
6. Rack one circuit breaker into the TEST position. When the on-off switch is in the ON position, the charging of the closing springs of an electrically operated circuit breaker indicates connection to the control power.
7. Rack the remaining circuit breakers into the TEST position, one at a time and verify that each is connected to control power.
8. Test all electrically and manually operated breakers for closing and tripping, while they are in the TEST position. Use the optional test set available with the trip unit for testing solid state tripping
9. De-energize the control circuit. If AC control power is from transformers in the switchgear, remove the temporary separate source of control power. Reinstall all fuses in the transformer circuit.
10. Set all relays, regulators, and other devices for proper operation of loads. The factory does not set the relays.
11. Disconnect all shorting screws from the terminal blocks in the current transformer circuits (see Figure 29). Note: Verify the proper phasing of all main circuits according to connection diagram.

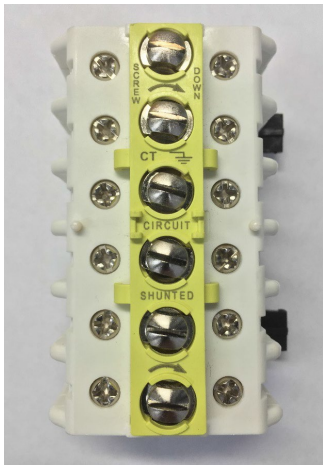

Figure 29: CT Shorting Terminal Block

Note: Verify the proper phasing of all main circuits according to connection diagram.

12. To open the short circuiting device, loosen all shorting screws (CCW rotation) until each one has extended up to the level of the yellow label strip as shown below. Do not loosen the ground screw.

13. Upon completion of testing, return all shorting screws to the shorted position by pushing the screw inward and turning until tight (CW rotation).

6.3 Final Inspection

DANGER

There are hazards of electrical shocks and/or burns whenever working in or around electrical equipment. Turn off power ahead of the switchgear before performing any inspection or maintenance operations. Check incoming line terminals to verify that the equipment is de-energized and grounded. Check out-going terminals to ensure that no back-feed condition exists.

Once installed and all connections made, perform a final check and test on the equipment and its controls. Check for correct equipment installation and that all connections are complete. Use extreme care to prevent the controlled equipment from being connected to the system while performing preliminary tests.

7. PLACING SWITCHGEAR INTO SERVICE – SAFETY PRECAUTIONS

DANGER

There are hazards of electrical shocks and/or burns whenever working in or around electrical equipment. Turn off power ahead of the switchgear before performing any inspection or maintenance operations. Check incoming line terminals to verify that the equipment is de-energized and grounded. Check out-going terminals to ensure that no back-feed condition exists.

The circuit breakers should be in the TEST position.

When working on switchgear, de-energize and ground the main-bus.

Before energizing any part of the switchgear make a complete check of the mechanical operation of all devices. Remove blocking wedges from relays, circuit breakers, meters, etc. Manually operate all circuit breakers and relays. Moving parts should not bind. Verify that there are no foreign objects in the equipment. Use compressed, clean, dry air to clean all inside and outside surfaces.

Make incoming and outgoing power connections after all other connections are complete. A note on the connection diagram indicates devices that are phase sensitive. Verify the phase sequence of the incoming power source before making connections.

Note: The secondary circuits of energized current transformers should never be open circuited.

The contact surfaces of the bus at bolted joints are plated. Clean contact surfaces with a clean cloth and an OSHA approved solvent. Bolt the bus together. Conductivity of a bolted joint depends on the pressure or torque applied.

Note: All bolted joints must be torqued per ABB specifications - see Appendix A.

Install rear split panels or close and latch rear doors. Close and latch all front doors.

7.1 Energizing the Main Bus

1. After completing the control circuit checkout, energize the equipment main bus.
2. Verify that all door and panel hardware is secure.
3. Energize the incoming bus to the main circuit breaker of the equipment. Observe if operation of instruments and relays are correct.
4. Energize the separate control power source, if furnished.
5. Energize the switchgear main bus by closing the main circuit breaker. Observe if operation of instruments and relays are correct.
6. Rack the circuit breakers to the CONNECTED position.
7. Close the desired feeder and tie-breaker circuit breakers.

8. STANDARD CONSTRUCTION

8.1 Standard Color

The standard paint color is ANSI 61. This finish is electro-static powder paint applied over an iron phosphate coating. This process achieves a smooth, uniform paint finish that conforms to all UL requirements.

8.2 Galvanized Steel Frame Construction

Unpainted parts are made of galvanized steel. Galvanized steel greatly exceeds the paint qualifications of IEEE C37.20.2.

8.3 Bus Support Insulation

The bus supports/standoff insulators (see Figure 30) are indoor epoxy type. The supports ensure safe operational clearances of bus under normal and abnormal (short circuit) conditions. No maintenance is required if the short-circuits do not cause any visual damage.

Figure 30: Bus Support (Standoff Insulators)

8.4 Primary Disconnect Assemblies

Circuit breaker primary disconnects consist primarily of a circle of fingers compressed by a garter spring. The springs are outside the current path. The fingers can be inspected by withdrawing the unit. The primary contacts are high pressure, self-aligning devices. All parts are plated to reduce electrical resistance. Refer to the associated breaker IOMM for details.

8.5 Secondary Disconnecting Devices

Circuit breakers have self-aligning disconnects sized for the required current. They make contact in the CONNECTED and TEST positions, without the need for a test jumper (see Figure 31).

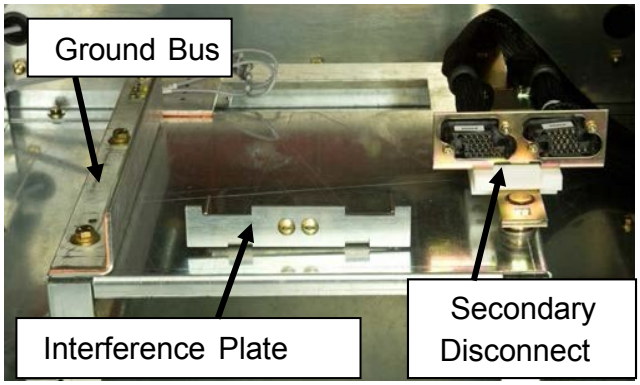

Figure 31: Circuit breaker self-aligning secondaries

8.6 Ground Bus Contacts

The ground bus contacts are under the circuit breakers. The circuit breakers are grounded in all positions (see Figure 31).

8.7 Interference plate

Interference plates installed in the circuit breaker compartments prevent the insertion of incompatible circuit breakers into the compartments. Verify the rating of the breaker and the compartment to ensure compatibility before attempting to insert it into the circuit breaker compartment.

8.8 Control Wires

ABB standard control wiring is insulated type SIS, made of flexible stranded conductors, unless otherwise specified by contract specifications.

9. MAINTENANCE

9.1 General

Maintaining the switchgear is essential to ensuring a long life of reliable operations. Specific site conditions, local codes, national codes and user operating requirements will be key drivers to determining maintenance needs and intervals. Owner will be responsible for determining what, if any, of the regulations exist and are applicable, and shall take necessary actions to comply with any such regulations.

A defined maintenance schedule should be developed for each specific site location. ABB Service should be contacting to assist in determining the specific site maintenance program and schedule.

Note: ABB offers an optional SwitchgearMD™ 24x7 switchgear monitoring solution and MySite Care for breaker monitoring that can be ordered in new switchgear or be retrofitted in the field. Condition-based maintenance eliminates unnecessary service and minimizes time spent by personnel in front of or within. The system has the ability to collect real-time temperature, humidity and partial discharge data and spot problems as soon as they develop, reducing the likelihood of costly unplanned outages.

Contact ABB for more information.

Following are general maintenance procedures and guidelines that can be adopted to the site specific maintenance schedule.

DANGER

There are hazards of electrical shocks and/or burns whenever working in or around electrical equipment. Turn off power ahead of the switchgear before performing any inspection or maintenance operations. Check incoming line terminals to verify that the equipment is de-energized and grounded. Check outgoing terminals to ensure that no back-feed condition exists.

9.2 General Inspections

Perform a visual inspection, front and rear, to see that there is no evidence of loose parts, warping, or undue vibration. Ensure all internal barriers are installed and properly secured and that all exterior doors are properly closed and latched. Take steps to remedy any deficiencies of this nature that may appear.

Ensure the switchgear is dry and kept free of moisture or dripping water. Evidence of moisture can be, but is not limited to, water droplets, condensation, oxidized metal, etc. Take steps necessary to ensure water ingression does not occur. However, be careful to not block vents as these are necessary to ensure the equipment operates at proper temperatures.

Ensure the switchgear is kept free of dust and dirt. If dust and/or dirt are found present, take steps to eliminate the source. Dust or dirt should not be allowed to enter the switchgear at any time. This can build up on electrical surfaces and cause electrical tracking over the conductor surfaces which could lead to flashovers.

Maintenance for individual components installed in the switchgear such as relays, meters, instrument transformers, control devices, etc., are defined by the instruction manuals for those components. The requirements for these components should be included in the overall site specific maintenance program.

Remove the covers of all panel devices where possible. Check wiring for secure connections. Clean contacts on relays and switches wherever necessary. Replace covers.

Remove air filters when used. Flush with clean water if necessary. Coat filters with 'Randolf Products', Super Coat Adhesive or equivalent.

Inspect the chains/sprocket (see Figure 32) and the lifting rail of lift truck, if used for normal operation. For normal operation use a heavy gear lubricant. In very dirty or gritty conditions, use a dry lubricant.

9.3 First Year Service Inspection

It is highly recommended that a thorough inspection and maintenance activity be performed at the end of the first year of service. The following activities should be performed.

DANGER

Turn off power ahead of the switchgear before performing any inspection or maintenance operations. Check incoming line terminals to verify that the equipment is de-energized and grounded. Check outgoing terminals to ensure that no back-feed condition exists.

CAUTION

Limit the use of solvents to removing grease and contamination from primary conductors, insulation and from unpainted metallic surfaces. Do not use alcohols or freons. Use OSHA approved solvents in accordance with local regulations. Use a non-flammable solvent with a threshold limit of 300 PPM or higher. Use solvents in well-ventilated areas.

1. Ensure that no unusual service conditions have existed, or do exist at the switchgear. Contact ABB Service if any such conditions exist or have existed. These include:
   - Ambient air temperature surrounding the switchgear has not been maintained between -30°C to +40°C.
   - Switchgear is above 1000m (3300ft).
   - Switchgear exposed to any damaging fumes, vapors, steam, salt air or oil vapors.
   - Switchgear exposed to excessive dust, abrasive dust and magnetic or metallic dust.
   - Switchgear exposed to explosive mixtures of dust or gases.
   - Switchgear exposed to abnormal vibration, shock or tilting.
   - Switchgear exposed to seismic shock.
   - Switchgear exposed to overvoltage or over current conditions beyond the stated ratings on the ratings nameplate.
2. Perform an overall visual inspection as outlined in section 9.2.
3. Check all indicators, meters and instruments for proper operation.
4. Make sure all bolted connections are secure. **All bolted joints must be torqued per ABB specifications – see Appendix A.**
   i. Bolted connections should be tight. Discoloration, excessive corrosion, brittle or discolored insulation may indicate an overheated connection. If found, follow the procedure described under section 9.5 "Bolted Joint Maintenance."
5. Verify operation of heaters and thermostats, if used.

6. Check for undue noise and vibration that might loosen bolted connections.
7. Inspect all power cables for tight connections and proper support.
8. Clean all bus insulation, insulator supports and insulator bushings thoroughly.
9. Inspect all control wiring for signs of wear and damage, especially at door hinge locations. Replace wire wherever doubtful.
10. Open all doors and ensure proper operation of hinges and latches.
11. Test and operate the breaker lift truck (if included with the switchgear).
12. Install and operate electric racking devices.
13. Perform any recommended maintenance or inspections required by the breakers. Reference the specific breaker Installation, Operation and Maintenance Manual for requirements.
14. When used, remove and clean all air filters. Flush with clean water if necessary. Coat filters with Randolf Products', Super Coat Adhesive or equivalent.
15. Inspect the chain and sprocket of the breaker lift truck when supplied, (see Figure 32) and the lifting rail of lift truck, if used for normal operation. For normal operation use a heavy gear lubricant. In very dirty or gritty conditions, use a dry lubricant.

Figure 32: Lift Truck chain and sprocket

16. After de-energizing the equipment, access the breaker compartment and ensure primary contact shutters operate properly.
17. Contact ABB Service if any abnormalities are found.
18. Perform any recommended maintenance or inspections required by relays, metering and other components as required by their respective instruction manuals.
19. Take inventory of all tools and accessories such as breaker racking handles, test jumpers, G&T devices, SmartRack electric racking device, etc.

9.4 Other Maintenance

If switchgear is exposed to any of the unusual service conditions as listed in section 9.3, point 1, additional maintenance and/or inspections may be required. Other maintenance or inspections may include the following.

DANGER

Turn off power ahead of the switchgear before performing any inspection or maintenance operations. Check incoming line terminals to verify that the equipment is de-energized and grounded. Check outgoing terminals to ensure that no back-feed condition exists.

1. Inspect, operate and lubricate breaker primary shutters.
2. Torque all primary conductor connection bolts to recommended values. **All bolted joints must be torqued per ABB specifications – see Appendix A.**
3. When IR ports are included, perform thermography tests using appropriate testing equipment.
4. Inspect primary insulation system for accumulated contamination. Clean insulation with a dry cloth, dry-air, vacuum, or if necessary with an OSHA approved solvent.
5. Disassemble, inspect, clean, lubricate, adjust and calibrate circuit breaker mechanisms as recommended in the instructions furnished with the circuit breaker.
6. Inspect and tighten all control wiring terminal connections. Check for loose lug crimps and broken or exposed wire strands.
7. Check the calibration and operation of protective relays.
8. Remove all circuit breakers and perform charge, close and tripping functions using the breaker test cabinet (if supplied) or the breaker test jumper.
9. Rack out and rack in all auxiliary units. Lubricate rails if necessary. Inspect all internal components, primary connections and secondary wiring.

Thorough inspections should be made of the switchgear after all seismic events, short circuit faults, lightning strikes and arcing faults. These inspections may determine further maintenance or repairs to be made to the equipment.

It is recommended that after 10 years of service, a thorough inspection and maintenance be performed similar to that outlined in section 9.3.

9.5 Bolted Joint Maintenance

DANGER

Turn off power ahead of the switchgear before performing any inspection or maintenance operations. Check incoming line terminals to verify that the equipment is de-energized and grounded. Check outgoing terminals to ensure that no back-feed condition exists.

1. Tighten all secondary control wire connections. Check for loose lug crimps and broken wire strands.
2. Open bus joints and inspect connection surfaces.
3. Clean surfaces with an OSHA approved solvent. Dress contact surfaces that show minor corrosion or pitting by lightly rubbing with a polishing cloth such as “3M Scotch Brite”. Take care to minimize the removal of plating.
4. Replace parts that show signs of heavy corrosion, arcing or melting.
5. Replace contact fingers and springs after exposure to excess heating at the breaker disconnect.
6. Before assembly, protect contact surfaces with No-Ox-ID ‘Special A Compound’, a product of Sanchem Chemical Co., ABB Part No. 713222A00, or equivalent.
7. Use proper torque in tightening bolted connections. **All bolted joints must be torqued per ABB specifications – see Appendix A.**

9.6 Care of Finish

The paint and galvanized finish is strong and durable. Always keep the switchgear clean. Wiping with a clean dry cloth will usually suffice. To remove oil and grease marks, use warm water and soap, and wipe dry with a clean, dry, soft cloth.

Because the color and finish may vary, consult the front sheet of the Bill of Materials before using touch-up paint. The standard paint color is ANSI 61, light gray.

9.7 Renewal Parts

Previous experience and the number of vertical sections in service are the best guidelines for determining the stocking of replacement parts. Order factory original replacement parts from ABB Inc., Lake Mary, Florida 32746. Specify quantity, part numbers, description, and nameplate data of the device requiring the replacement parts.

For replacement parts, call toll free: 1-800- 929-SWGR.
Outside of USA call: 1-407-732-2000 Ext. 2510

9.8 End of life of Product

ABB products are manufactured to meet or exceed the standards of compliance for quality and environmental management systems in accordance with ISO 9001 and ISO 14001. All of these items can be supplied with a certificate of quality.

9.9 Methods of Disposal

Disposal can be carried out in a manner of ways depending upon material of product. Below is the recommended method of disposal for various raw materials.

The duty of ABB is to facilitate subsequent recycling or disposal at the end of product life. During disposal of the product, it is always necessary to act in accordance with local legal requirements in force.

RAW MATERIAL	RECOMMENDED METHOD OF DISPOSAL
Metal material (Fe, Cu, Al, Ag, Zn, W, ect.)	Separation and recycling
Thermoplastics	Recycling or disposal
Epoxy resin	Separation of metal and disposal of remains
Rubber	Disposal
Oil (transformer oil)	Draining and recycling or proper disposal
SF6 gas	Discharging from equipment
Packing material	Recycling or disposal

10. DISCLAIMER OF WARRANTIES AND LIMITATION OF LIABILITY

There are no understandings, agreements, representations of warranties, expressed or implied, including warranties of merchantability or fitness for a particular purpose, other than those specifically set out by an existing contract between the parties. Any such contract states the entire obligation of the seller. The contents of this document shall not become part of or modify any prior or existing agreement, commitment or relationship. The information, recommendations, descriptions and safety notations in this document are based on ABB experience and judgment with respect to metal-clad and metal-enclosed switchgear. This information should not be considered to be all inclusive or covering all contingencies.

No warranties, expressed or implied, including warranties of fitness for a particular purpose or merchantability, or warranties of fitness for a particular purpose or merchantability, or warranties arising from course of dealing or usage of trade, are made regarding the information, recommendations, descriptions and safety notations contained herein. In no event will ABB be responsible to the user in contract, in tort (including negligence), strict liability or otherwise for any special, indirect, incidental or consequential damage or loss whatsoever including but not limited to damage to or loss of use of equipment, plant or power system, cost of capital, loss of profits or revenue, cost of replacement power, additional expenses in the use of existing power facilities, or claims against the user by its customers resulting from the use of information, recommendations, descriptions and safety notations contained herein.

11. APPENDIX A – TORQUE REQUIREMENTS FOR SAE GRADE 5 STEEL HARDWARE

Table 2: below applies to SAE Grade-5 unlubricated steel hardware into unlubricated, threaded steel material unless otherwise stated. Torque hardware within the maximum/minimum tolerance.

Hardware size (inch.)	**Torque Value**		
	Maximum Ft-lbs	**Target Ft-lbs**	**Minimum Ft-lbs**
1/4-20 Taptite - (for material thickness 0.104")	11	**10**	8
1/4-20 Taptite - (for material thickness 0.119")	16	**15**	13
5/16-18 (hex head)	20	**19**	17
3/8-16 hex bolt	35	**30**	15
3/8-16 flange bolt (for Epoxy stand-off insulator)	35	**30**	15
3/8-16 steel threaded stud- (CT mtg)	20	**19**	18
3/8-16 fiberglass threaded stud- (CT mtg)	12	**11**	10
1/2-13 hex bolt	45	**40**	30
5/8-11 hex bolt (for Epoxy stand-off insulator)	40	**38**	35

Table 2:Torque requirements for SAE Grade 5 Steel Hardware.

REVISION HISTORY

Rev.	Page	Change Description	Date / Initial
-	all	Initial release	2018-04-20 AGK
B	10	Added instructions for 4000A	2019-03-18

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