



Advance 27

27kV medium voltage, metal-clad
switchgear

Installation, Operations and Maintenance
Manual

Power and productivity
for a better world™



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1.0 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:

WARNING

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

DANGER

“Danger” indicates a hazardous situation that has a high probability of death, 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.

2.0 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 Advance 27 medium voltage, metal-clad 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.
- Special construction details.
- Elementary and schematic diagrams.
- Connection diagrams

3.0 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.

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 intermediate storage is necessary.

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 "FOB Factory." 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.



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.

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 ship 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, store upright in their original shipping carton oriented as indicated on the shipping crates. See document 1VAL050601-MB for details on breaker storage.

4.0 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.

The ceiling height must also be checked considering the top-mounted ventilation boxes.

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 or direct entry through an outside, weatherproof access door.

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. 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 27 frames as shown on the floor plan drawings.

5.0 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.

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 Figures 2 and 3).



Figure 2: Forklift provisions in shipping channels



Figure 3: Forklift forks penetrating shipping channels

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).

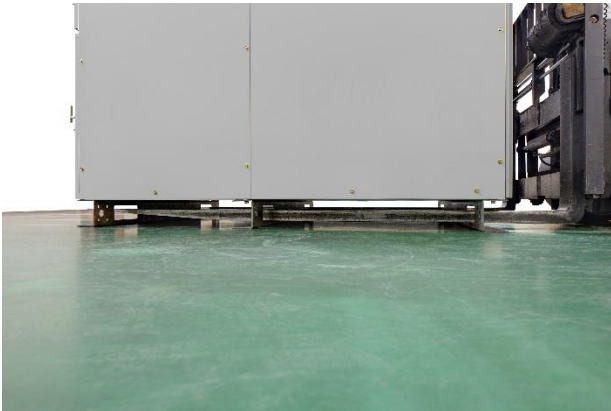


Figure 4: Complete fork penetration of all 3 shipping channels

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 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 (provided upon request) 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" x 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 and move on steel pipe rollers with the shipping bases attached.



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.

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.

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 per the guidelines outlined on the ABB factory

drawings or welding. Consult the factory for welding guidelines.

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 joints must be torqued **per ABB specification 1VAL-T0004-100843**.

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.

Note: *After completing all connections to secondary (control) circuits, follow these circuits and remove temporary connections from current transformer secondaries (see Figure 6).*

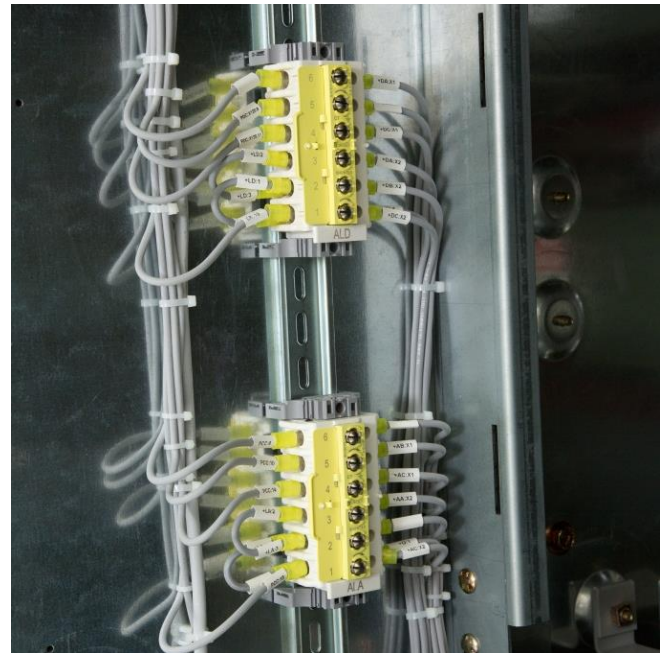


Figure 6: CT Shorting Blocks

Note: *Failure to remove the jumpers will interfere with meters, relays, or other devices in these circuits.*

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.

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 specification 1VAL-T0004-100843.*

Install the bus joint covers (boots) by first sliding the internal skirt around the bus bars. This should be done prior to installing the main bus bars (see Figure 7).



Figure 7: Internal boot skirts

Apply the supplied sealant, Dow Corning, Molykote compound #111, between the bus bar and the internal skirt and to the inner sections of the boot that will contact the inner skirt (see Figure 8).



Figure 8: Silicon sealant application to the boot

Install the boot around the joint and internal skirts assuring that complete coverage between the skirts and the boot with the sealant is attained.

Complete the boot installation by applying additional sealant to the seams of the boot and fastening in place with provided nylon hardware (see Figure 9).



Figure 9: Final boot installation

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.

WARNING

All secondary power and control wiring should be routed through the provided locations and utilize the rubber grommets cut with the appropriate size center hole to accommodate the wiring bundle.

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.

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" aluminum and should be utilized in the final assembly.

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 crated and attached to the pallet (see Figure 10). Untighten both clamp screws from the pallet (see Figure 11).

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



Figure 10: Breaker crated on the pallet



Figure 11: Clamp screws

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.

2. The TEST position disengages the main disconnecting devices, 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.

Mechanical interlocks prevent moving a circuit breaker from one position to another unless the circuit breaker is open. The interlocks also prevent closing of the breaker between positions.

5.10.1 Insertion

1. Open the breaker cell door completely (see Figure 12).

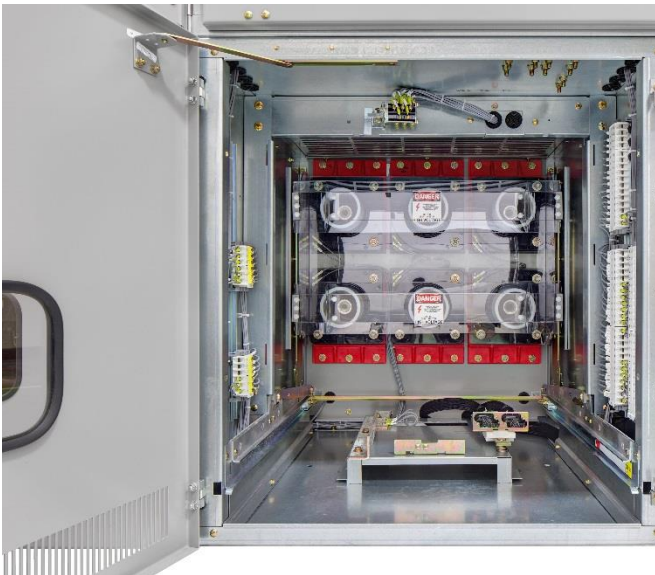


Figure 12: Breaker Cell door open

2. With the lift truck platform at ground level and the foot brake engaged (see Figure 13). 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 14 and 15).

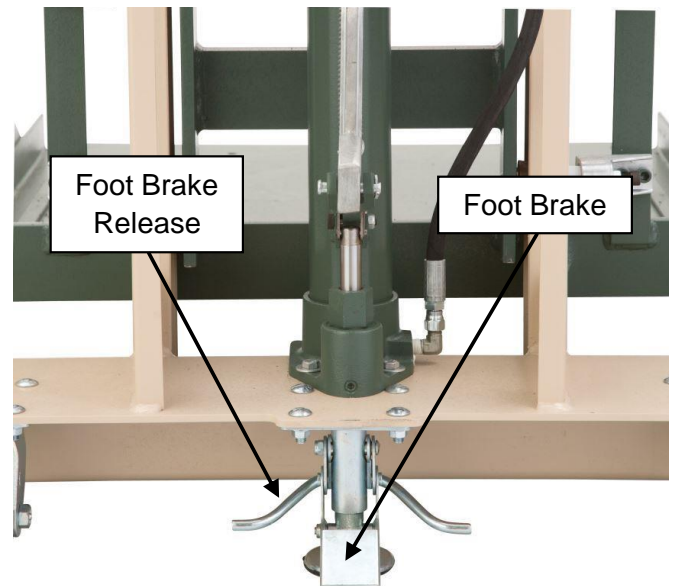


Figure 13: Lift truck foot brake

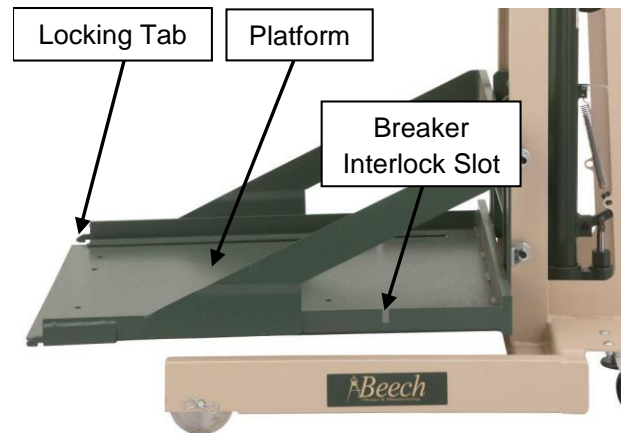


Figure 14: Lift truck

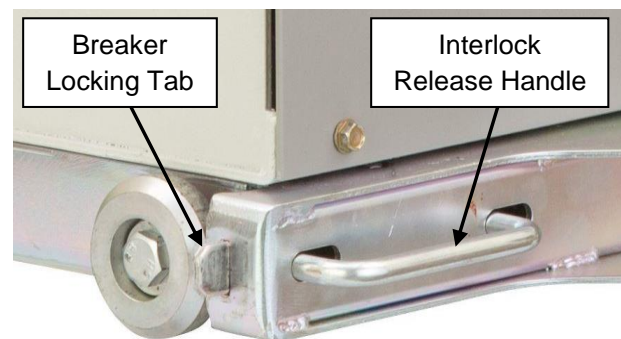


Figure 15: Breaker Truck Interlock, tabs and handles

3. Raise the lift truck platform by pumping the foot pedal (see Figure 16). Release the foot brake and push the lift truck towards the breaker cell (see Figure 17).



Figure 16: Lift truck foot pedal



Figure 17: Lift truck with breaker

4. Align the locking tabs (see Figure 14) of the lift-truck with the lift truck holding slots (see Figure 18) 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 19) to lock the locking tabs in the lift truck holding slot. 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 18: Module interlock slots (left hand shown)



Figure 19: Lift truck control valve

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 circuit breaker 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 15) with the module interlock slots (see

Figure 18).

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.*

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 20).



Figure 20: Circuit breaker in DISCONNECT position

11. Close and secure the breaker compartment door.

To rack from the DISCONNECTED position to the TEST Position:

1. Press down on the racking release handle on the breaker compartment

door (see Figure 21).



Figure 21: Racking release handle

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 Figure 22).

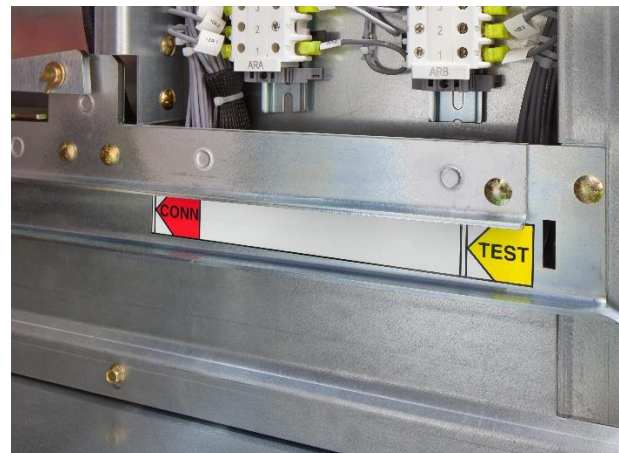


Figure 22: Circuit breaker position indicator



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

To rack from the TEST position to the 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 23).



Figure 23: Circuit breaker in CONNECTED position

5.10.2 Removal

To rack from the CONNECT position to the TEST position:

1. 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.

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.

Removal from the DISCONNECTED position with a lift truck.

1. Open the breaker compartment door.
2. Align the locking tabs of the lift truck with the lift truck holding slots 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. Release the circuit breaker from the

compartment by pulling the interlock release handles toward the center of the unit.

4. Pull the drawout unit straight onto the lift truck platform. Keep the unit level as possible.
5. Align the breaker interlock tabs with the lift truck slots. Engage the breaker interlock tabs by returning the handles to their outward position.
6. Verify that the handles are fully outward and the breaker interlock tabs are in the lift truck slots.
7. Raise the lift truck platform to disengage the lift truck locking tabs, release the foot brake and pull the lift truck away from the frame.



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 draw-out modules from upper positions with the lift-truck.

5.11 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 not a racking release handle on the compartment door.

To rack from the DISCONNECTED position to the CONNECTED position:

1. Engage the racking screw with the Racking Tool and rotate clockwise (CW) approximately 25 turns.
2. Verification can be made by confirming the position indicator on the right side rail shows CONN.

To rack from the CONNECTED position to the DISCONNECTED position:

1. Engage the racking screw with the Racking Tool and rotate counter clockwise (CCW) approximately 25 turns.

CPT/Fuse Auxiliary Modules

In the DISCONNECTED position, the interlock key(s) are removed from the CPT fuse unit interlock located at the top of the compartment (see Figure 24). This prevents the racking of the CPT/Fuse unit from DISCONNECTED to the CONNECTED position. The key should be stored remotely to prevent accidental switching between the "ON" or "OFF" position or inserted into the secondary breaker Kirk lock located inside the low voltage compartment. Kirk lock plunger normally extends out when the key is

removed.

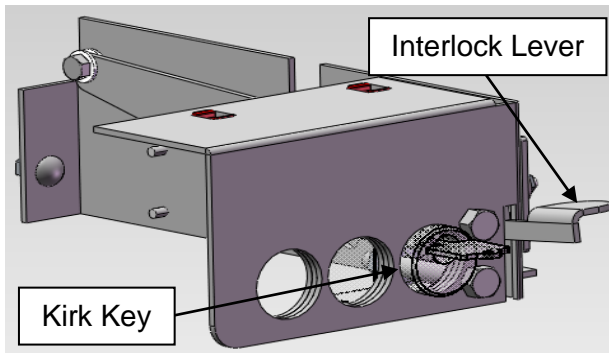


Figure 24: CPT Fuse blocking mechanism.

5.11.1 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 prevent the breaker from switching to "ON" position (see Figure 25).

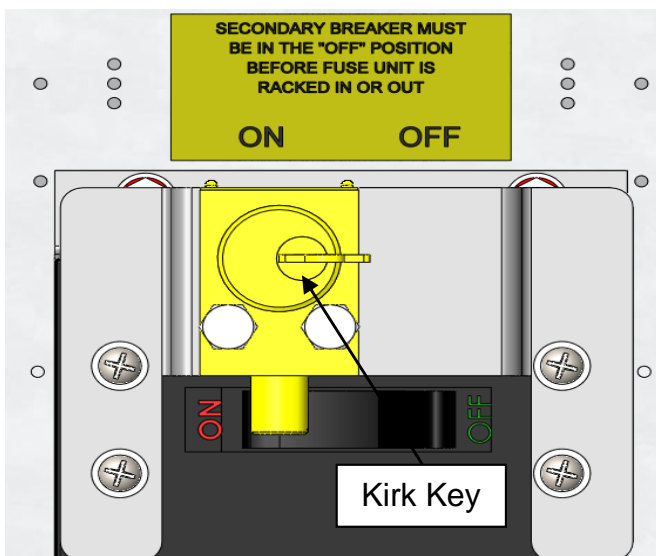


Figure 25: Secondary breaker interlock

2. Open the CPT/Fuse unit door.
3. Insert the key to the CPT/Fuse unit Kirk

lock and turn the key to retract the Kirk lock plunger and now the spring will retract the blocking mechanism.

4. Close and secure the CPT fuse unit door.
5. Engage the racking screw with the racking tool and rotate clockwise (CW), until the racking screw stops and the unit is in the CONNECTED position, approximately 25 turns.
6. After confirming that the CPT is in CONNECTED position via the position indicator on the right side truck rail, open the door of CPT/Fuse unit.
7. Press down the CPT fuse unit interlock lever and remove the key from CPT fuse unit Kirk lock (see Figure 25). The key can be removed only when the Kirk lock plunger is completely engaged with the interlock mechanism.
8. Close and secure the CPT fuse unit door.
9. 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.

5.11.2 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
2. Open the CPT/Fuse unit door.

3. Insert the key to the CPT/Fuse unit Kirk lock and turn the key to retract the Kirk lock plunger and now the spring will retract the blocking mechanism.
4. Close and secure the CPT fuse unit door.
5. Engage the racking screw with the racking tool and rotate counter-clockwise (CCW), until the racking screw stops and the unit is in the DISCONNECTED position, approximately 25 turns.
6. After confirming that the CPT/Fuse unit is in DISCONNECTED position via the position indicator on the right side truck rail, open the CPT/Fuse unit door.
7. Press down the CPT/Fuse unit interlock lever and remove the key from CPT/Fuse unit Kirk lock. The key can be removed only when the Kirk lock plunger is completely engaged with the interlock mechanism.
8. The CPT/Fuse device can now be removed from the compartment via the lift truck.
9. Close and secure the CPT fuse unit door.

6.0 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 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
27,000 volts	60,000	45,000	45,000

Table 1

* 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 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.

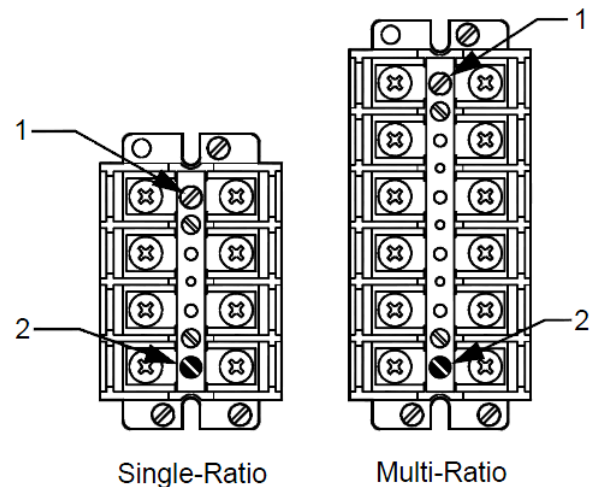
4. Check each control switch or push-button. Make sure that it is in the OPEN position.
5. Connect a temporary control power source to the circuit load terminals in the switchgear. Energize the control circuit from the temporary control power source. Refer to the project specific electrical drawings 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. Remove shorting screws from the terminal blocks in the current transformer circuits. Store screws in the tapped holes in the corners of the blocks.

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

To open the short circuiting device:

Single Ratio - Remove and store the shorting screw (1).

Multi Ratio - Remove the shorting screw (1). Insert shorting screw according to connection diagram. Do not remove the ground screw (2).



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.

7.0 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 sure 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 specification 1VAL-T0004-100843.*

7.1 Energizing the Main Bus

After completing the control circuit checkout, energize the equipment main bus.

Verify that all door and panel hardware is secure.

Energize the incoming bus to the main circuit breaker of the equipment. Observe if operation of instruments and relays are correct.

Energize the separate control power source, if furnished.

Energize the switchgear main bus by closing the main circuit breaker. Observe if operation of instruments and relays are correct.

Rack the circuit breakers to the **CONNECTED** position.

Close the desired feeder and tie-breaker circuit breakers.

8.0 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 ANSI C37.20.2 Section 5.2.8.

8.3 Bus Support Insulation

The bus supports (see Figure 26) are indoor porcelain 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 26: Bus Support

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.

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 27).

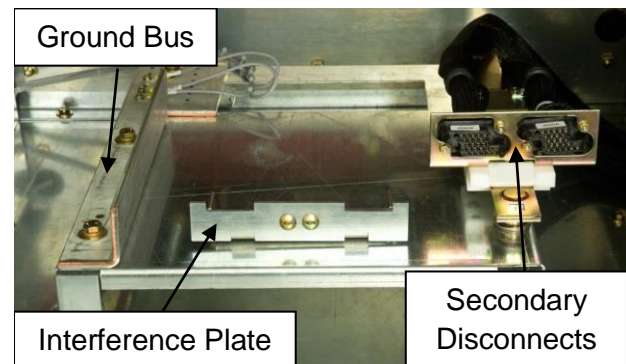


Figure 27: Circuit breaker self-aligning secondaries

8.6 Ground Bus Contacts

The ground bus contacts are under the circuit breakers. The circuit breakers are grounded in all positions (see Figure 27).

8.7 Control Wires

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

9.0 Maintenance

9.1 General

Inspect all switchgear installations at frequent intervals. Perform a visual inspection, front and rear, to see that there is no evidence of loose parts, warping, or undue vibration. Take steps to remedy any deficiencies of this nature that may appear. Keep the assembly dry. Cover to prevent moisture from dripping on equipment. Do not block vents.

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.

9.2 Annual Inspection

Perform the following recommended inspection and maintenance once a year, or sooner, if required by local conditions or regulations.

1. Perform an overall visual inspection.
2. Check all indicators, meters and instruments for proper operation.
3. Make sure all bolted connections are secure. **All bolted joints must be torqued per ABB specification 1VAL-T0004-100843.** Bolted connections should be tight. Discoloration, excessive corrosion, embrittled or discolored insulation may indicate an overheated connection. If found, follow the procedure described under section 9.5 "Bolted Joint Maintenance."
4. Verify operation of heaters and thermostats, if used.
5. Check for undue noise and vibration that might loosen bolted connections.
6. Look for evidence of moisture in the switchgear. Evidence of moisture can be but not limited to water droplets, condensation, oxidized metal, etc.
7. Inspect all cables for tight connections and ample support.
8. Inspect control wiring for signs of wear and damage, especially at door hinge locations. Replace wire wherever doubtful.
9. Examine resistors and other devices prone to over heating.
10. Open all hinged doors and inspect hinges and latches.
11. Clean insulation thoroughly.
12. Withdraw and clean all drawout components. Refer to Circuit Breaker Installation Operation and Maintenance Manual **1VAL050502-MB** before cleaning contacts.
13. Clean the stationary portion of the switchgear by wiping with a clean cloth. Use dry, compressed air in inaccessible areas.

14. Remove the covers of all panel devices where possible. Check wiring for secure connections. Clean contacts on relays and switches wherever necessary. Replace covers.
15. Remove air filters when used. Flush with clean water if necessary. Coat filters with Randolph Products', Super Coat Adhesive or equivalent.
16. Inspect the chains/sprocket (see Figure 28



) 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.

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.*

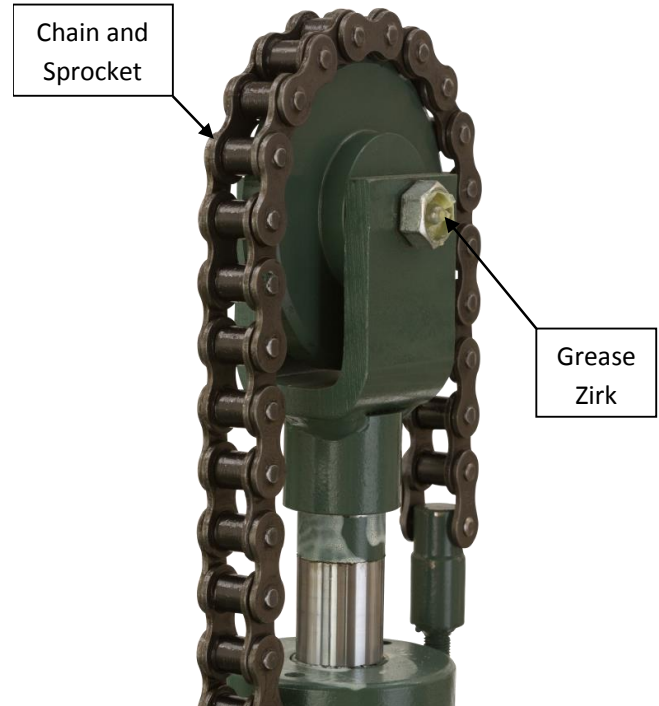


Figure 28: Lift Truck chain and sprocket

17. Follow the recommendations of any individual device instructions furnished for maintenance of the device.
18. Contact ABB Service if any abnormality is experienced.

9.3 24 Month (Two Year) Inspection

In addition to the annual inspection, perform the following recommended inspection and maintenance at 24 month (two year) intervals, or sooner, if required by local conditions or regulations.

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. Clean the circuit breaker stationary primary contacts. Refer to Circuit Breaker Installation Operation and Maintenance Manual **1VAL050502-MB** for detailed instructions.
2. Inspect secondary wiring bundles for signs of discoloration because of heat or chafing. Check for cracked or embrittled insulation. Replace wire whenever unsure.
3. Inspect primary insulation system for accumulated contamination. Clean insulation with a dry cloth, dry-air, vacuum, or if necessary with an OSHA approved solvent.
4. Check the calibration of protective relays.
5. Follow the recommendations of any individual device instructions furnished for maintenance of the device.
6. Contact ABB Service if any abnormality is experienced.

9.4 10 Year Maximum Inspection

In addition to the annual inspections and maintenance, perform the following recommended inspections and maintenance every ten years, or sooner, if required by local conditions or regulations.

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. Disassemble, inspect, clean, lubricate, adjust and calibrate circuit breaker mechanisms as recommended in the instructions furnished with the circuit breaker.
2. Torque all primary conductor connection bolts to recommended values. **All bolted joints must be torqued per ABB specification 1VAL-T0004-100843.**
3. Tighten all secondary control wire connections. Check for loose lug crimps and broken wire strands.
4. Contact ABB Service if any abnormality is experienced.

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. Replace all sealant, Dow Corning, Molykote compound #111, between the bus bars, the internal skirt and the bus joint boot as per section 5.6.
8. Use proper torque in tightening bolted connections. **All bolted joints must be torqued per ABB specification 1VAL-T0004-100843.**

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

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.

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
Thermoplasts	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

9.9 Disclaimer of Warranties and Limitation of Liability

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.

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