CENTERLINE 200/400 A Two-High Cabinet, Standard and Arc-Resistant Enclosure

Bulletin Numbers 1512B, 1512BT, 1512BP, 1512DM, 1512DO, 1512M, 1562E, 1591B, 1592BF, 1592BP

Allen-Bradley
by ROCKWELL AUTOMATION

User Manual Original Instructions

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.

IMPORTANT Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.

SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.

BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

Chapter 3

Common Installation

Chapter 4

Maintenance

Chapter 5

Spare Parts

Appendix A

ArcShield Unit Information

Appendix B

ArcShield Plenum Installation Instructions

Appendix C

ArcShield Chimney Installation Instructions

Appendix D

Integrated Protective Maintenance Grounding Device

Appendix E

History of Changes

Notes:

Summary of Changes

This publication contains the following new or updated information. This list includes substantive updates only and is not intended to reflect all changes.

Topic	Page
Added information around stress cones	24, 39, 46
Added 3000 A Power Splicing configuration graphic	44
Added section on isolation switch maintenance	63
Added attention statement around connecting arc-resistant equipment	77
Added Appendix D, Integrated Protective Maintenance Grounding device	97

About This Publication

This publication pertains to the Rockwell Automation Bulletin 1512B medium voltage controller. The Bulletin 1512B structure provides one complete medium voltage controller unit.

The installation section provides instructions for both the standard enclosure type and the Rockwell Automation arc resistant type (ArcShield™).

The product Bulletin numbers covered by this document are:

- 1512B: 200/400 A, FVNR controller
- 1512BT: 200/400 A, Transformer Feeder
- 1512BP: 200/400 A, Prepared Space

IMPORTANT This document is to be used for all Bulletin 1512A unit types, including arc resistant (ArcShield) units. Important information specifically for ArcShield units can be found in Appendix A, Appendix B and Appendix C.

ATTENTION: Users must refer to the information in Appendix A, Appendix B and Appendix C to correctly install and maintain ArcShield arc resistant units. Failure to do so may negate the arc resistant benefits provided by ArcShield, exposing personnel to risk of serious injury or death.

This document may also be used as a reference guide for the following Bulletin numbers:

- 1512DM: 200/400 A, VFD Input Contactor Units
- 1512DO: 200/400 A, VFD Output Contactor Units
- 1512M: 200/400 A, VFD Output Bypass Starter
- 1562F: 200/400 A, MV SMC-50 Solid-State (up to 4800V), Reduced Voltage Starter
- 1591B: Incoming Line Unit
- 1592BF: Fused Load Break Switch for Feeders
- 1592BP: Fused Load Break Switch for Feeders, prepared space

Download Firmware, AOP, EDS, and Other Files

Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes from the Product Compatibility and Download Center at rok.auto/pcdc.

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
Medium Voltage 450 A Contactor, Series G User Manual, publication 1502-UM060	Provides information on handling, installing, maintaining, and troubleshooting 450 A medium voltage contactors.
EtherNet/IP Network Devices User Manual, ENET-UM006	Describes how to configure and use EtherNet/IP devices to communicate on the EtherNet/IP network.
Ethernet Reference Manual, ENET-RM002	Describes basic Ethernet concepts, infrastructure components, and infrastructure features.
System Security Design Guidelines Reference Manual, SECURE-RM001	Provides guidance on how to conduct security assessments, implement Rockwell Automation products in a secure system, harden the control system, manage user access, and dispose of equipment.
Industrial Components Preventive Maintenance, Enclosures, and Contact Ratings Specifications, publication IC-TD002	Provides a quick reference tool for Allen-Bradley industrial automation controls and assemblies.
Safety Guidelines for the Application, Installation, and Maintenance of Solid-state Control, publication SGI-1.1	Designed to harmonize with NEMA Standards Publication No. ICS 1.1-1987 and provides general guidelines for the application, installation, and maintenance of solid-state control in the form of individual devices or packaged assemblies incorporating solid-state components.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, rok.auto/certifications.	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at rok.auto/literature.

Installation – Standard Enclosure

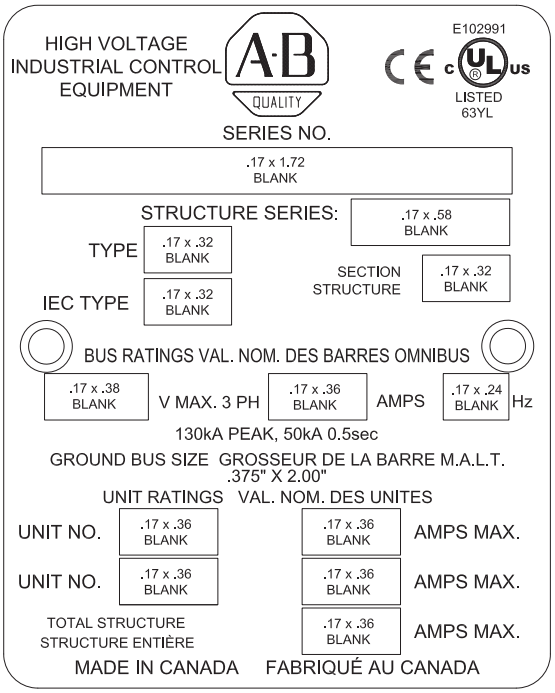
IMPORTANT For information on the installation site preparation, see publication MV-QS050.

ATTENTION: Use suitable personal protective equipment (PPE) per local codes or regulations. Failure to do so may result in severe burns, injury or death.

Starter Identification

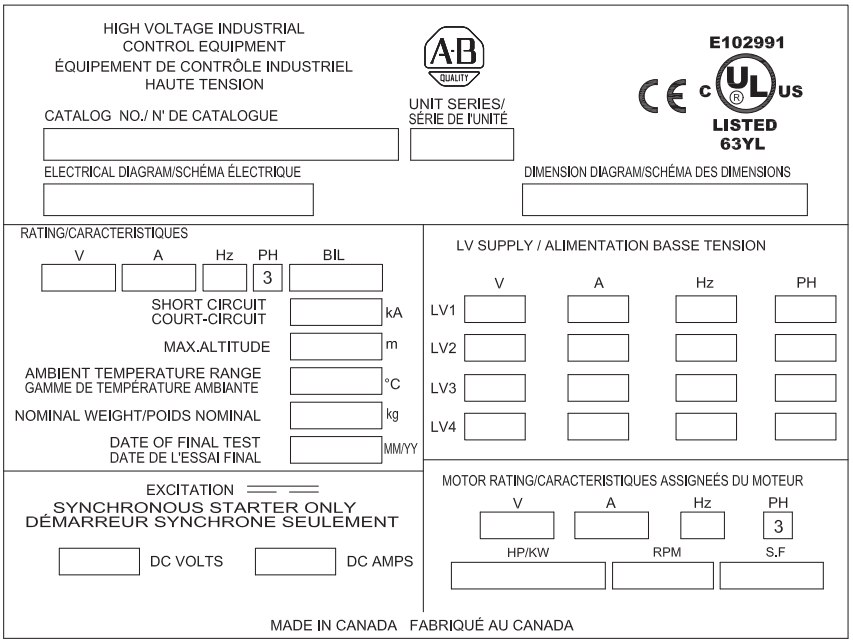
A structure nameplate is attached to the right-side flange of the structure (see Figure 1). Refer to the nameplate for information such as series number, section number, NEMA enclosure type, unit ratings and bus ratings.

Figure 1 - Typical Structure Nameplate



A unit nameplate is also found in the low voltage compartment with specific unit motor application information (see Figure 2).

Figure 2 - Typical Unit Nameplate



Refer to these nameplates whenever you contact Rockwell Automation for assistance. Be prepared to provide such information as series number, structure series, unit series, diagram schematic and catalog number.

Prepared Space

When ordering a starter kit to complete a prepared space[(a)], provide the following information to ensure the proper components are supplied.

Series Number

Provide the series number from the structure with the prepared space. The number is stamped on a nameplate on the right-hand flange of the starter (see Figure 1). The series number is also available from the dimension drawings for the starter.

Motor Data

Provide the following motor data:

- Locked rotor current
- Full load current
- Maximum locked rotor time
- Acceleration time
- Motor service factor
- Motor horsepower

(a) Not available on arc resistant cabinets.

Starter Features

Provide information regarding any special features required for the starter kit. Indicate if these features are different from the motor control features in the existing, complete power cell.

Recommended Torque Values

When reinstalling components or when reassembling the cabinet, tighten the following bolt sizes to the specified torque values:

Table 1 - Hardware Torque Values

1/4 in. hardware	8 N•m (6 lb•ft)
5/16 in. hardware	15 N•m (12 lb•ft)
3/8 in. hardware	27 N•m (20 lb•ft)
1/2 in. hardware	65 N•m (48 lb•ft)

Environmental Conditions

The controller must accept nominal plant power of 2400V, 3300V, 4200V, 4800V, 5500V, 6600V, 6900V (+5/-15%), or 7200 (+0/-15%), 3 phase 50/60 Hz (± 3%).

The standard controller must operate in an ambient temperature range of 0...40 °C (32...104 °F) with a relative humidity of up to 95% (non-condensing). Higher ambient temperature conditions are supported with factory assistance.

The equipment shall be capable of being stored in an environment with an ambient temperature range of -40...+85 °C (-40...+185 °F).

If storage temperature fluctuates or if humidity exceeds 85%, space heaters must be used to prevent condensation. The equipment must be stored in a heated building having adequate air circulation.

WARNING: The equipment should never be stored outside.

Rockwell Automation products are built using materials that comply with Class 1: Industrial Clean Air sulfur environments as defined in IEC Standard 60654-4 (Operating Conditions for Industrial-Process Measurement and Control Equipment), and G1 as defined in ISO-S71.04-1985 (Environmental Conditions for Process Measurement and Control Systems: Airborne Contaminants).

High Altitude Application

The equipment shall operate at altitudes from 0...1000 m (0...3300 ft) above sea level, without derating. For applications above 1000 m (3300 ft), the maximum current and basic impulse levels (BIL) of the controllers shall be derated, and vacuum contactors may be compensated for operation at the specified altitude (see publication 1500-SR020).

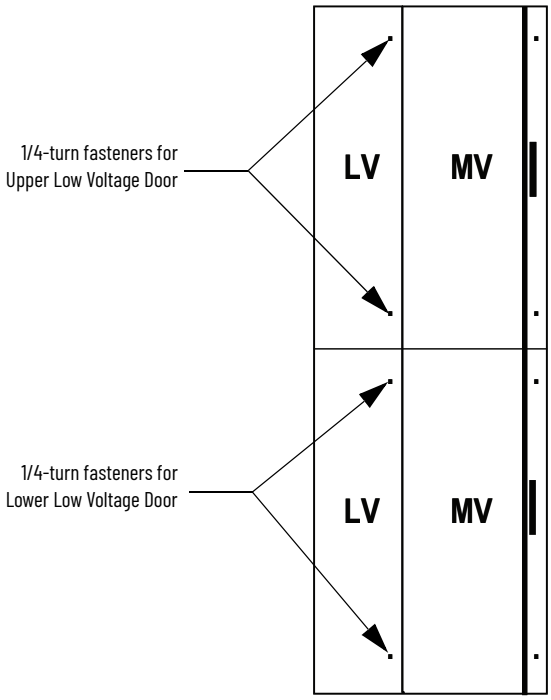
Door Opening Procedure

Opening the Low Voltage Doors

Low voltage doors are identified as LV in Figure 3.

1. To access the compartments for standard cabinets – use a flat-head screwdriver and turn both of the 1/4-turn fasteners at least 90° in a counterclockwise direction.
2. The door is now released and will swing open.
3. Reverse the procedure to secure the doors.

Figure 3 - Access to Low Voltage Compartments



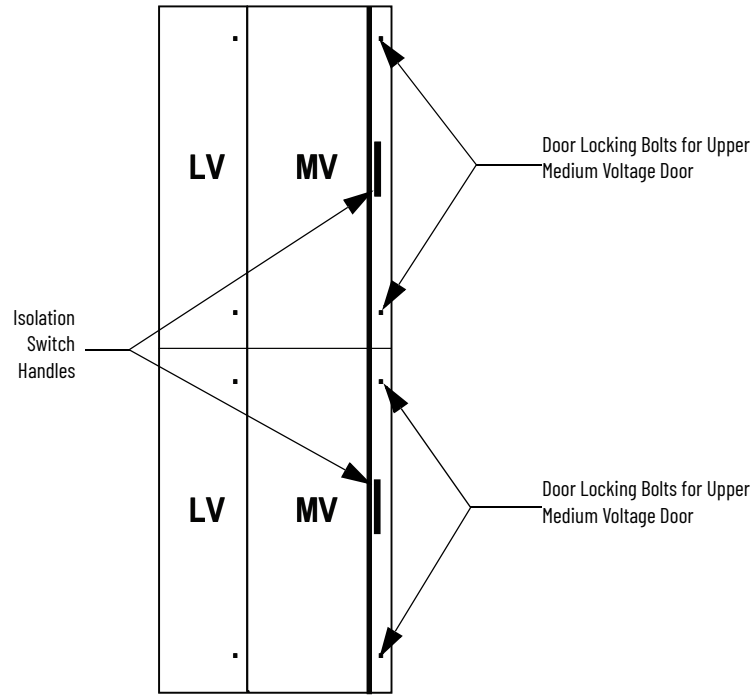
Opening the Medium Voltage Doors

ATTENTION: Medium voltage components are located behind the swing-out low voltage panel (standard cabinets only). Complete the Power Lock-out procedure (see Power Lock-out Procedure on page 53) before attempting to open the swing-out low voltage panel. Failure to do so may result in severe burns, injury or death.

ATTENTION: Complete the Power Lock-out procedure (see Power Lock-out Procedure on page 53) before beginning any service procedures to the unit. Failure to do so may result in severe burns, injury or death.

Medium voltage doors are identified as MV in Figure 4.

Figure 4 - Access to Medium Voltage Compartments



IMPORTANT Each medium voltage door has its own isolation switch handle and interlocking safeguards. Upper and lower power cells are separated by an isolation barrier.

Refer to Access to the Power Bus on page 16 for the procedure to open the swing-out low voltage panel behind the low voltage door (for standard cabinet only).

1. Electrically open the contactor by pressing the STOP button on the starter or at the remote control location.
2. Move the isolation switch handle to the OFF position.
3. Unscrew the locking 3/8-1.75 bolts for both MV doors.

   The doors are now released and will swing open to the left.
4. Reverse the procedure to close the door.

IMPORTANT Ensure that the swing-out low voltage panel is in its original position before attempting to close the MV door. When closing the medium voltage door, ensure all door locking bolts on the right side of the MV door are in place and tightened until the door is flush with the flange. **Do not overtighten the bolts**. If the door is not securely fastened, it will not be possible to move the isolation switch handle to the ON position.

ATTENTION: Complete the Power Lock-out procedure (see Power Lock-out Procedure on page 53) before beginning any service procedures to the unit. Failure to do so may result in severe burns, injury or death.

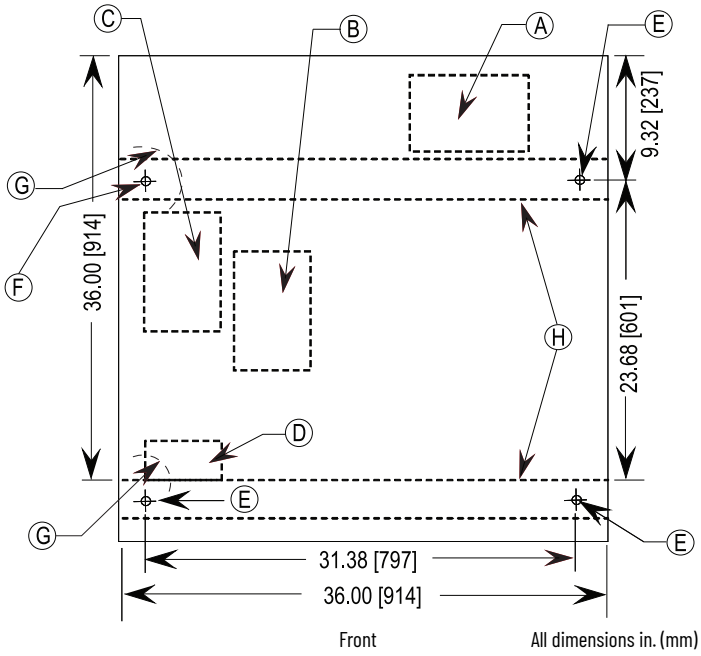
Anchoring

Place the controller in the desired installation location. Use M12 (1/2 in.) floor mounting bolts to securely fasten the controller to the mounting surface. See Figure 5 as an example of the location of the mounting holes in the cabinet.

Refer to Dimension Drawing provided with order documentation for additional details related to cabinet floor plan.

IMPORTANT Pre-determined cabinets have been designed for Uniform Building Code (UBC) seismic zone 1, 2A, 2B, 3 and 4, and IBC (International Building Code) seismic activity without overturning or lateral movement, provided they are securely mounted according to UBC, IBC and local building codes. This can include concrete pad design, steel floor design and the sizing of cabinet anchors. Concrete floor cutouts must **not** be adjacent to floor anchor bolts and must be sized to seismic load. Consult factory if floor mounting must be reviewed by an accredited engineer. Many jurisdictions require an engineer from the local area to review the design. Seismic qualification does not indicate that the equipment will function properly after a seismic event.

Figure 5 - Cabinet Floor Plan



Ⓐ Line cable conduit opening.

Ⓑ Load cable conduit opening for bottom compartment.

Ⓒ Load cable conduit opening for top compartment.

Ⓓ Control wire conduit opening. Each opening provides access to top and bottom compartments.

Ⓔ Mounting holes for 1/2 in. (M12) anchor bolts.

Ⓕ Mounting holes for 1/2 in. (M12) anchor bolts (required for seismic applications only).

Ⓖ Minimum distance to concrete floor cut-out required for seismic applications.

Ⓗ 1.00 (25) x 3.00 (76) non removable sill channels.

Seismic Applications

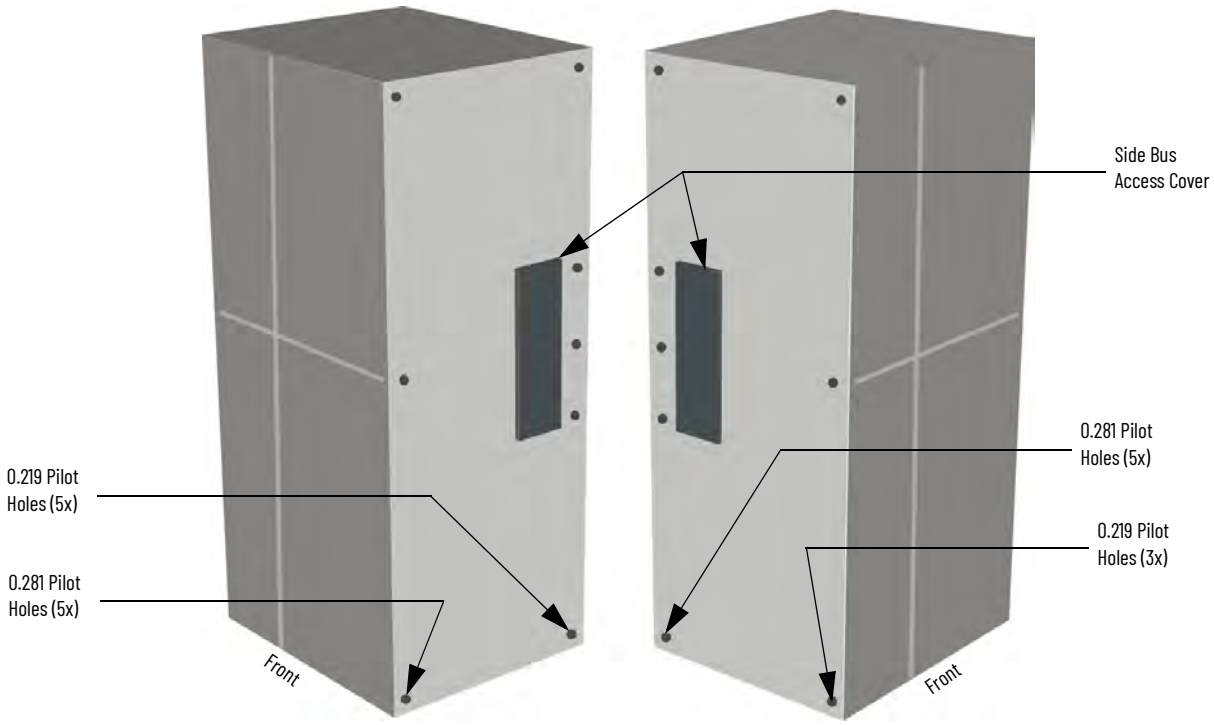
- **For installations on concrete –** the minimum depth and radius of concrete supporting the cabinet anchors is dependent on seismic loads. Refer to important information above.
- **For installations on a metal structure –** the metal plate depth and cabinet anchoring method is dependent on seismic loads.

Joining Sections

Joining hardware can be found in a package mounted on the front of the shipping skid. Refer to publication MV-QS050 for level floor surface requirements.

1. Position the left side of the section on a level surface and secure the section in place with 12 mm (1/2 in. [M12]) floor mounting bolts (refer to Anchoring on page 14).
2. When joining NEMA Type 12, apply a continuous 3 mm (1/8 in.) wide bead of silicone sealer around the perimeter of one section.
3. Remove the side bus access covers if applicable.
4. Position the right section against the left section. Ensure that the surface is level.
5. Secure the sections together using the 1/4-20 self-tapping screws (12 lb•ft [15 N•m]). Thread the screw through the 7 mm (0.281 in.) clearance hole to the corresponding 6 mm (0.219 in.) pilot hole. To access the front clearance holes of the left-side cabinet, open the medium voltage doors. To access the rear clearance holes remove the rear covers of the starter. If rear access is not available, refer to Front Access– Access to Power Bus on page 18.
6. Secure the right section to the floor using M12 (1/2 in.) floor mounting bolts (refer to Anchoring on page 14).

Figure 6 - Joining Sections



Access to the Power Bus

ATTENTION: This procedure requires contact with medium voltage components. To avoid shock hazards, lock out incoming power before working on the equipment (see Power Lock-out Procedure on page 53). Verify with a hot stick or appropriate voltage measuring device that all circuits are voltage free. Failure to do so may result in severe burns, injury or death.

Rear Access

1. Remove the hardware securing the center rear bus access cover (see Figure 7).
2. Remove the center rear bus access cover.
3. Once the rear bus cover is removed, you will see the three power bus bars and the ground bus bar (see Figure 8).

Figure 7 - Access to Power Bus from Side and Rear of Cabinet

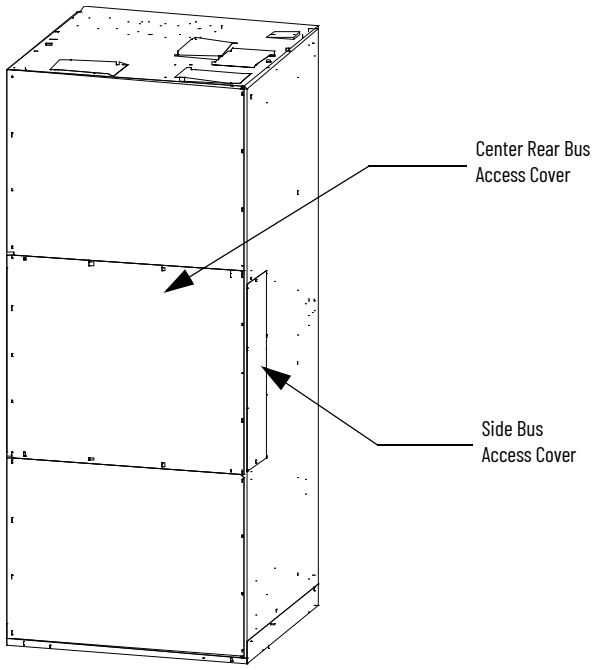


Figure 8 - Bus Bars from Back Access

Side Access

A side bus access cover is located on each side of the controller.

1. Remove the hardware from the appropriate side bus access cover (see Figure 7).
2. Remove the side bus access cover.
3. Once the side bus access cover is removed, you will see the three power bus bars and the ground bus (see Figure 9).

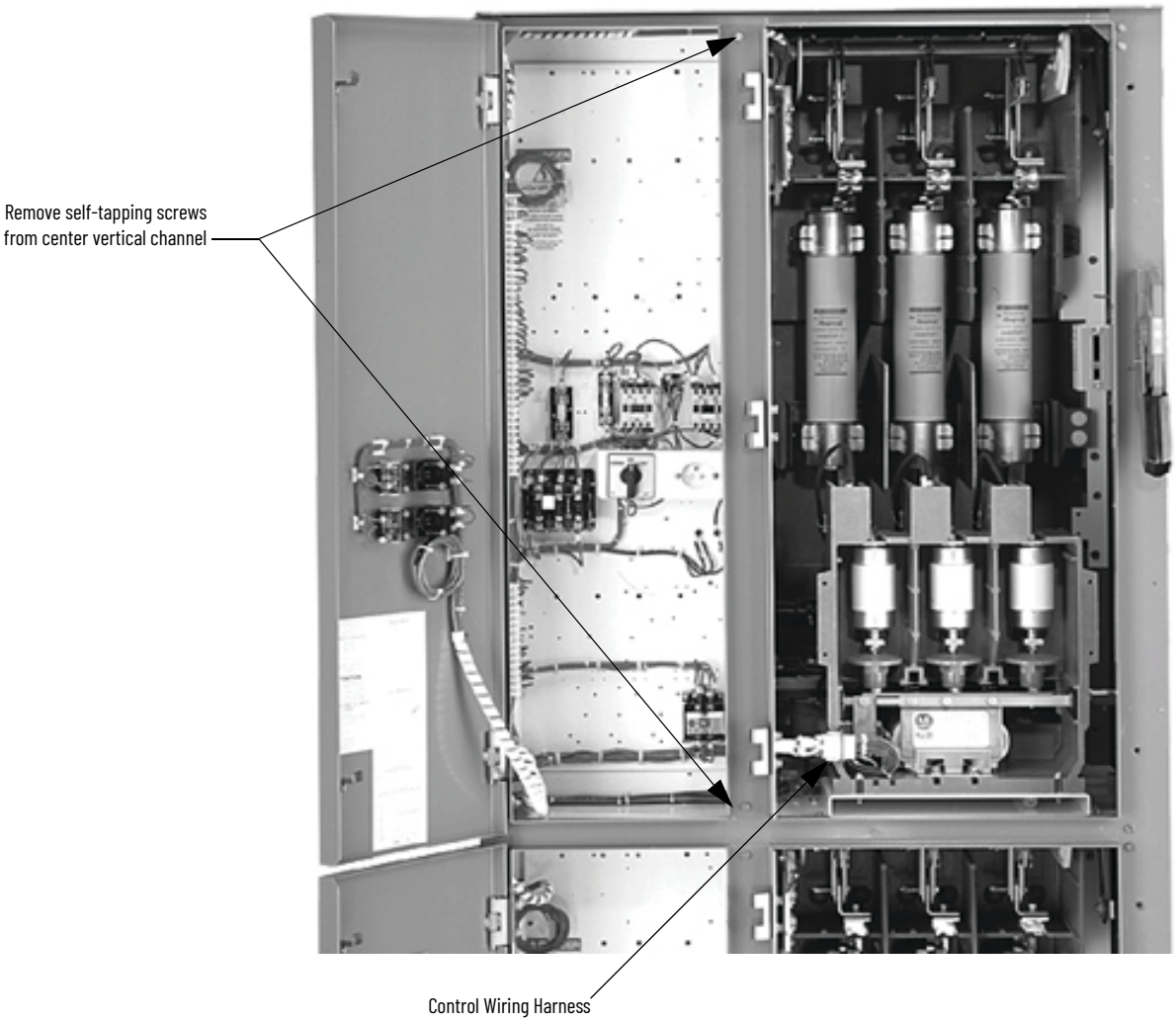
Figure 9 - Side Bus Access Cover Removed

Front Access– Access to Power Bus

ATTENTION: To avoid shock hazards, lock out incoming power (see Power Lock-out Procedure on page 53) before working on the equipment. Verify with a hot stick or appropriate voltage measuring device that all circuits are voltage free. Failure to do so may result in severe burns, injury or death.

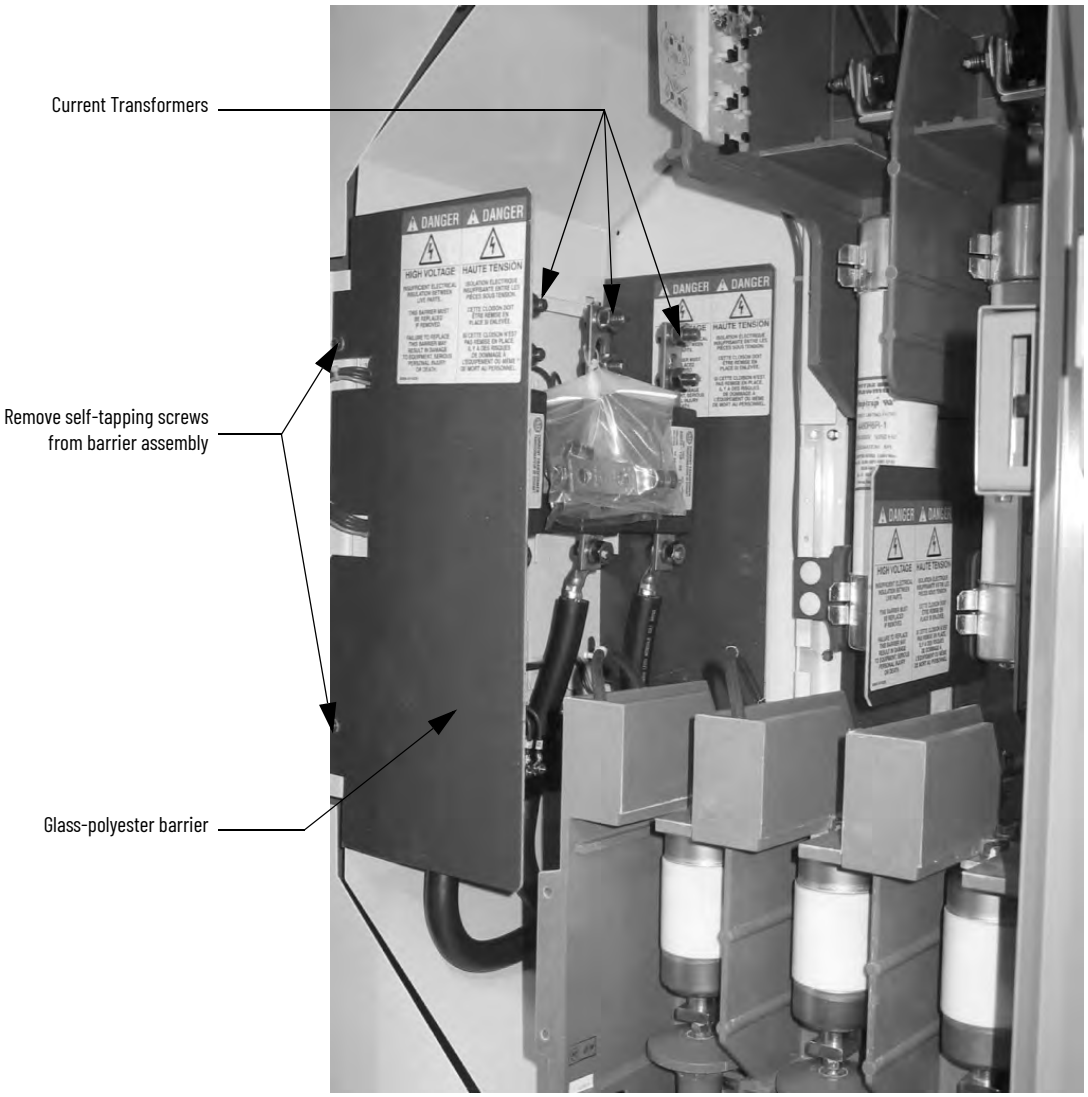
1. Open the doors and remove the hinge pins.
2. Open the low voltage cell doors (refer to Opening the Low Voltage Doors on page 12).
3. Disconnect the control wiring harness from the wire plug at the lower left side of the contactor.
4. Remove the two 1/4-20 self-tapping screws from the center vertical channel (see Figure 10).
5. Pull on the center vertical channel to swing out the low voltage panel.

Figure 10 - Center Vertical Channel



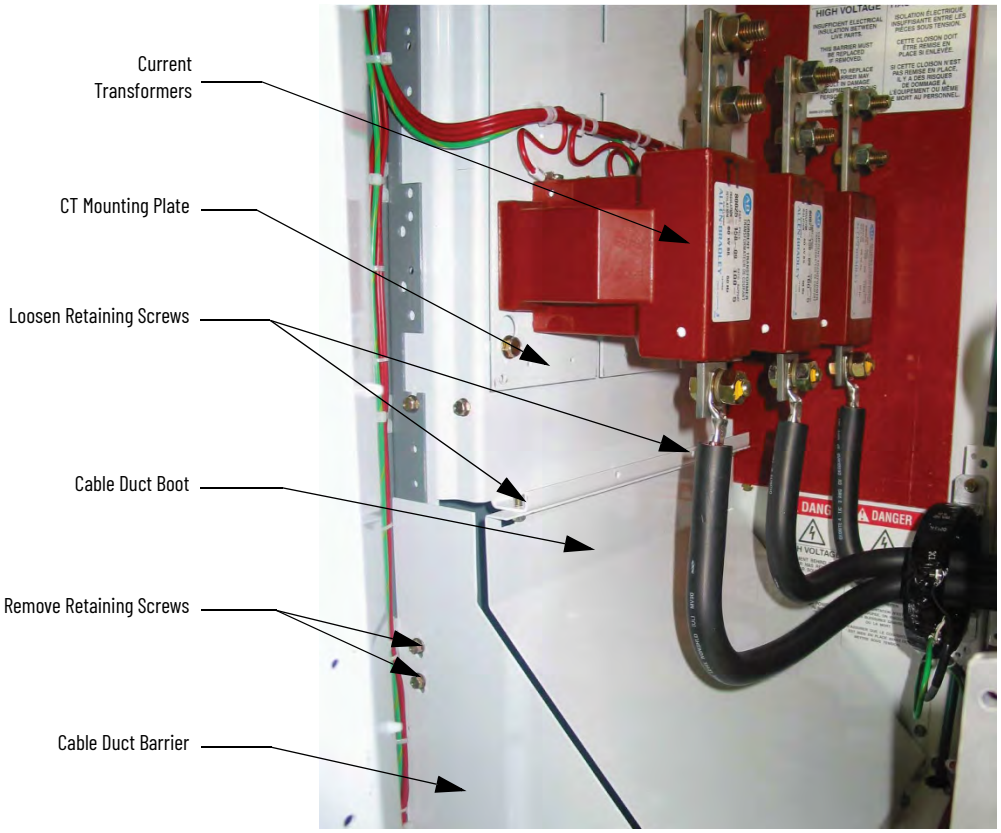
6. Remove each glass-polyester barrier located in front of the current transformers (see Figure 11).

Figure 11 - Removing Glass-polyester Barrier



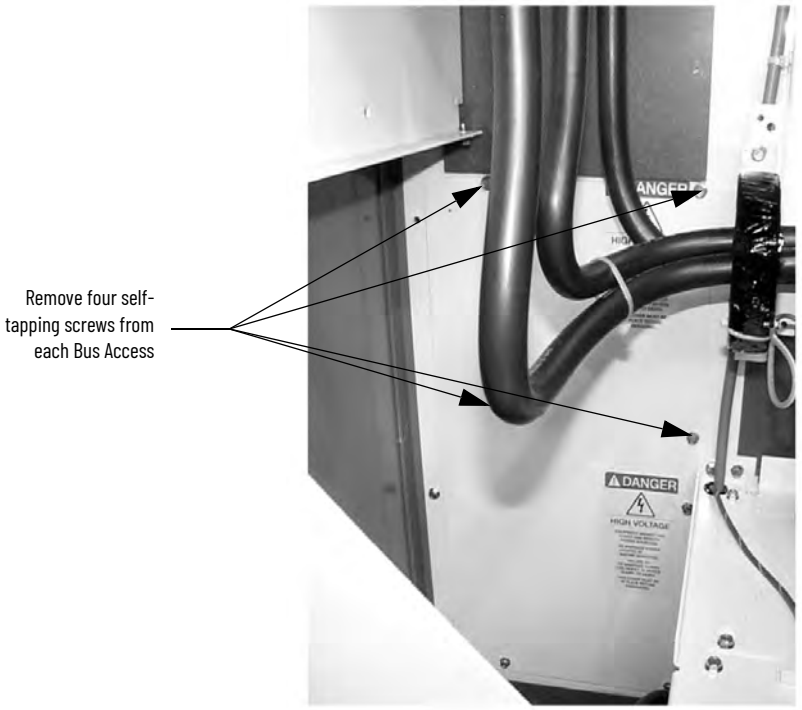
7. Remove the 1/4-20 retaining screw from the cable duct barrier and remove the barrier (see Figure 12).
8. Remove the two 1/4-20 retaining screws from the cable duct boot and remove the boot (see Figure 12).

Figure 12 - Removing Cable Duct Boot and Barrier



9. To access the left side of the power bus, locate the two bus access covers at the rear, left side of the power cell. Remove the four 1/4-20 self-tapping screws from each cover and remove the covers (see Figure 13).

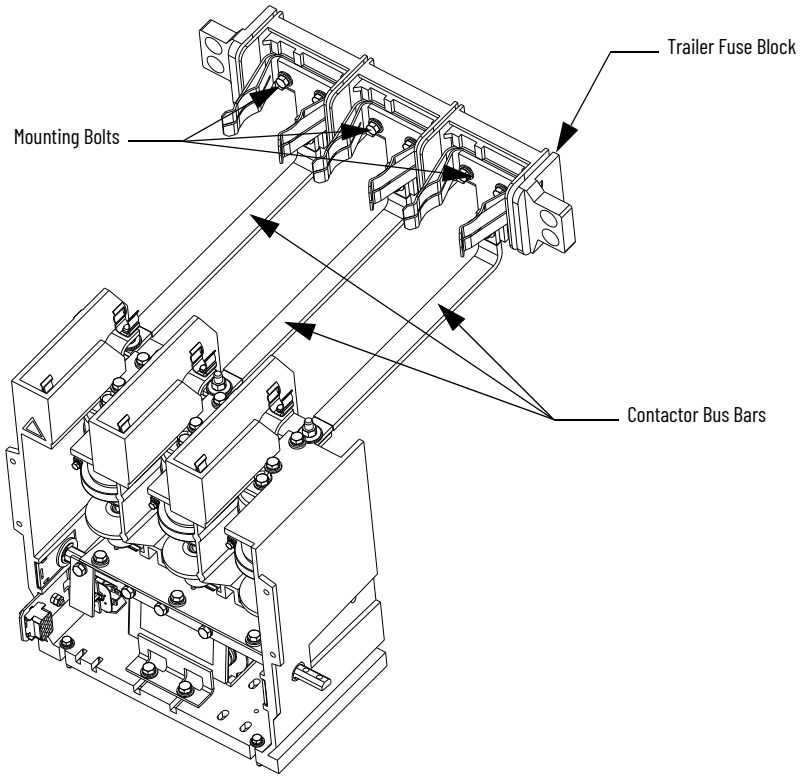
Figure 13 - Removing Bus Access Covers



10. If access to the right side of the power bus is required, remove the vacuum contactor from the upper power cell (refer to Removing the Contactor on page 58 of Chapter 1).

11. Remove the power fuses from the isolation switch.
12. Remove the interphase barriers from the trailer fuse block by raising them vertically up and out of the mounting slots (see Figure 14).
13. Use a 9/16-in. socket to remove the contactor bus bars from the isolation switch trainer fuse block.

Figure 14 - Contactor Bus Bars (Trailer Fuse Block for Clip-on Fuses Shown)

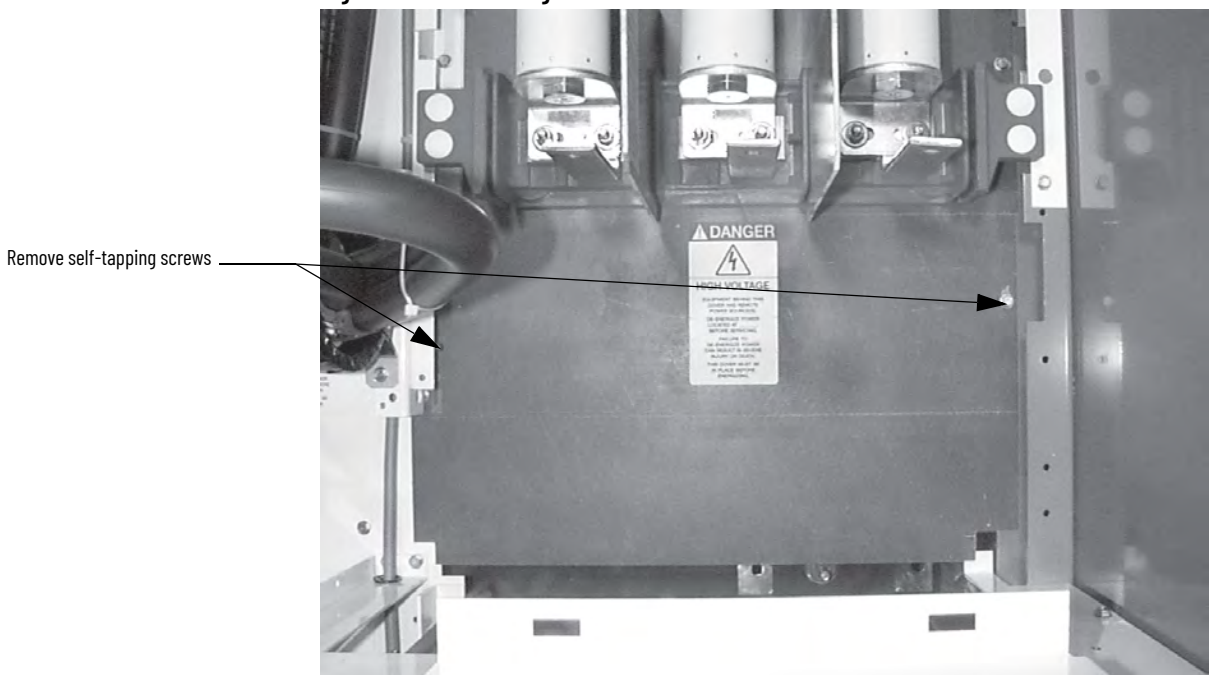


14. Disconnect the secondary control wiring from the control power transformer (CPT) and remove the CPT mounting plate. Leave the CPT attached to the plate.

ATTENTION: The CPT is heavy and assistance may be required to safely remove and transport the unit. Use caution when removing the CPT. Failure to do so may result in personal injury and/or damage to the equipment.

15. To access the right side of the power bus, remove the 1/4-20 self-tapping screws from the lower glass-polyester bus access cover and remove the cover (see Figure 15).
16. Reverse the procedure to reassemble the cabinet. Ensure that the barriers are put back in place and all parts and tools are accounted for.

Figure 15 - Access to Right Side of Power Bus

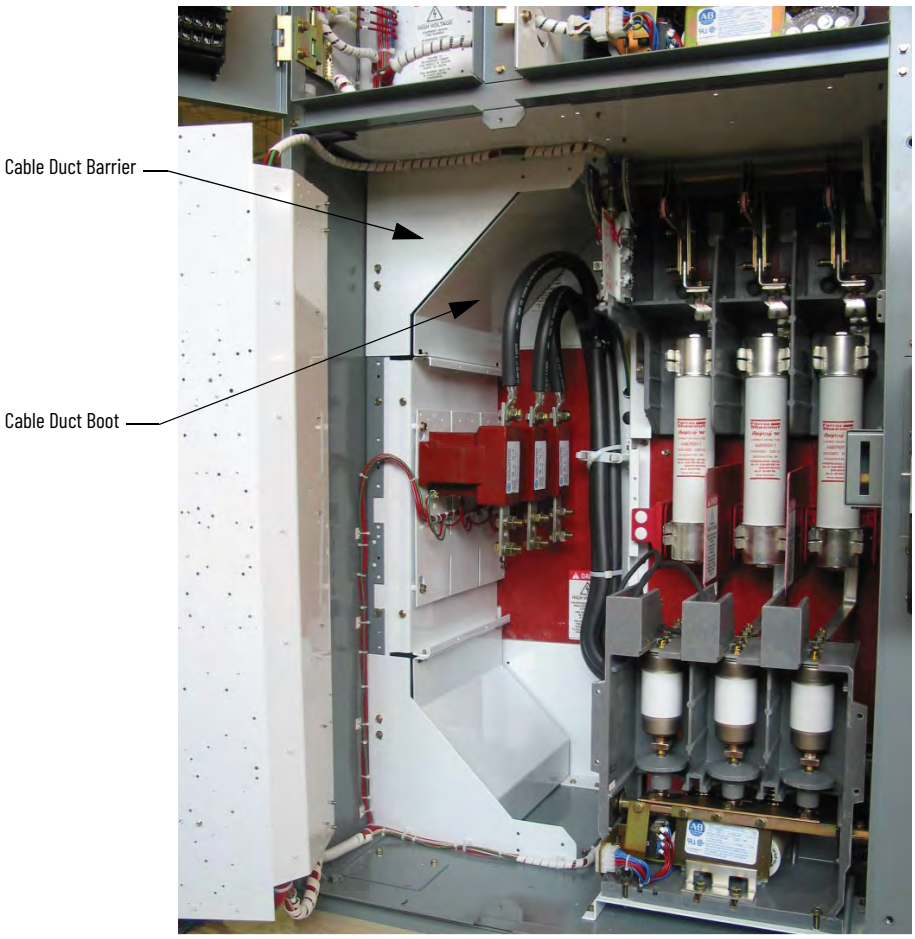


ATTENTION: Ensure all barriers are replaced before re-energizing the equipment. Failure to do so may result in electrical faults and cause damage to equipment or serious injury to personnel.

Front Access – Bottom Exiting Load Cables

If the cables in your cabinet exit from the bottom, the procedure to access the power bus is almost identical to the one above. Follow the procedure for Top Exiting Load Cables on page 25, but remove the cable duct barrier and cable duct boot from the top of the lower power cell, rather than those at the bottom (see Figure 16).

Figure 16 - Bottom Cable Exit Configuration



Load Cable Connections

ATTENTION: To avoid shock hazards, lock out incoming power (see Power Lock-out Procedure on page 53) before working on the equipment. Verify with a hot stick or appropriate voltage measuring device that all circuits are voltage free. Failure to do so may result in severe burns, injury or death.

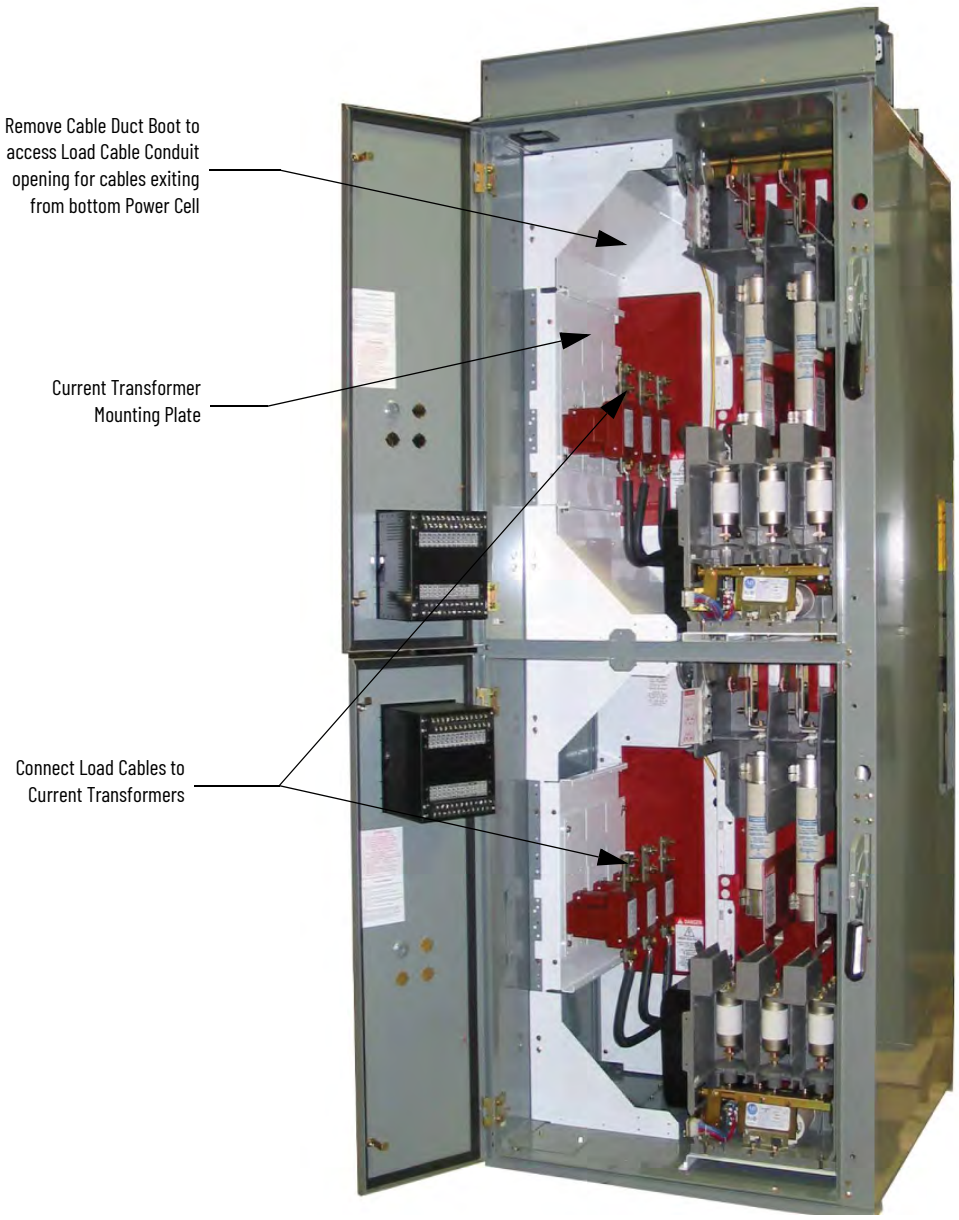
IMPORTANT The current transformers may be positioned for top or bottom cable exit. Follow the appropriate procedure described for your starter configuration.

IMPORTANT Refer to dimensional drawings provided with order documentation for additional details.

IMPORTANT Stress cones should be internal non-skirted style only. The use of external style (skirted style) is not recommended due to space considerations.

1. Open the MV power cell door.
2. Remove the cable duct boot at the top of the cabinet for top exiting load cables, or remove the one at the bottom of the cabinet for bottom exiting load cables (see Figure 17).

Figure 17 - Access to Load Cable Conduit Openings (Top exit cable configuration shown) (LV panels removed for clarity)



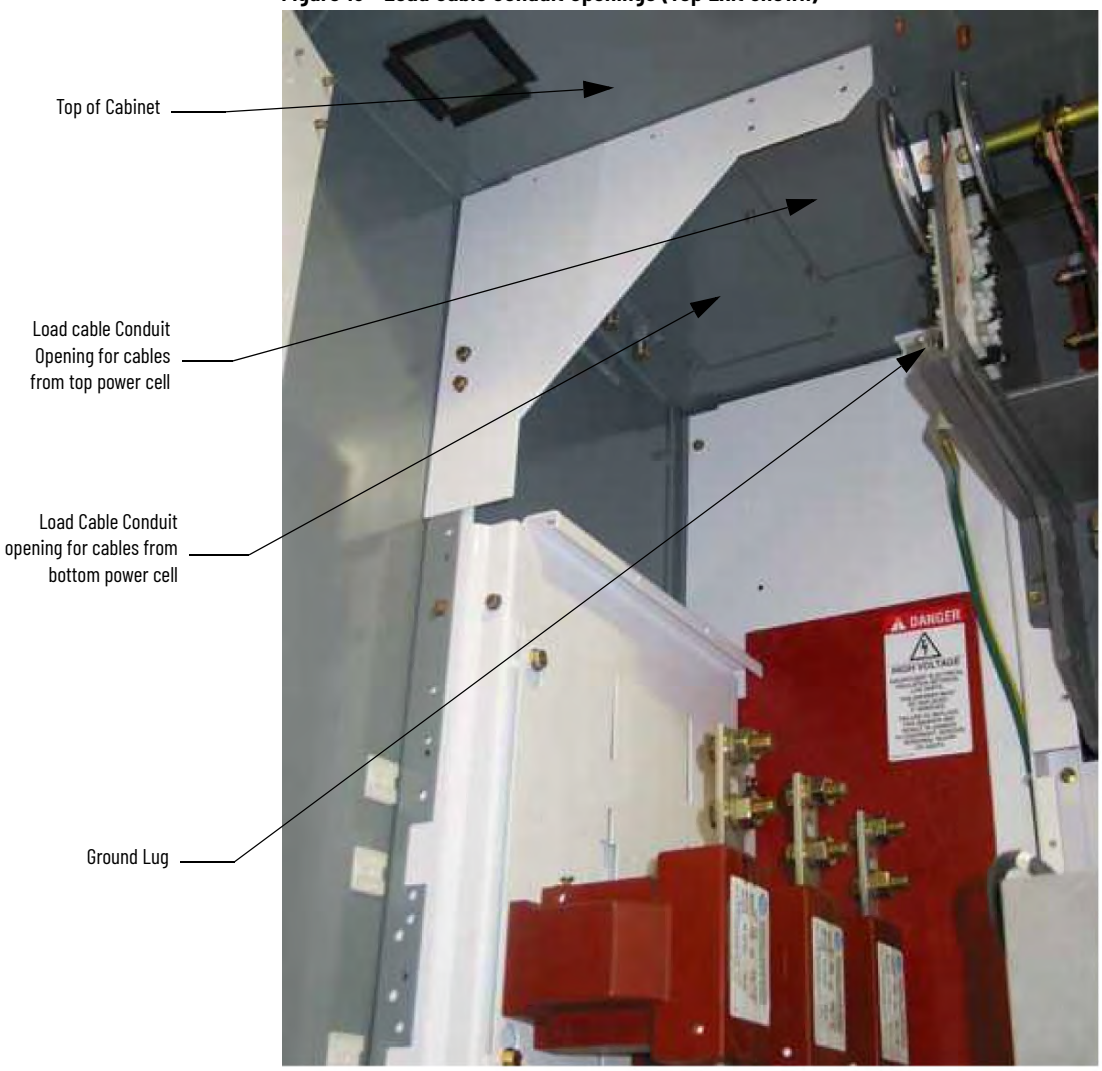
3. Remove the appropriate load cable conduit openings in the top or bottom of the cabinet (see Figure 18 or Figure 19).

Refer to Dimensional Drawings provided with order documentation for additional details.

Top Exiting Load Cables

4. Load cables for the bottom power cell should be routed first. Pull the cables into the cabinet through the appropriate opening (see Figure 18). Run the cables behind the current transformer mounting plate and into the bottom power cell.

Figure 18 - Load Cable Conduit Openings (Top Exit Shown)



5. For the top power cell, pull the cables into the cabinet through the appropriate opening (see Figure 18).
6. Connect the cables to the terminal assembly and tighten the 1/2-13 hardware to 45 lb•ft (61 N•m).
7. Connect cable shields to the ground lug.
8. Reinstall the cable duct boot and reassemble the cabinet.

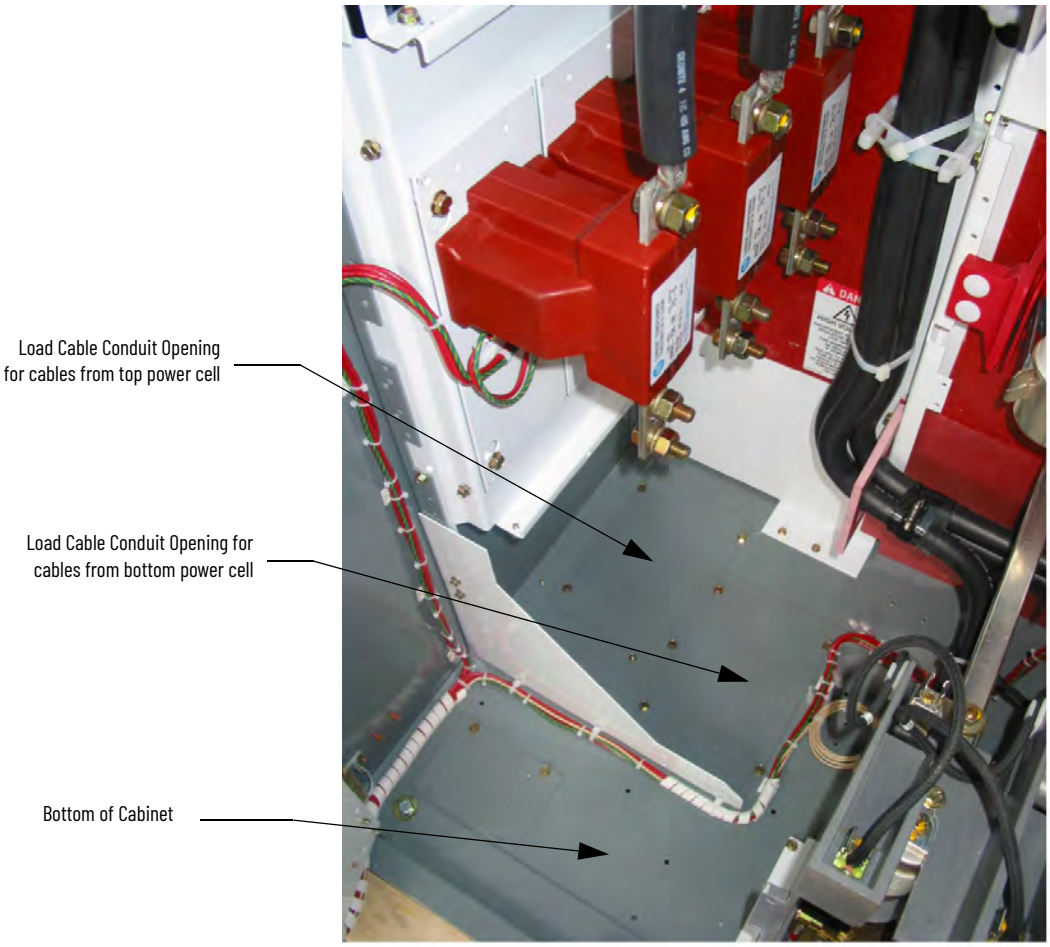
ATTENTION: Ensure all barriers are replaced before re-energizing the equipment. Failure to do so may result in electrical faults and cause damage to equipment or serious injury to personnel.

Bottom Exiting Load Cables

Follow steps 1-4 from the previous section.

1. Load cables for the top power cell should be routed first. Pull the cables into the cabinet through the appropriate opening (see Figure 19). Run the cables behind the current transformer mounting plate and into the top power cell.

Figure 19 - Load Cable Conduit Openings (Bottom Exit Shown)



2. For the bottom power cell, pull the cables into the cabinet through the appropriate opening (see Figure 19).
3. Connect the cables to the current transformers and tighten the connections to 65 N•m (48 lb•ft).
4. Connect cable shields to the ground lug.
5. Reinstall the cable duct boot and reassemble the cabinet.

ATTENTION: Ensure all barriers are replaced before re-energizing the equipment. Failure to do so may result in electrical faults and cause damage to equipment or serious injury to personnel.

Notes:

Installation – Arc-Resistant Enclosure

This installation section contains information on arc resistant styles of enclosures, referred to in this manual as ArcShield™.

IMPORTANT For information on the installation site preparation, see Publication MV-QS050.

ATTENTION: Use suitable personal protective equipment (PPE) per local codes or regulations. Failure to do so may result in severe burns, injury or death.

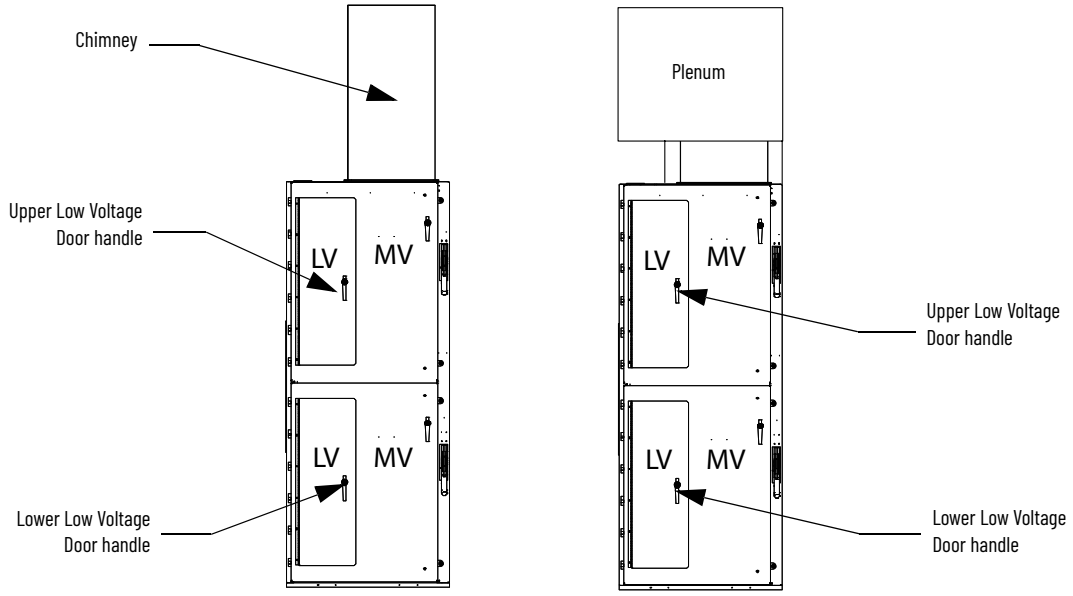
Door Opening Procedure

Opening the Low Voltage Doors

Low voltage doors are identified as LV in Figure 20 on page 29.

1. To access the compartments for ArcShield cabinets – turn the release handle counter-clockwise 90°.
2. The door is now released and will swing open.
3. Reverse the procedure to secure the door.

Figure 20 - Access to Low Voltage Compartments

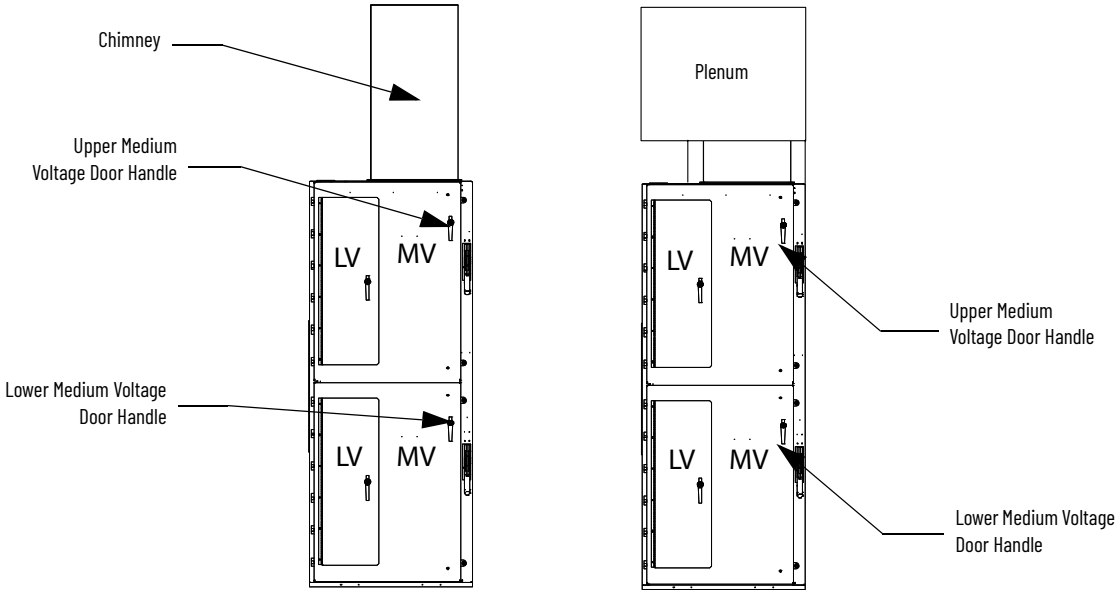


Opening the Medium Voltage Doors

ATTENTION: Complete the Power Lock-out procedure (see Power Lock-out Procedure on page 53) before beginning any service procedures to the unit. Failure to do so may result in severe burns, injury or death.

Medium voltage doors are identified as MV in Figure 21.

Figure 21 - Access to Medium Voltage Compartments



IMPORTANT Each medium voltage door has its own isolation switch handle and interlocking safeguards. Upper and lower power cells are separated by an isolation barrier.

Refer to Access to the Power Bus on page 33 for the procedure to open the swing-out low voltage panel behind the low voltage door (for standard cabinet only).

1. Electrically open the contactor by pressing the STOP button on the starter or at the remote control location.
2. Move the isolation switch handle to the OFF position (see Figure 22).
3. To access the compartments for ArcShield cabinets, turn the release handle counter-clockwise 90°.

IMPORTANT Only rotate the arc latching handle when the door locking bolts are tightened (see Figure 22). The arc latching-mechanism can be damaged by forcing the arc latching handle

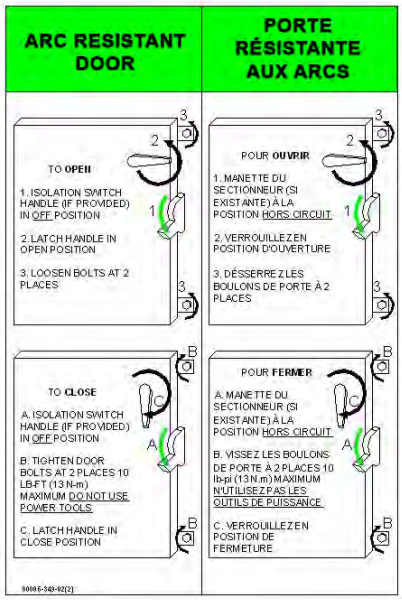
4. Unbolt the 3/8-1.75 door locking bolts for medium voltage door.

   The door is now released and will swing open.
5. Reverse the procedure to close the door. Tighten the 3/8-1.75 door lock-bolts by hand until threads are engaged.
6. Door lock bolts must be adequately tightened (see Recommended Torque Values on page 11)

IMPORTANT When closing the medium voltage door, ensure all 3/8-1.75 door locking bolts on the right side of the MV door are in place and tightened until no gap between side sheet flange and door locking bolt collar. **Do not overtighten the bolts**. If the door is not securely fastened, it will not be possible to move the isolation switch handle to the ON position.

On all ArcShield starters, the sticker in Figure 22 is attached to each door for your reference.

Figure 22 - Label on Arc Resistant Door



Anchoring

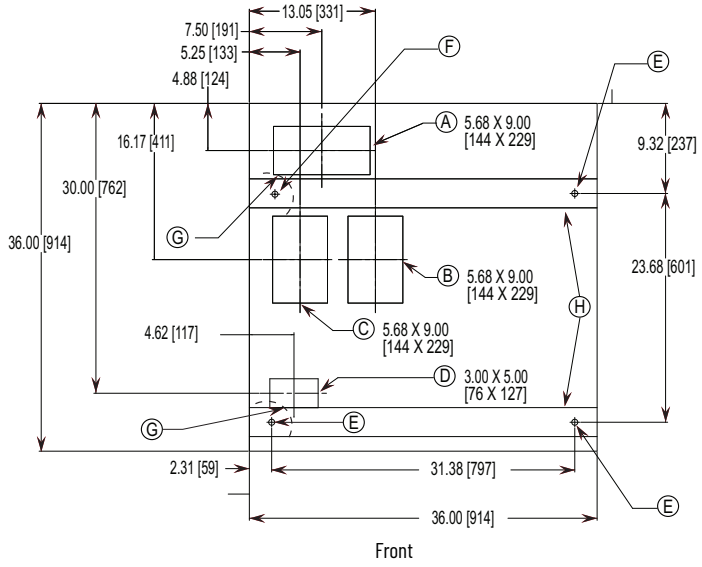
Place the controller in the desired installation location. Use M12 (1/2 in.) floor mounting bolts to securely fasten the controller to the mounting surface. See Figure 23 as an example of the location of the mounting holes in the cabinet.

Refer to Dimension Drawing provided with order documentation for additional details related to cabinet floor plan.

IMPORTANT Pre-determined cabinets have been designed for Uniform Building Code (UBC) seismic zone 1, 2A, 2B, 3 and 4, and IBC (International Building Code) seismic activity without overturning or lateral movement, provided they are securely mounted according to UBC, IBC and local building codes. This can include concrete pad design, steel floor design and the sizing of cabinet anchors. Concrete floor cutouts must **not** be adjacent to floor anchor bolts and must be sized to seismic load. Consult factory if floor mounting must be reviewed by an accredited engineer. Many jurisdictions require an engineer from the local area to review the design. Seismic qualification does not indicate that the equipment will function properly after a seismic event.

ATTENTION: Complete the Power Lock-out procedure (see Power Lock-out Procedure on page 53) before beginning any service procedures to the unit. Failure to do so may result in severe burns, injury or death.

Figure 23 - Cabinet Floor Plan



Ⓐ Line cable conduit opening.

Ⓑ Load cable conduit opening for bottom compartment.

Ⓒ Load cable conduit opening for top compartment.

Ⓓ Control wire conduit opening. Each opening provides access to top and bottom compartments.

Ⓔ Mounting holes for 1/2 in. (M12) anchor bolts.

Ⓕ Mounting holes for 1/2 in. (M12) anchor bolts (required for seismic applications only).

Ⓖ Minimum distance to concrete floor cut-out required for seismic applications.

Ⓗ 1.00 (25) x 3.00 (76) removable sill channels.

Seismic Applications

- **For installations on concrete –** the minimum depth and radius of concrete supporting the cabinet anchors is dependent on seismic loads. Refer to important information above.
- **For installations on a metal structure –** the metal plate depth and cabinet anchoring method is dependent on seismic loads.

Joining Sections

Joining hardware can be found in a package mounted to the front of the shipping skid.

Refer to publication MV-QS050 for level floor surface requirements.

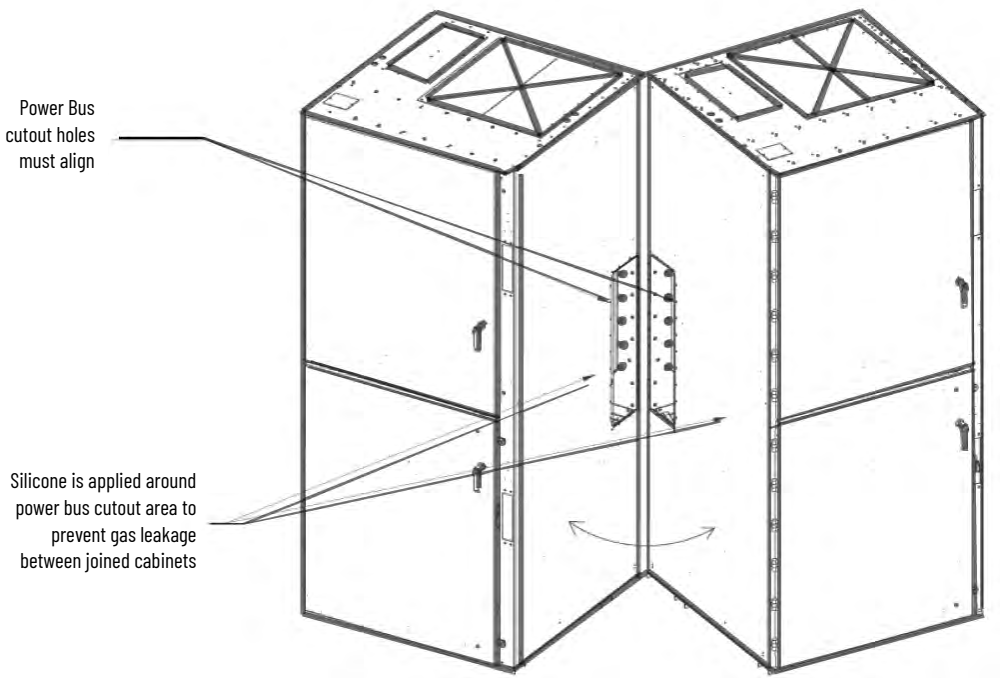
1. Position the left side section on a level surface and secure the section in place with M12 (1/2 in.) floor mounting bolts (refer to Anchoring on page 31).
2. When joining ArcShield sections, apply a continuous 3 mm (1/8 in.) wide bead of silicone sealer around the perimeter of one section.
3. Remove the side bus access covers if applicable.
4. Position the right section against the left section. Ensure that the surface is level.

5. Secure the sections together using the 1/4-20 self-tapping screws (12 lb•ft [15N•m]).
6. Thread the screw through the 7 mm (0.281 in.) clearance hole to the corresponding 6 mm (0.219 in.) pilot hole.
   a. To access the front clearance holes of the left-side cabinet, open the medium voltage doors.
   b. To access the rear clearance holes remove the rear covers of the starter. If rear access is not available, refer to Front Access – Access to Power Bus on page 36 of Chapter 1.
7. When joining the ArcShield sections, use the provided 1/4-20 self-tapping screws (12 lb•ft [15N•m]) to secure the perimeter of the horizontal bus opening, ensure all bolts are installed.

   Before joining sections together, ensure there is a silicone seal around the bus bar opening.
8. Secure the right section to the floor using M12 (1/2 in.) floor mounting bolts (refer to Anchoring on page 31).

IMPORTANT To prevent arc gas from escaping, all mounting holes on the sides and floor of the enclosure must have hardware installed.

Figure 24 - Joining Sections



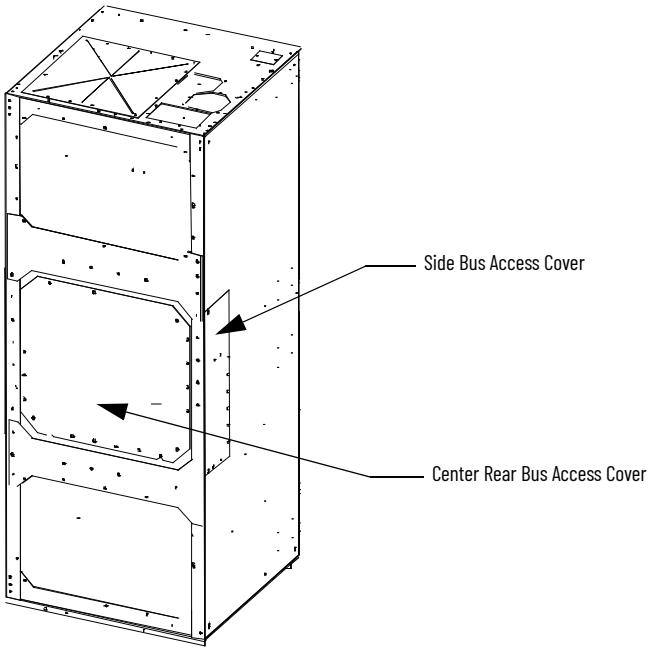
Access to the Power Bus

ATTENTION: This procedure requires contact with medium voltage components. To avoid shock hazards, lock out incoming power before working on the equipment (see Power Lock-out Procedure on page 53). Verify with a hot stick or appropriate voltage measuring device that all circuits are voltage free. Failure to do so may result in severe burns, injury or death.

Rear Access

1. Remove the hardware securing the center rear bus access cover (see Figure 25).
2. Remove the center rear bus access cover.
3. Once the rear bus cover is removed you will see the three power bus bars and ground bus (see Figure 27).

Figure 25 - Access to Power Bus from Side and Rear of Cabinet



Side Access

A side bus access cover is located on each side of the controller.

1. Remove the hardware from the appropriate side bus access cover.
2. Remove the side bus access cover (see Figure 25).
3. ArcShield units at the end of a line-up have a ground connection to the inner plate of the side bus access cover (see Figure 26 to Figure 28). This connection must be maintained to ensure unit arc resistant performance.

Figure 26 - Side Bus Access Cover Warning Label

Figure 27 - Side Bus Access Cover Ground Connection

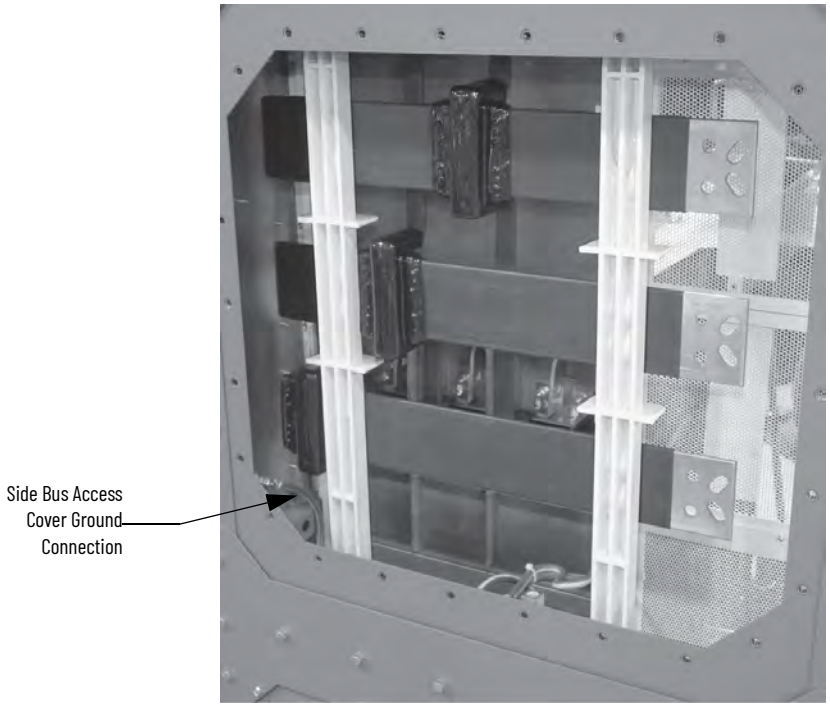
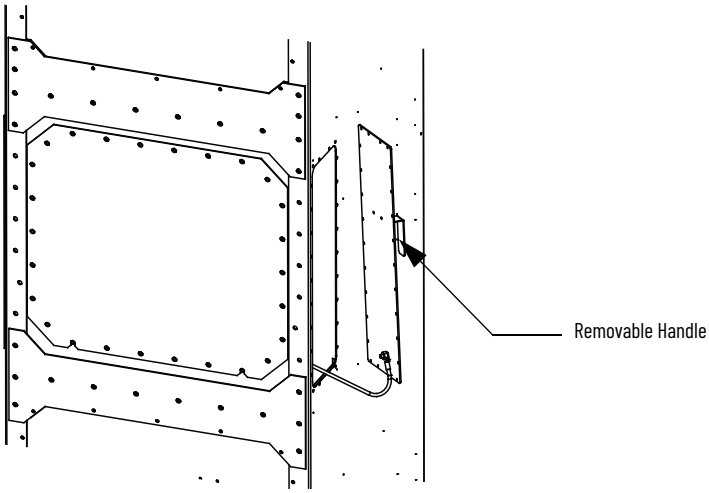


Figure 28 - ArcShield Ground Plate



Front Access – Access to Power Bus

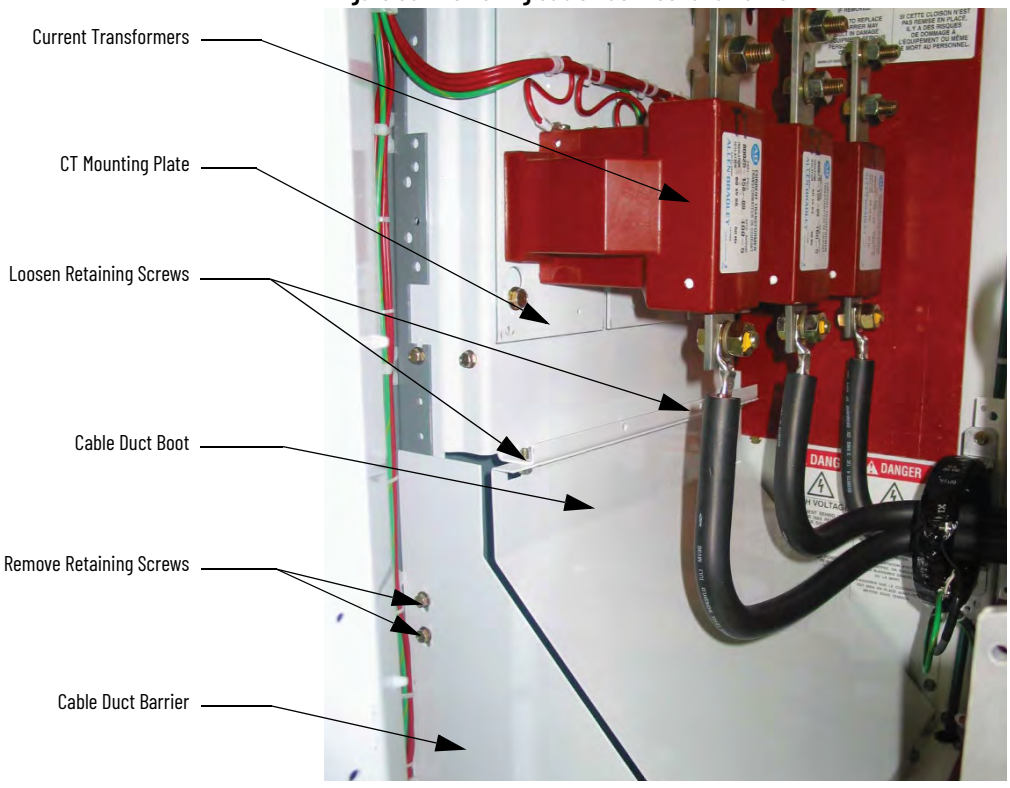
ATTENTION: To avoid shock hazards, lock out incoming power (see Power Lock-out Procedure on page 53) before working on the equipment. Verify with a hot stick or appropriate voltage measuring device that all circuits are voltage free. Failure to do so may result in severe burns, injury or death.

1. Open the medium voltage power cell door (see Figure 29).

Figure 29 - ArcShield Power Cell (Upper)

2. Remove the 1/4-20 retaining screw (12 lb•ft [15N•m]) from the cable duct barrier and remove the barrier (see Figure 30).
3. Remove the two 1/4-20 retaining screws (12 lb•ft [15N•m]) from the cable duct boot and remove the boot (see Figure 30).

Figure 30 - Removing Cable Duct Boot and Barrier

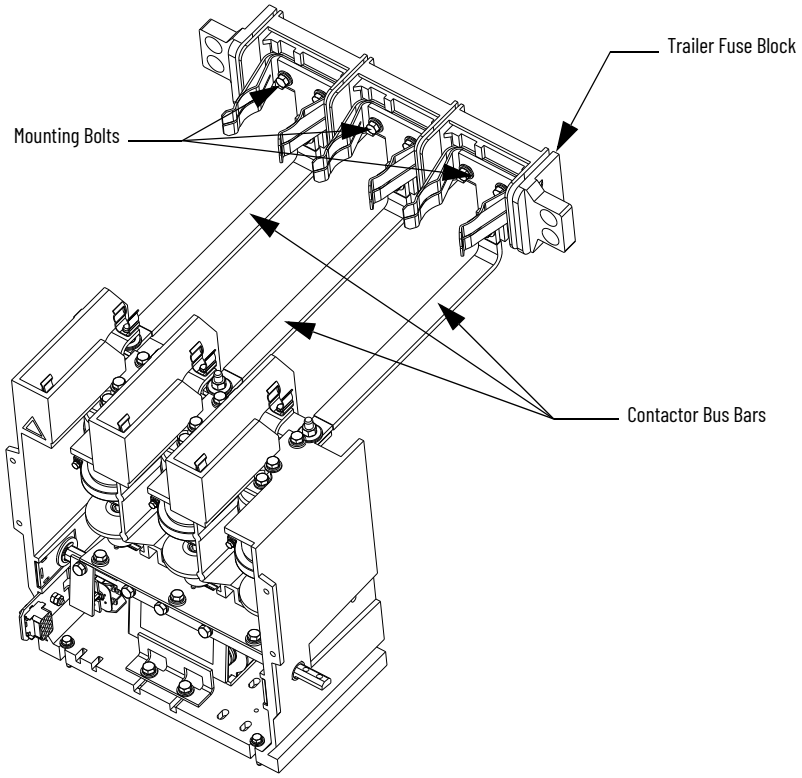


4. To access the left side of the power bus, locate the two bus access covers at the rear, left side of the power cell. Remove the four 1/4-20 self-tapping screws (12 lb•ft [15N•m]) from each cover and remove the covers (see Figure 31 on page 37).

Figure 31 - Removing Bus Access Covers

5. If access to the right side of the power bus is required, remove the vacuum contactor from the upper power cell (see Removing the Contactor on page 58).
6. Remove the power fuses from the isolation switch.
7. Remove the interphase barriers from the trailer fuse block by raising them vertically up and out of the mounting slots (see Figure 32).
8. Use a 9/16-in. socket to remove the contactor bus bars from the isolation switch trainer fuse block.

Figure 32 - Contactor Bus Bars (Trailer Fuse Block for Clip-on Fuses Shown)



9. Disconnect the secondary control wiring from the control power transformer (CPT) and remove the CPT mounting plate. Leave the CPT attached to the plate.

ATTENTION: The CPT is heavy and assistance may be required to safely remove and transport the unit. Use caution when removing the CPT. Failure to do so may result in personal injury and/or damage to the equipment.

10. To access the right side of the power bus, remove the 1/4-20 self-tapping screws (12 lb•ft [15N•m]) from the lower glass-polyester bus access cover and remove the cover (see Figure 33).
11. Reverse the procedure to reassemble the cabinet. Ensure that the barriers are put back in place.

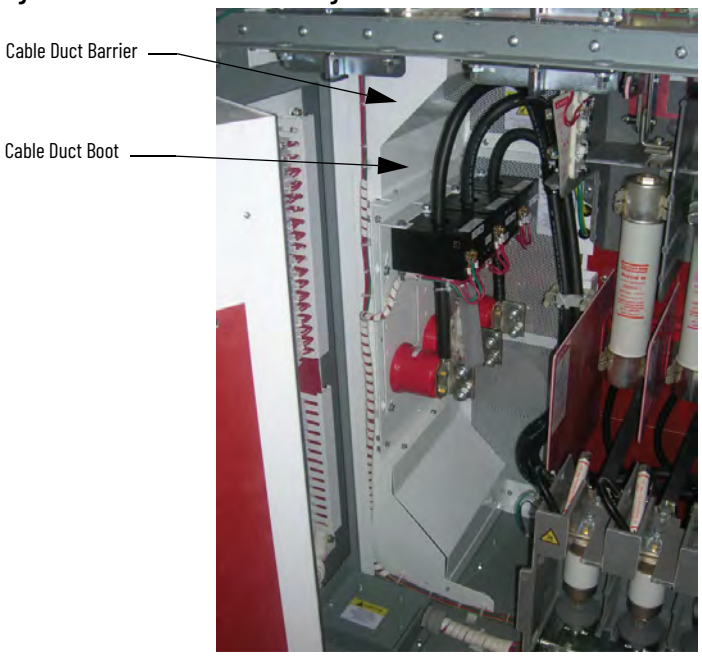
Figure 33 - Access to Right Side of Power Bus

ATTENTION: Ensure all barriers are replaced before re-energizing the equipment. Failure to do so will defeat the structure's arc resistant capabilities and result in electrical faults and cause damage to equipment or serious injury to personnel.

Front Access – Bottom Exiting Load Cables

If the cables in your cabinet exit from the bottom, the procedure to access the power bus is almost identical to the one above. Follow the procedure for Top Exiting Load Cables on page 40, but remove the cable duct barrier and cable duct boot from the top of the lower power cell, rather than those at the bottom (see Figure 34).

Figure 34 - Bottom Cable Exit Configuration



Load Cable Connections

ATTENTION: To avoid shock hazards, lock out incoming power (see Power Lock-out Procedure on page 53) before working on the equipment. Verify with a hot stick or appropriate voltage measuring device that all circuits are voltage free. Failure to do so may result in severe burns, injury or death.

IMPORTANT The current transformers may be positioned for top or bottom cable exit. Follow the appropriate procedure described for your starter configuration.

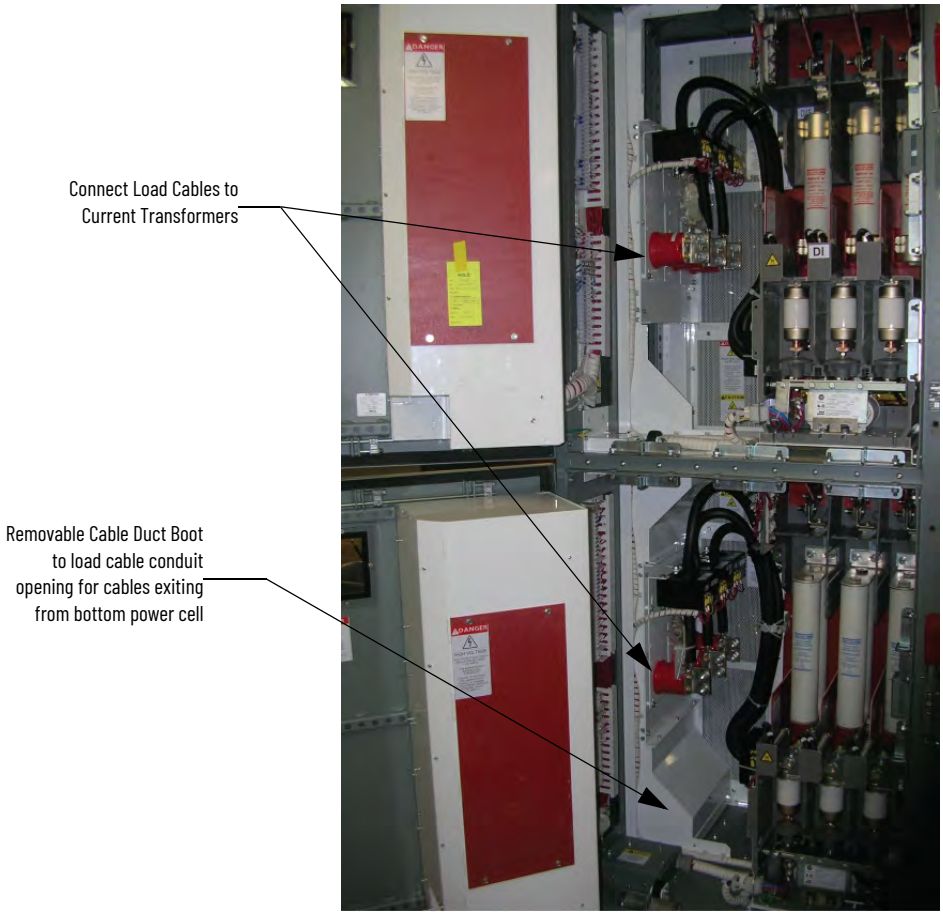
IMPORTANT **For ArcShield units**, cable size should not exceed 1-500 MCM or 2-350 MCM per phase.

Stress cones should be internal non-skirted style only. The use of external style (skirted style) is not recommended due to space considerations.

1. Follow steps 2 to 6 from Front Access – Access to Power Bus on page 36 for the procedure to swing out the low voltage panel.

2. Remove the cable duct boot at the top of the cabinet for top exiting load cables, or remove the one at the bottom of the cabinet for bottom exiting load cables (see Figure 35).

Figure 35 - Access to Load Cable Conduit Openings (Bottom Exit Cable)



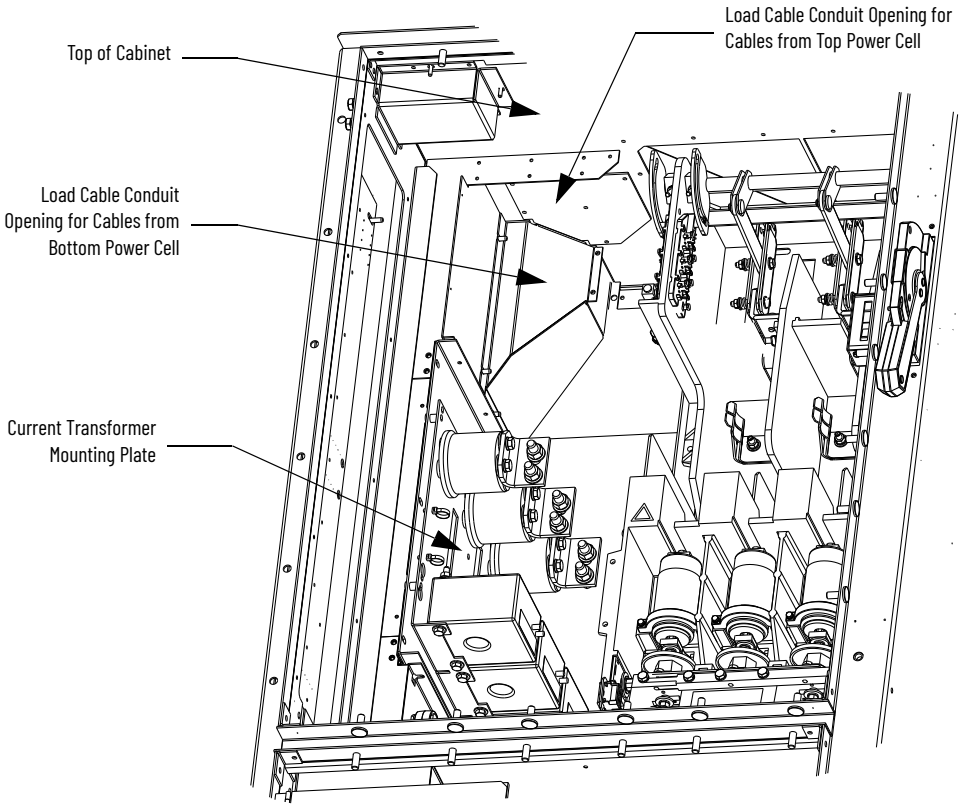
3. Remove the appropriate load cable conduit openings in the top or bottom of the cabinet (see Figure 36 or Figure 37).

Top Exiting Load Cables

Follow steps 1-4 from previous section.

1. Load cables for the bottom power cell should be routed first. Pull the cables into the cabinet through the appropriate opening (see Figure 36).
2. Run the cables behind the current transformer mounting plate and into the bottom power cell.
3. For the top power cell, pull the cables into the cabinet through the appropriate opening (see Figure 36).

Figure 36 - Load Cable Conduit Openings



4. Connect the cables to the current transformers and tighten the connections to 61 N•m (45 lb•ft).
5. Connect cable shields to the ground lug.
6. Reinstall the cable duct boot and reassemble the cabinet.

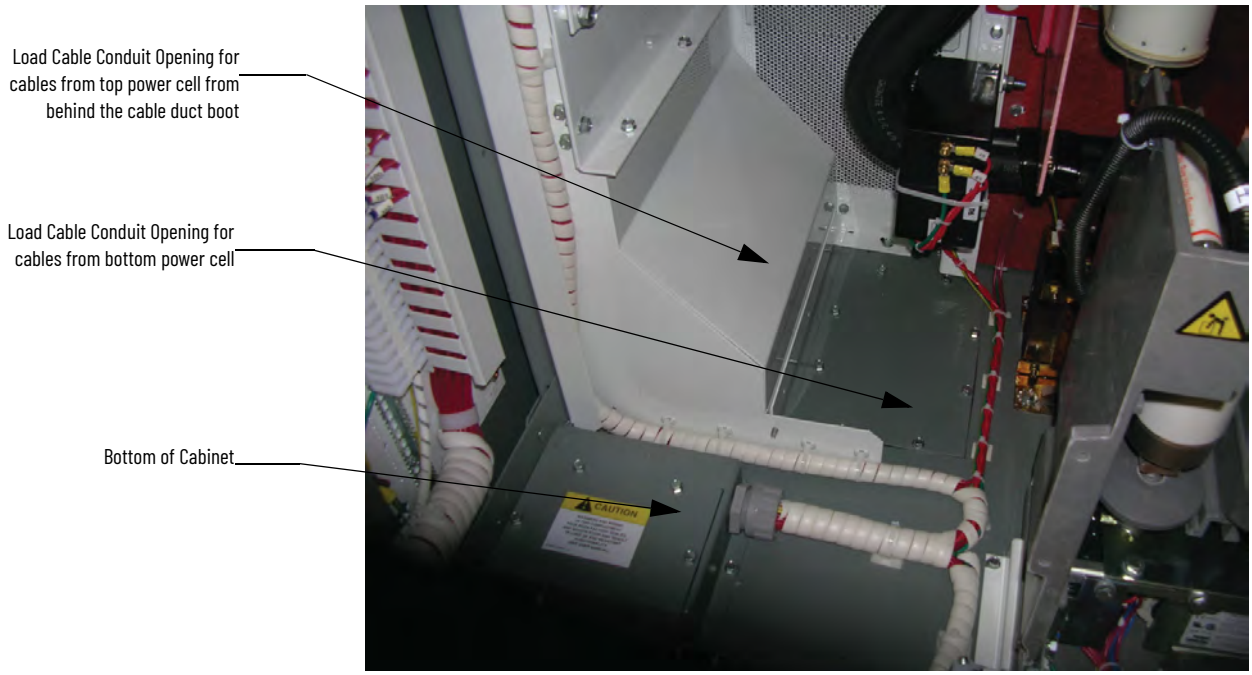
ATTENTION: Ensure all barriers are replaced before re-energizing the equipment. Failure to do so will defeat the structure's arc resistant capabilities and result in electrical faults and cause damage to equipment or serious injury to personnel.

Bottom Exiting Load Cables

Follow steps 1-4 from previous section.

1. Load cables for the top power cell should be routed first. Pull the cables into the cabinet through the appropriate opening (see Figure 37). Run the cables behind the current transformer mounting plate and into the top power cell.

Figure 37 - Load Cable Conduit Openings



2. For the bottom power cell, pull the cables into the cabinet through the appropriate opening (see Figure 37).
3. Connect the cables to the current transformers and tighten the connections to 65 N•m (48 lb•ft).
4. Connect cable shields to the ground lug.
5. Reinstall the cable duct boot and reassemble the cabinet.

ATTENTION: Ensure all barriers are replaced before re-energizing the equipment. Failure to do so will defeat the structure's arc resistant capabilities and result in electrical faults and cause damage to equipment or serious injury to personnel.

Common Installation

Bus Splicing

Power Bus

ATTENTION: This procedure requires contact with medium voltage components. To avoid shock hazards, lock out incoming power before working on the equipment (see Power Lock-out Procedure on page 53). Verify with a hot stick or appropriate voltage measuring device that all circuits are voltage free. Failure to do so may result in severe burns, injury or death.

1. The power and ground bus splice kit can be found in a package mounted to the front of the shipping skid.

   IMPORTANT Verify that the structure series numbers on the splice kit package match the structure series number found on the cabinet nameplate (refer to Starter Identification on page 9 of Chapter 1 for details regarding the nameplate).

2. Refer to Front Access– Access to Power Bus on page 18 of Chapter 1 for either standard or ArcShield enclosure.
3. For a **1200A** power bus, assemble the splice bars as shown in Figure 38. Tighten the nuts to 61 N•m (45 lb•ft).

   For a **2000A** power bus, assemble the splice bars as shown in Figure 39. Tighten the nuts to 61 N•m (45 lb•ft).

   For a **3000A** power bus, assemble the splice bars as shown in Figure 40. Tighten the nuts to 61 N•m (45 lb•ft).

   IMPORTANT Attach the bus links to the cabinet on the left side first - as viewed from the front of the unit.

   IMPORTANT Always place the bus clamps on the rear side of each main horizontal bus or splice bar, as viewed from the front of the unit.

Figure 38 - Typical 1200A Power Bus Splicing Configuration (Viewed from Front)

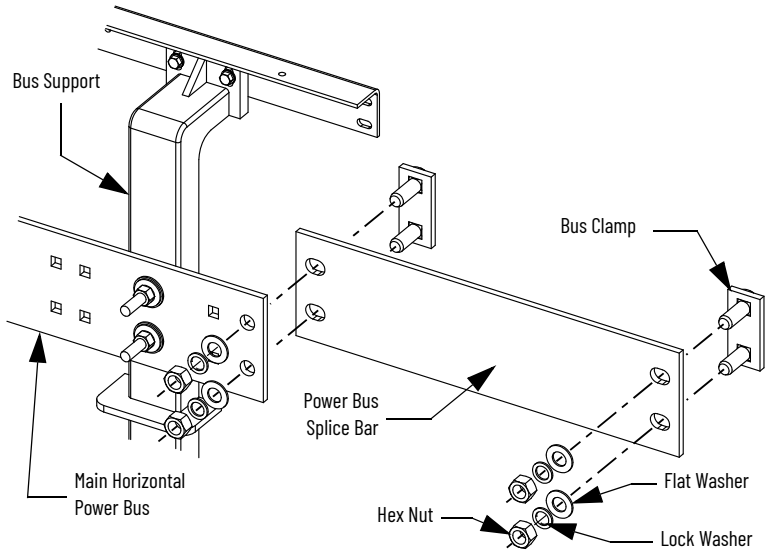


Figure 39 - Typical 2000A Power Bus Splicing Configuration (Viewed from Front)

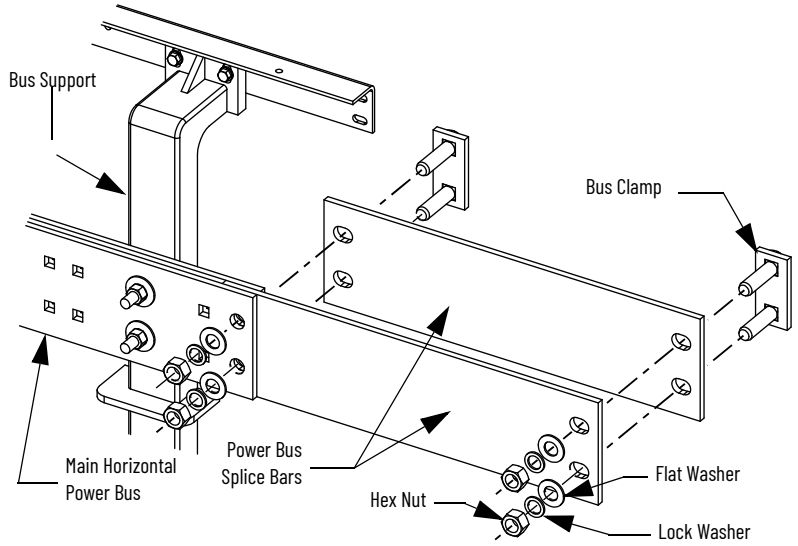
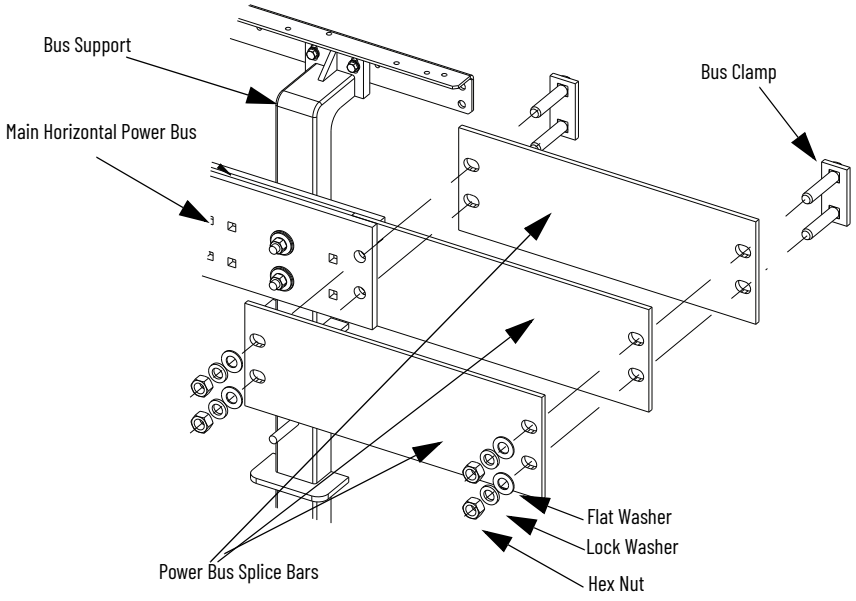


Figure 40 - Typical 3000 A Power Bus Splicing Configuration (Viewed from Front)



ATTENTION: Ensure all barriers are replaced before re-energizing the equipment. Failure to do so may result in electrical faults and cause damage to equipment or severe injury to personnel.

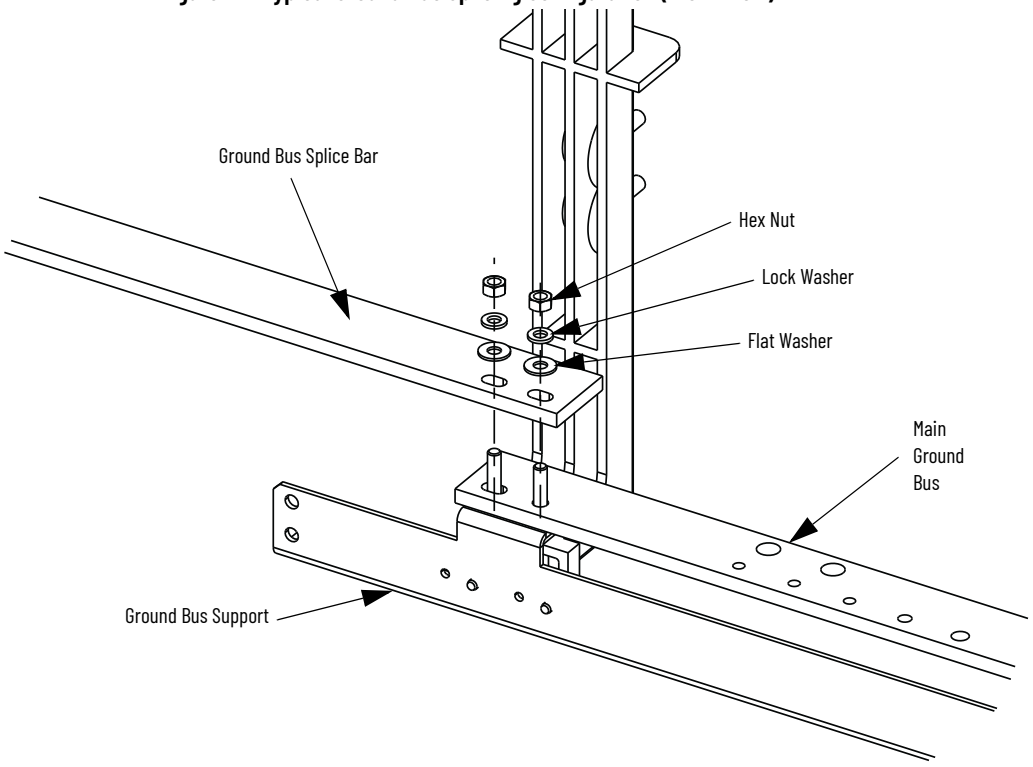
Insulated Power Bus Splicing

If the starter is equipped with insulated power bus, then a splice kit with insulated links, insulating boots and tape will be provided. Refer to the kit for installation instructions.

Ground Bus

1. See Figure 41 to determine the correct ground splice configuration and assemble as shown.
2. Torque the hardware to 14.5 N•m ± 1 N•m (11 lb•ft ± 1 lb•ft).
3. Check all hardware for correct tightness and replace all covers and plates.

Figure 41 - Typical Ground Bus Splicing Configuration (Front View)



ATTENTION: Ensure all barriers are replaced before re-energizing the equipment. Failure to do so may result in electrical faults and cause damage to equipment or severe injury to personnel.

Incoming Line Cable Connections

ATTENTION: To avoid shock hazards, lock out incoming power (see Power Lock-out Procedure on page 53) before working on the equipment. Verify with a hot stick or appropriate voltage measuring device that all circuits are voltage free. Failure to do so may result in severe burns, injury or death.

Incoming cables are connected to the power bus in the last section on the left.

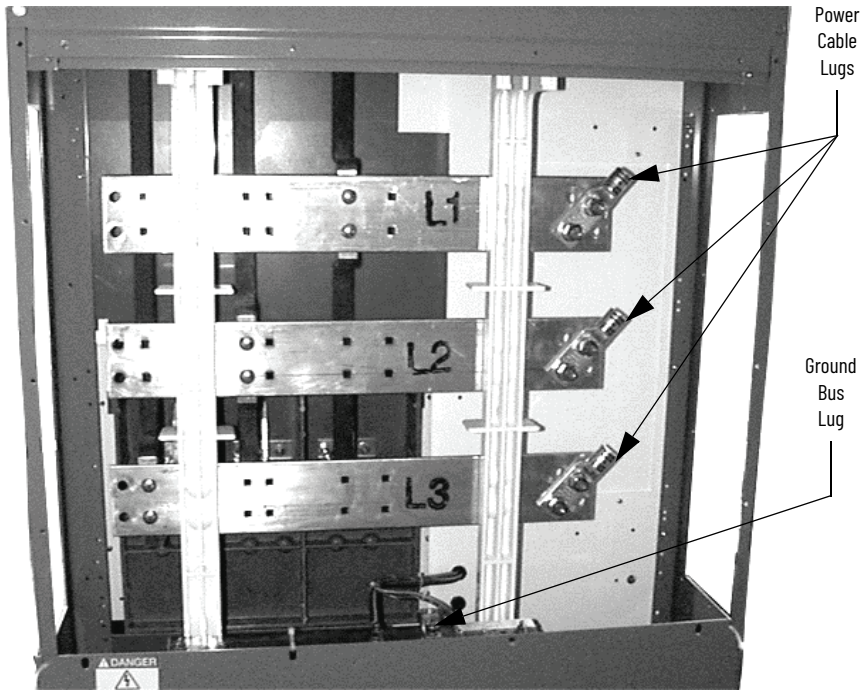
IMPORTANT **For Non-ArcShield units**, cable size should not exceed 1-750 MCM or 2-500 MCM per phase.

For ArcShield units, cable size should not exceed 1-500 MCM or 2-4/0 per phase. For larger cables, an incoming line module must be used.

Stress cones should be internal non-skirted style only. The use of external style (skirted style) is not recommended due to space considerations.

1. Remove the center-back plate or side plate to access the power bus. If access to the rear of the unit is not possible, refer to Front Access– Access to Power Bus on page 18 of Chapter 1 for either standard or ArcShield enclosures.
2. Connect the incoming power lines to the power bus. Torque to specifications (see Recommended Torque Values on page 11) (see Figure 42).

Figure 42 - Incoming Line Cable Connections

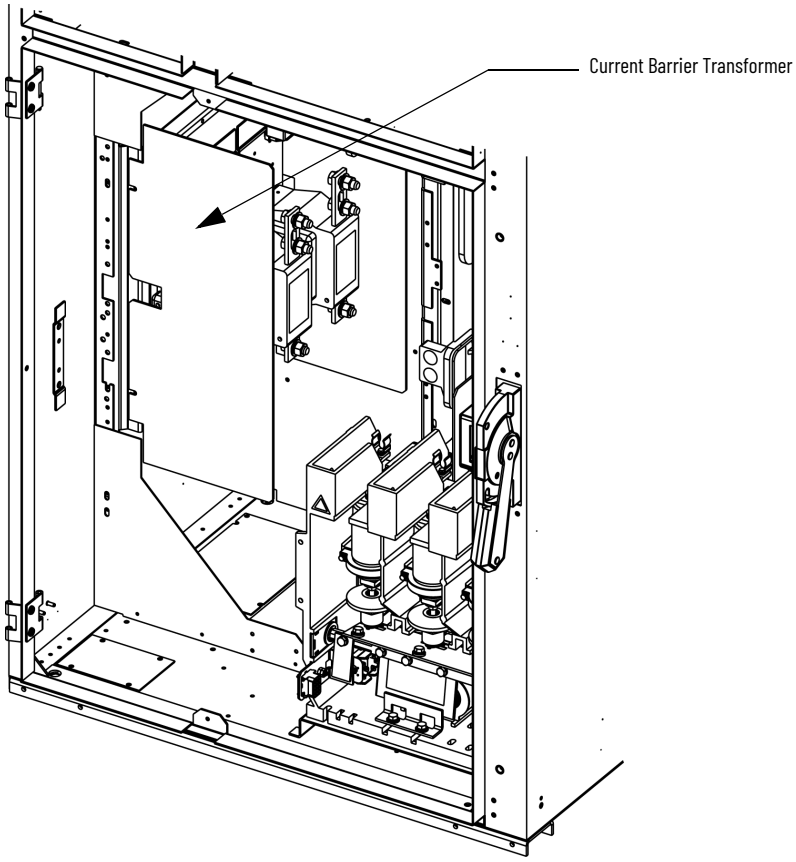


IMPORTANT If line cables require installation by front access, complete the incoming line connection before installing load cables.

3. Connect the ground wire to the ground bus lug.
4. Connect any external control wires to the control panel terminal blocks in the low voltage compartment. Refer to wiring diagram.

Installation of Current Transformer Barrier

Figure 43 - Current Transformer Barrier



ATTENTION: Ensure current transformer barrier is installed before re-energizing the equipment. Failure to do so may result in electrical faults and cause damage to equipment or serious injury to personnel.

Hi-Pot and Insulation Resistance Test

Insulation integrity should be checked before energizing medium voltage electrical equipment. Use a high voltage AC insulation resistance tester (5000V type is recommended).

ATTENTION: Exercise caution when performing high voltage tests on the equipment. Failure to do so may result in electric shock causing severe burns, injury or death.

ATTENTION: Disconnect power factor correction capacitors (if so equipped) before performing the Hi-Pot test. Failure to do so may result in personal injury or damage to the equipment. See Power Lock-out Procedure (see Power Lock-out Procedure on page 53) for information on dissipating any stored power in the capacitors.

ATTENTION: Remove all primary fuses for the control power transformer and/or the potential transformer. Failure to do so may cause damage to the equipment during the Hi-Pot test.

Insulation can be tested from phase to phase and from phase to ground. The recommended level for AC Hi-Pot testing is (2 X V_{LL}) volts, where V_{LL} is the rated line-to-line voltage of the power system. The leakage current must be less than 20 mA. Record the result for future comparison testing.

If an insulation resistance tester is used, it should indicate 50,000 megohms or greater if the unit is isolated from the line and the motor. If the unit is connected to a motor, the insulation resistance tester should indicate 5000 megohms or greater (phase to ground).

Start-up Procedure

Contactor Inspection

See publication 1502-UM060 for information on pre-energization inspection, vacuum bottle integrity test and insulation resistance test.

Preliminary Checks

Verify the following:

- Contactor current and voltage ratings are correct for the attached load;
- Control voltage is correct;
- Settings for protective relays;
- Heater elements (if provided) in overload relay are secure and undamaged;
- Equipment grounding;
- External power and control connections match electrical diagrams;
- All hardware is correctly reinstalled and torqued to specifications (see Recommended Torque Values on page 11);
- All barriers are replaced to correct positions;
- All fuses are correct class, type and rating;
- Mechanical interlocks and isolation switch function properly;
- Ensure that any microprocessor-based protection relay is programmed;
- Interior of cabinet is free from dirt, loose bolts, tools or metal chips. Vacuum clean if necessary;
- All tools are accounted for. If you cannot locate a tool, do not energize the unit until it is found.

Testing Contactor Operation

1. Connect the appropriate external power supply (120 or 230V AC) to the test receptacle in the control panel. Turn the selector switch to the TEST position.

ATTENTION: Some control circuit configurations may require control jumpers to let the contactor close during the test procedure. Do not jumper any isolation switch contacts such as ISa or ISb (see Figure 65 on page 69 for the location of these contacts). Using jumpers for these contacts may result in equipment damage or injury to personnel.

2. Electrically operate the contactor several times. Inspect the armature plate to verify that it fully contacts the magnetic cores.
3. Turn the selector switch to the OFF position and unplug the test voltage.
4. Remove any metal filings or loose hardware from around the magnetic cores of the vacuum contactor. The debris is attracted to the coil once it is energized and could prevent the contactor from closing properly.

Typical Wiring Diagrams

Figure 44 - Typical Wiring Diagram: Electrically Held Vacuum Contactor (Relay Control)

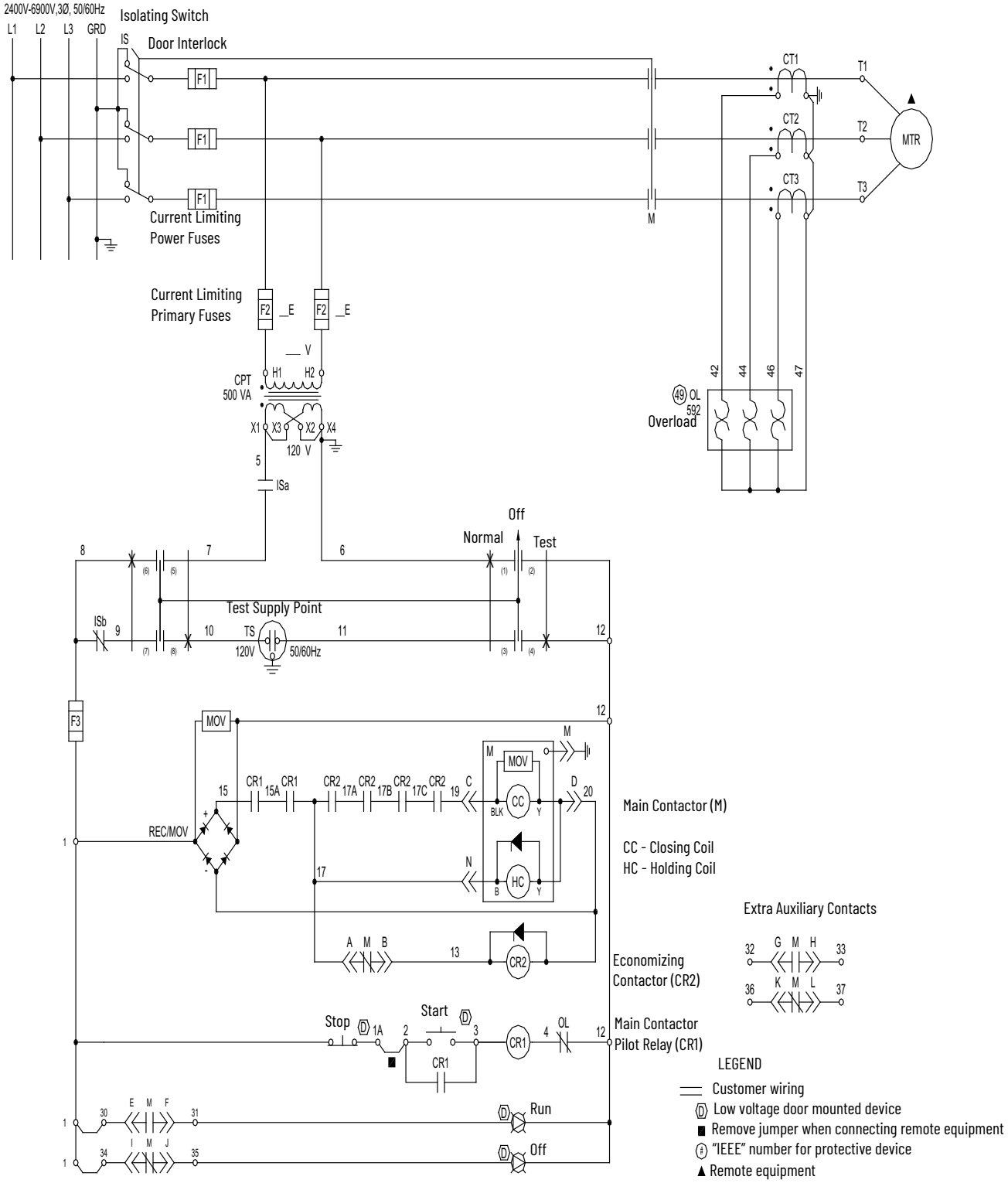
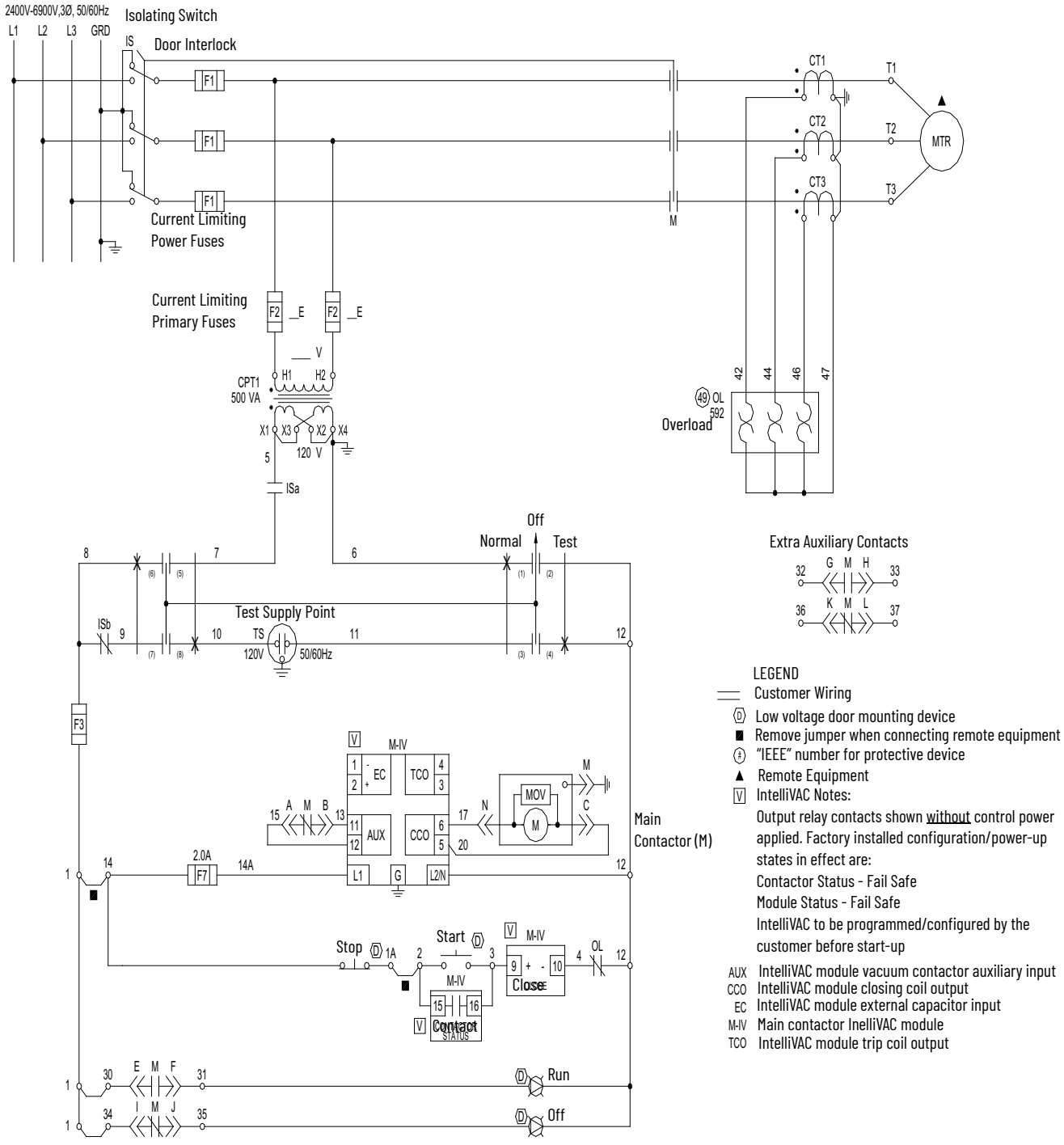


Figure 45 - Typical Wiring Diagram: Electrically Held Vacuum Contactor (*with* IntelliVAC Control)



Maintenance

ATTENTION: Use suitable personal protective equipment (PPE) per local codes or regulations. Failure to do so may result in severe burns, injury or death.

IMPORTANT Establish a maintenance and inspection schedule for the equipment. Annual servicing, or every 20,000 operations (whichever comes sooner) is the minimum recommended. Extreme operating conditions may warrant additional attention.

Tool Requirements

IMPORTANT Some components of this product incorporate Imperial hardware. Rockwell Automation recommends the use of the appropriate tools to successfully complete the maintenance procedures on these components. If you cannot obtain such tools, contact your area Rockwell Automation sales office for assistance.

- Torque wrench: 0...65 N•m (0...48 lb•ft)
- Sockets: 3/8 in., 7/16 in., 9/16 in., 3/4 in. and 7/8 in.
- Ratchet handle and extension
- Wrenches: 7/16 in., 1/2 in., 9/16 in., 3/4 in. and 7/8 in.
- Feeler gauges: 1.3 mm (0.050 in.), 2 mm (0.080 in.), 0.5 mm (0.020 in.)
- Flat-blade screwdriver
- Nyogel 759G/760G Lubricant, Rockwell Automation part no. 80158-357-51

Recommended Torque Values

When reinstalling components, or when reassembling the cabinet, tighten the following bolt sizes to the specified torque values:

Table 2 - Hardware Torque Values

1/4 in. hardware	8 N•m (6 lb•ft)
5/16 in. hardware	14.5 N•m (11 lb•ft)
3/8 in. hardware	27 N•m (20 lb•ft)
1/2 in. hardware	61 N•m (45 lb•ft)

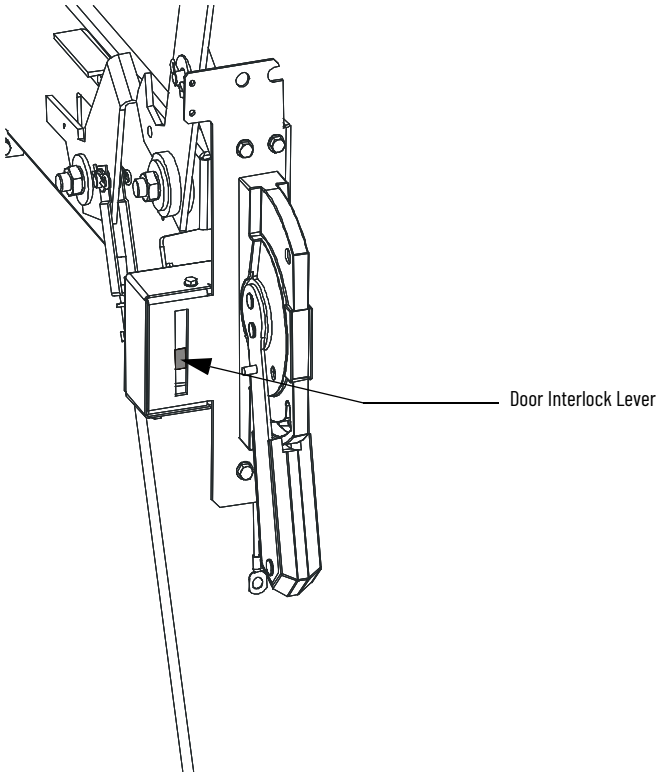
Door Interlock Circumvention

ATTENTION: The door interlock mechanism is designed to prevent access to the medium voltage cell while the unit is energized. When the unit is in operation, do not circumvent this interlocking safety feature. Always disconnect and lock out incoming power (refer to Power Lock-out Procedure on page 53) before proceeding with any adjustments requiring the handle to be moved to the ON (closed) position. Failure to do so may result in electric shock causing severe burns, injury or death.

Some of the following sections may require moving the isolation switch handle to the ON position while the medium voltage door is open. The interlocking safeguards in the mechanism are designed to prevent the handle from moving to the ON position while the cabinet door is open.

- To circumvent this safety feature, use a screwdriver, or other tool, to depress the door interlock lever in a downward movement.
- Hold the lever down while moving the handle to the ON (closed) position.

Figure 46 - Door Interlock Lever



ATTENTION: Use suitable personal protective equipment (PPE) per local codes or regulations. Failure to do so may result in severe burns, injury or death.

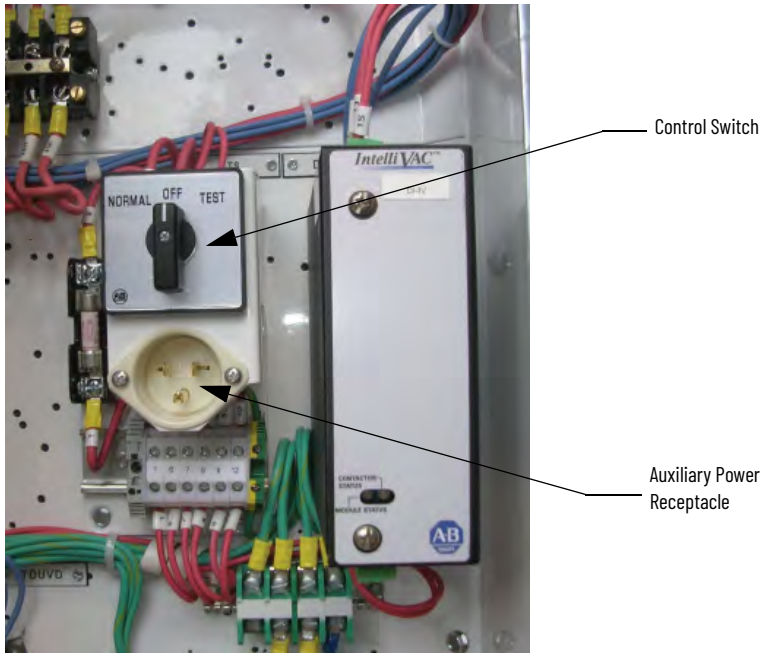
ATTENTION: Always perform the Power Lock-out procedure before servicing the equipment. Failure to do so may result in severe burns, injury or death.

Power Lock-out Procedure

ATTENTION: The following procedure requires moving the isolation switch handle to the ON position. To avoid shock hazards, disconnect and lock out incoming power before proceeding with servicing the equipment.
Failure to lock out incoming power will result in a live power cell once the isolation switch handle is in the ON position and may cause severe burns, injury or death. Rockwell Automation does not assume any responsibility for injuries to personnel who have not completed the following safety procedure prior to servicing the equipment.

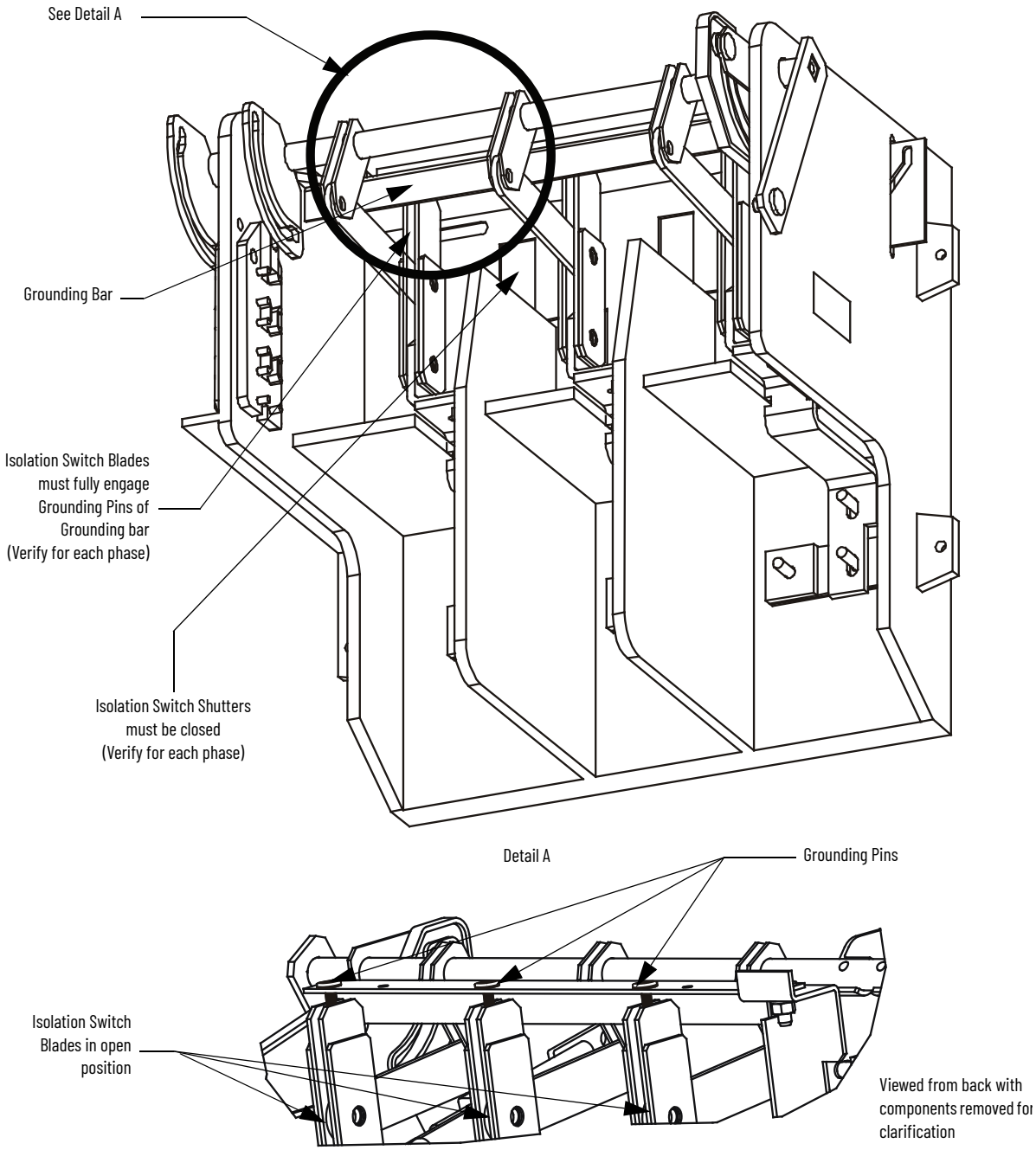
1. Disconnect and lock out all feeder power supplies to the starter.
2. Move the isolation switch handle to the OFF position.
3. If the unit is equipped with power factor correction capacitors, stored energy must be dissipated before entering the power cell. Wait at least five minutes before entering the power cell or dissipate the power using the following procedure:
   a. Verify that the isolation switch handle is in the OFF position.
   b. Open the low voltage door.
   c. Connect the appropriate power supply (120 or 230V) into the auxiliary control power circuit as shown on the electrical drawing (see Figure 47).
   d. Move the control switch to the TEST position.

Figure 47 - Control Panel (IntelliVAC Control)



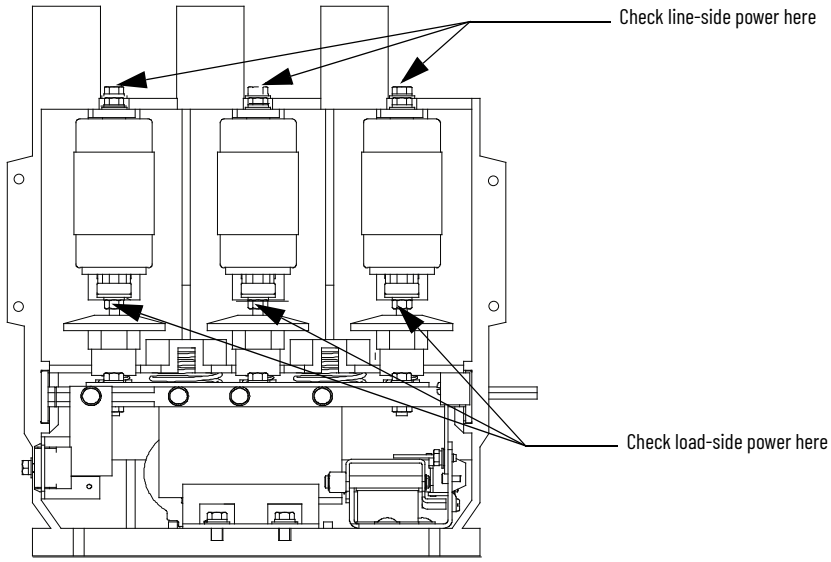
   e. Electrically operate the contactor by pushing the START button on the unit or at a remote location.
   f. Disengage the contactor and move the control switch to the OFF position. Disconnect the external power supply.
   g. Complete the Power Lock-out procedure
4. Open the medium voltage door.
5. Visually inspect that the isolation switch blades fully engage the grounding pins on the grounding bar. The isolation switch shutters should be closed (see Figure 48).

Figure 48 - Inspecting Isolation Switch in Open Position



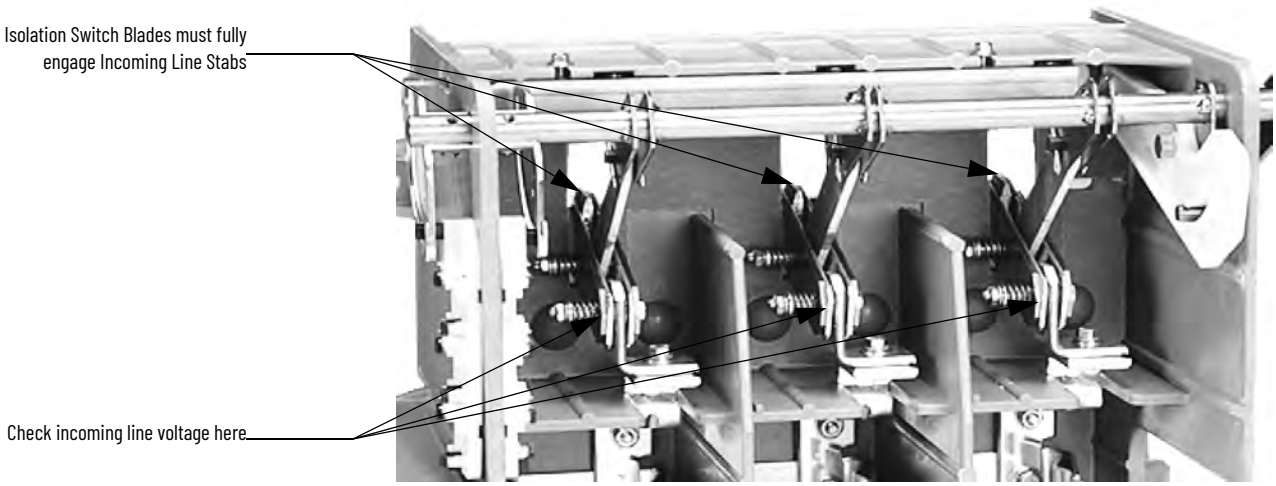
6. Check the line and load sides of the contactor with a hot stick or appropriate voltage measuring device for the system voltage, to verify that they are voltage free (see Figure 49).
   a. Check for line-side voltage at the top vacuum bottle terminals.
   b. Check for load-side voltage at the bottom vacuum bottle terminals.

Figure 49 - Contactor Voltage Checkpoints



7. Use the Door Interlock Circumvention procedure (refer to Door Interlock Circumvention on page 52) to move the isolation switch handle to the ON position.
8. Check the isolation switch blades with a hot stick or appropriate voltage measuring device for the system voltage, to verify that they are voltage free (see Figure 50).

Figure 50 - Isolation Switch Voltage Check Points

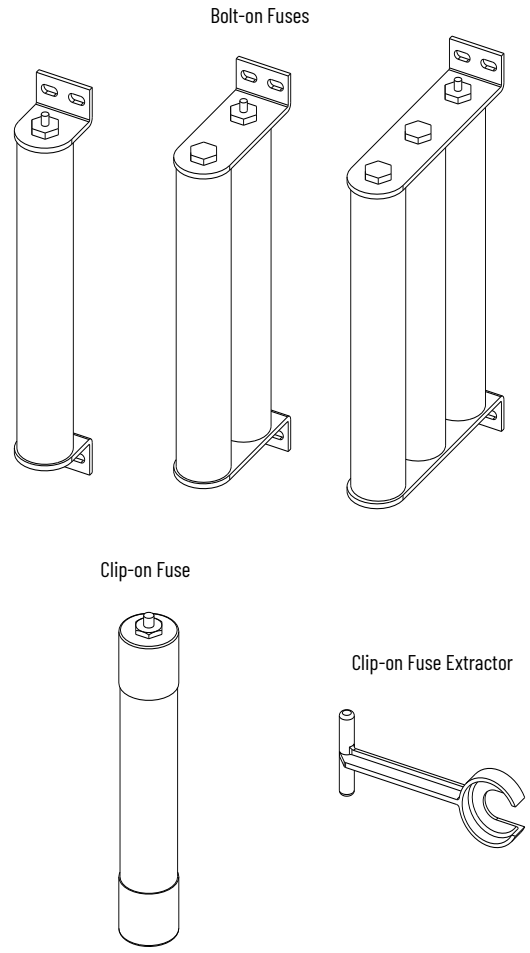


9. Once all power circuits are verified to be voltage free, move the isolation switch handle back to the OFF position. The unit is now safe to service.

Fuse Removal and Replacement

ATTENTION: Only personnel who have been trained and understand the Bulletin 1500 product line are to work on this equipment. Suitable safety equipment and procedures are to be used at all times.

Figure 51 - Medium Voltage Power Fuses



ATTENTION: Servicing energized industrial control equipment can be hazardous. Severe injury or death can result from electrical shock, burn, or unintended actuation of control equipment. Hazardous voltages may exist in the cabinet even with the circuit breaker in the OFF position. Recommended practice is to disconnect or lock out control equipment from power sources, and confirm discharge of stored energy in capacitors. If it is necessary to work in the vicinity of energized equipment, the safety related work practices of NFPA 70E, Electrical Safety requirements for Employee Work places, must be followed.

ATTENTION: To prevent electrical shock, ensure the main power has been disconnected and equipment has been tagged and locked out. Verify that all circuits are voltage free using a hot stick or appropriate voltage-measuring device. Failure to do so may result in injury or death.

The main power fuse has a pop up indicator pin located at one end of the fuse. When a fuse has opened, the indicator will be in its extended position. The fuse should be oriented in the fuse clip assembly so that the indicator is at the top.

ATTENTION: The fuses may be hot for up to one hour after operating. Verify the temperature before handling and use insulated hand protection if needed. Failure to do so may result in burns.

Bolt-on Fuse Removal/Installation

Tools required: 3/8-in. drive ratchet, 2-in. extension, 6-in. extension, 12-in. extension, 1/2-in. socket, 3/8-in. drive torque wrench.

The fuse configuration will determine what length of extension will be required to get at the mounting hardware. The fuse configuration will also determine what size of interphase barriers are installed, the lower barriers can be removed to provide better access to the fuse mounting nuts.

1. Remove the two lower mounting nuts, lock and flat washers from the mounting studs.
2. Remove the upper two mounting nuts, lock and flat washers from the mounting studs and remove the fuse from the fuse mounting studs.
3. Install the replacement fuse on the four mounting studs, hold the fuse in place and install the upper two flat washers, lock washers and nuts. Torque nuts to 14.5 N•m (11 lb•ft).
4. Install the lower two flat washers, lock washers and nuts. Torque nuts to 14.5 N•m (11 lb•ft).
5. If interphase barriers were previously removed ensure they are properly reinstalled.

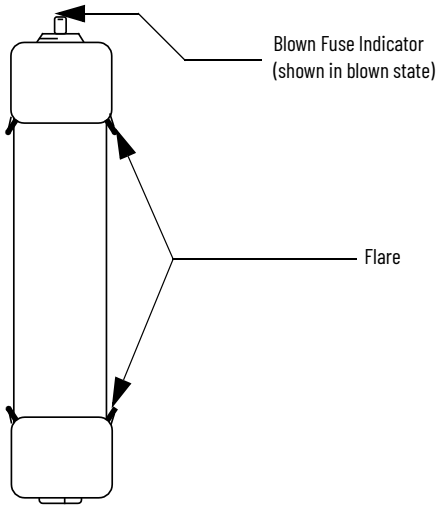
Clip-on Fuse Removal/Installation

Recommended tool: Fuse extractor part # 80144-491-02 (optional)

The interphase barriers located at the bottom of the fuse assembly can be removed to ease the removal and installation of the fuse.

1. Place the cup section of the fuse extractor over the top of the fuse.
2. Pull back on fuse extractor with a quick motion to dislodge the upper portion of the fuse from top fuse clip.
3. Set fuse extractor aside.
4. Remove the lower portion of the fuse from fuse clip by pulling up and slightly rotating the fuse in one entire movement.
5. To install the replacement fuse, place the fuse between the fuse clips.
6. Ensure that the flares on the fuse ferrules are properly located with respect to the fuse clips.
7. Apply a rapid shove to the bottom portion of the fuse barrel to force the fuse into the clip.
8. Apply a rapid shove to the top portion of the fuse barrel to force the fuse into the clip.
9. Grip center of fuse barrel with both hands and apply slight back and forward force to ensure fuse has been properly seated in the fuse clips.
10. Again check and verify that the flares at the top and bottom of the fuse are not in the contact area of the fuse clip.
11. If interphase barriers were previously removed ensure they are properly reinstalled.

Figure 52 - Clip-on Style Medium Voltage Power Fuse



Contactor Maintenance

Refer to publication 1502-UM060 for contactor maintenance instructions.

Removing the Contactor

ATTENTION: To avoid shock hazards, lock out incoming power (refer to Power Lock-out Procedure on page 53) before working on the equipment. Verify with a hot stick or appropriate voltage measuring device that all circuits are voltage free. Failure to do so may result in severe burns, injury or death.

1. Complete the Power Lock-out Procedure (refer to Power Lock-out Procedure on page 53).
2. Disconnect the control wiring harness from the wire plug at the lower left side of the contactor (See Figure 53)
3. Remove the control power transformer primary fuses from the top of the contactor.
4. Disconnect the control power transformer primary leads from the fuse terminals at the top of the contactor.
5. Use a 9/16-in. socket wrench to disconnect the power cables and bus bars from the rear of the contactor.
6. Remove the nylon contactor bushing 1/4-20 retaining-screw (12 lb•ft [15 N•m]) retaining screw from the contactor interlock lever.
7. Slide the contactor interlock rod and the nylon contactor bushing out of the groove in the contactor interlock lever (see Figure 54).

Figure 53 - Removing the Contactor (Front view)

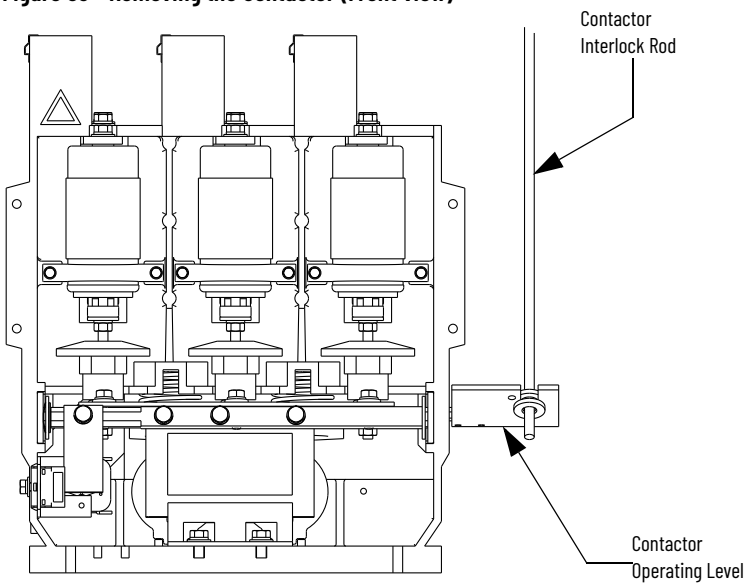
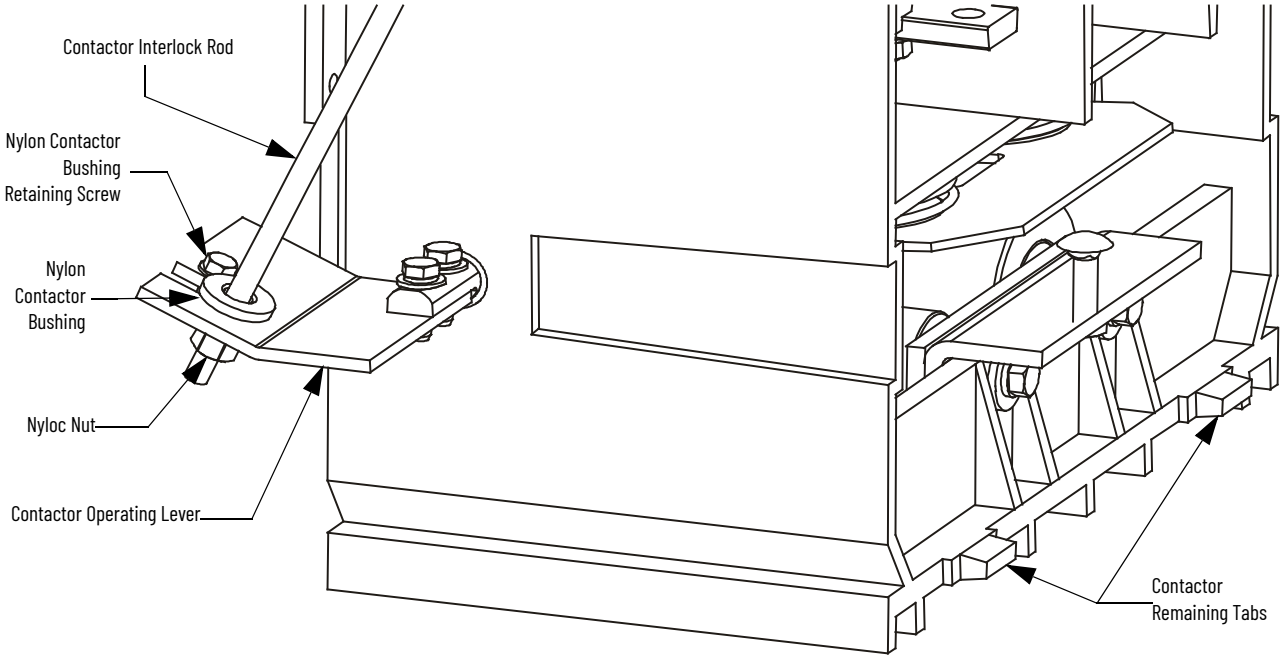


Figure 54 - Removing the Contactor (Right-side view)



8. Remove the two 5/16-18 contactor mounting bolts (11 lb•ft [14.5 N•m]) at the front of the contactor.
9. Slide the contactor forward slightly to disengage the retaining tabs at the rear of the contactor from the mounting bracket inside the cabinet.
10. Carefully remove the contactor from the cabinet.

ATTENTION: The contactor weighs approximately 22 kg (50 lb) and assistance may be required to safely remove it from the cabinet and transport it. Failure to use caution when moving the contactor may result in equipment damage and/or personal injury.

11. If the contactor is being replaced with a new one, move the contactor interlock lever to the new contactor.

ATTENTION: The retaining screw is **critical** to the mechanical integrity of the isolation switch. It is very important to ensure this screw is replaced during reassembly.

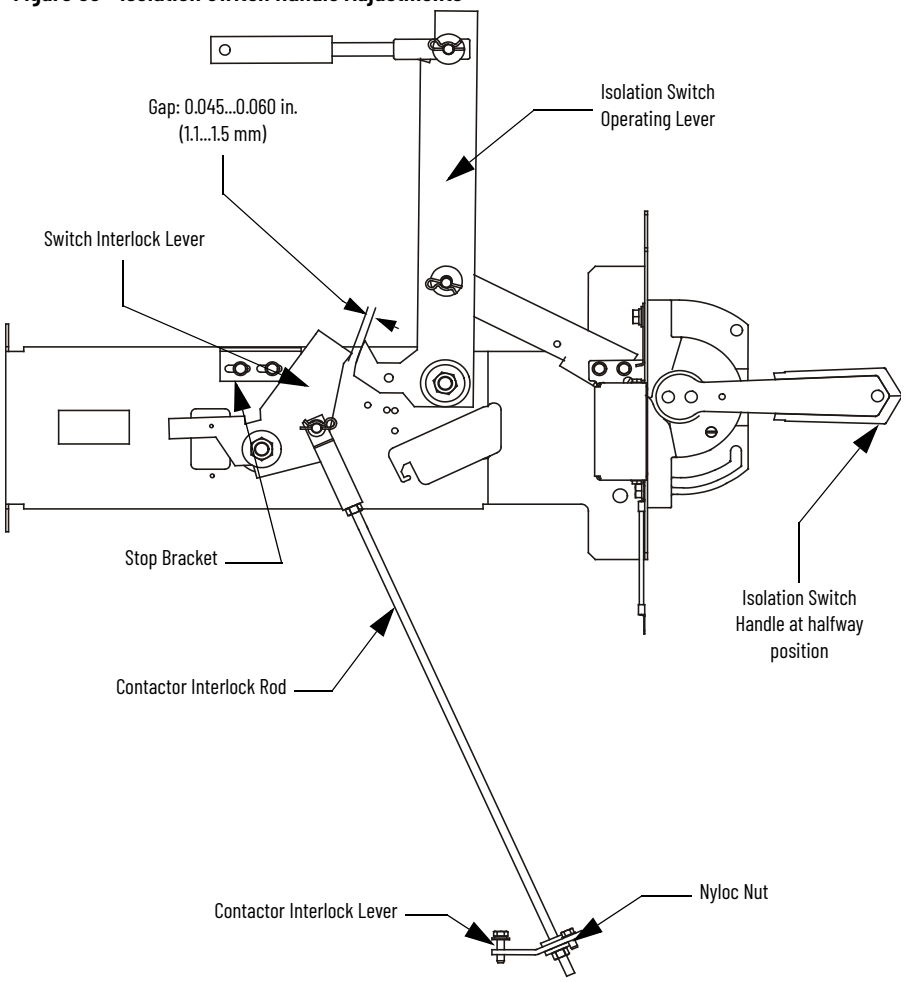
12. To reinstall the contactor, reverse the procedure. Make sure the mounting bolts (11 lb•ft [14.5 N•m]), power cable hardware (45 lb•ft [61 N•m]), and bus bar hardware (45 lb•ft [61 N•m]) is properly torqued.
13. Adjust the contactor interlock rod according to the Contactor Interlock Rod Adjustment procedure (refer to Contactor Interlock Rod Adjustment on page 60).

Contactor Interlock Rod Adjustment

ATTENTION: To avoid shock hazards, lock out incoming power (refer to Power Lock-out Procedure on page 53) before working on the equipment. Verify with a hot stick or appropriate voltage measuring device that all circuits are voltage free. Failure to do so may result in severe burns, injury or death.

1. Complete the Power Lock-out Procedure (refer to Power Lock-out Procedure on page 53).
2. Open the medium voltage door. Use the Door Interlock Circumvention procedure (refer to Door Interlock Circumvention on page 52) to move the isolation switch handle halfway between the OFF and ON position (see Figure 55). Keep the handle in this position until the adjustment procedure is completed.
3. With the contactor in the OFF position, insert a 1.5 mm (0.060 in.) feeler gauge in the gap between the interlock lever and the isolation switch operating lever. The gap must be between 1.0 mm to 2.0 mm (0.039 in. to 0.078 in.).
4. To reduce the gap distance, follow steps 5...7.
   To increase the gap distance follow steps 8...10.

Figure 55 - Isolation Switch Handle Adjustments



To Reduce the Gap Distance

5. Loosen the two screws in the stop bracket and move the stop bracket up against the interlock lever.
6. With the feeler gauge positioned in the gap, move the interlock lever and the stop bracket closer to the isolation switch operating lever to reduce the gap space.
7. Tighten the 1/4-20 in. stop bracket screws (12 lb•ft [15 N•m]).
8. Tighten the nyloc nut until it is snug against the contactor interlock lever. Do not overtighten the nyloc nut as it will move the interlock lever and reduce the gap. Proceed to Step 11.

To Increase the Gap Distance

9. Loosen the two screws in the stop bracket and move the stop bracket away from the interlock lever.
10. Loosen the nyloc nut until the gap reaches the desired size.
11. Move the stop bracket until it just touches the interlock lever and tighten the screws.
12. Apply Loctite 290 (or equivalent adhesive) to the 1/4-20 in. stop bracket screws and torque the screws to 12 lb•ft (15 N•m).
13. Move the isolation switch handle to the ON position.

14. Manually close the contactor by attaching locking pliers to the contactor operating lever and pushing down until the armature plate contacts the magnetic cores (see Figure 56). Verify that the interlock lever overlaps the isolation switch operating lever by at least 3 mm (0.125 in.) (see Figure 57).

Figure 56 - Closing Contactor Manually (Some parts not shown)

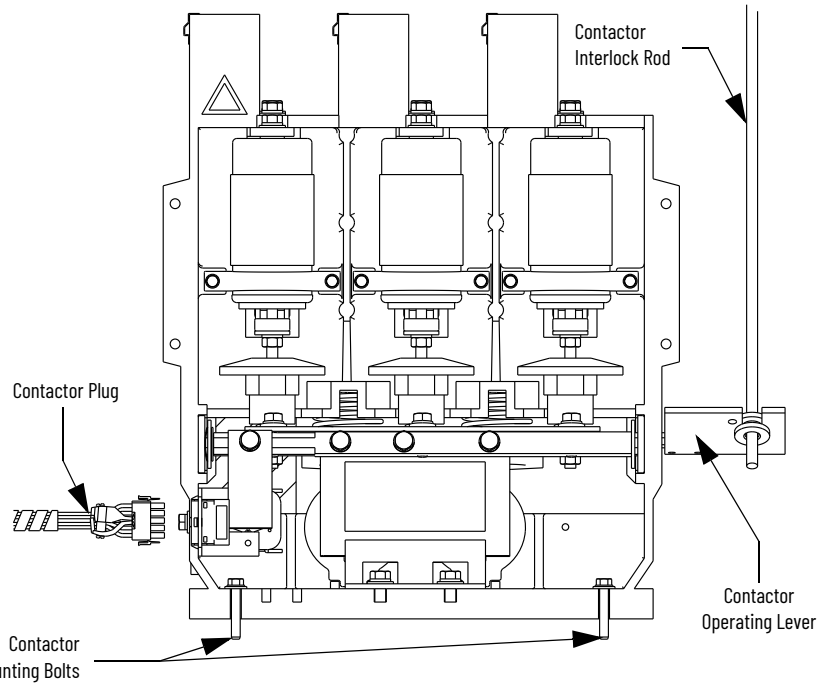
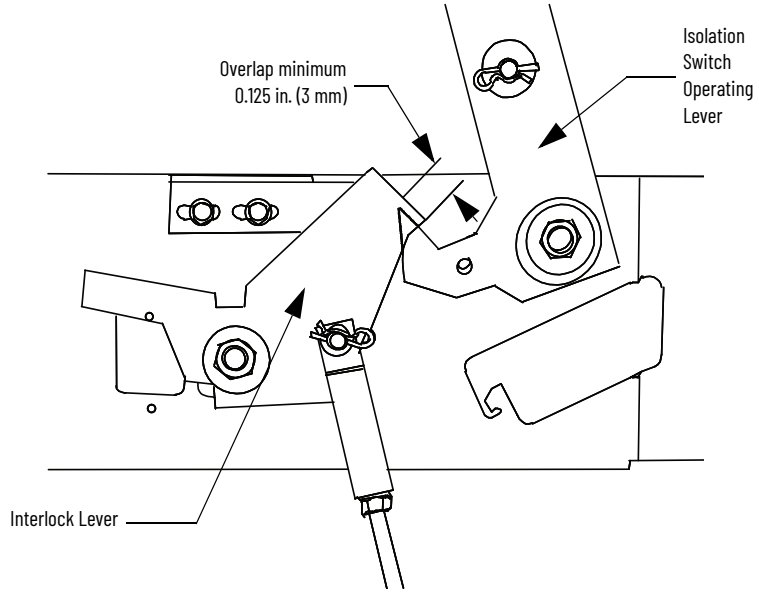


Figure 57 - Isolation Switch Operating Lever Overlap



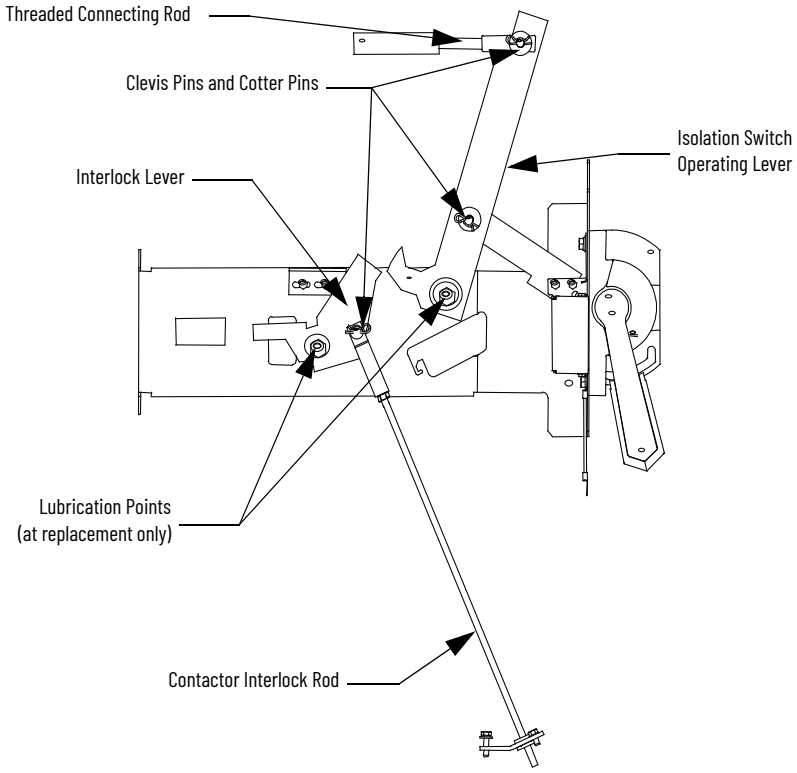
15. Open the contactor. Verify that the interlock lever and the rod move freely and that the return springs move the assembly back to the starting position.

Isolation Switch Mechanism Inspection and Maintenance

ATTENTION: To avoid shock hazards, lock out incoming power (refer to Power Lock-out Procedure on page 53) before working on the equipment. Verify with a hot stick or appropriate voltage measuring device that all circuits are voltage free. Failure to do so may result in severe burns, injury or death.

1. Complete the Power Lock-out Procedure (refer to Power Lock-out Procedure on page 53).
2. Open the medium voltage door.
3. Inspect the condition of the clevis pin and cotter pins shown in Figure 58. Replace any worn parts.
4. If it is necessary to replace the isolation switch operating lever or the interlock lever, apply Dow Corning 55 O-ring lubricant (Rockwell Automation part no. RU-8216, or equivalent) to the pivot points before installing the new components (see Figure 58).

Figure 58 - Isolation Switch Handle Mechanism Lubrication Points



5. Inspect the mounting hardware on the isolation switch operating lever and contactor interlock rod (see Figure 58). Tighten any loose hardware.
6. If an infrared window is available, complete the following steps (during normal equipment run mode):
   a. Using a thermal camera, measure the temperature of the isolation switch at least every 6 months.
   a. Monitor every reading and record temperature variations.

   Temperatures above 100 °C (212 °F) is cause for concern. See Recommended Corrective Action on page 64.

7. If an infrared window is not available, complete the following steps:
   a. Perform a visual inspection of the isolation switch.

   Look for dried, dark-colored, hardened grease or pitting on the incoming line stabs.

   A healthy isolation switch has a thin layer of clear lubricant.

   ATTENTION: Do not add grease. Do not remove existing grease and apply a different lubricant.

   b. Using a micro-ohmmeter, take resistance measurements as close as possible to the isolation switch and load connections (from the main power bus to the top of the power fuses).

   Measurements greater than 150 μΩ will prompt hardware changes. See Recommended Corrective Action on page 64.

Recommended Corrective Action

1. Replace all three movable blades.
   - 400/600 A isolation switch: torque to 11 ft•lb (14.9 N•m)
   - 800 A isolation switch: torque to 19 ft•lb (25.8 N•m)
2. If there is hardened, dark colored grease or pitting on the isolation switch terminals, replace the incoming line stabs.

   Pitting can indicate incorrect adjustment of the isolation switch auxiliary switches.

Contact technical support for assistance.

Isolation Blade Switch Adjustment

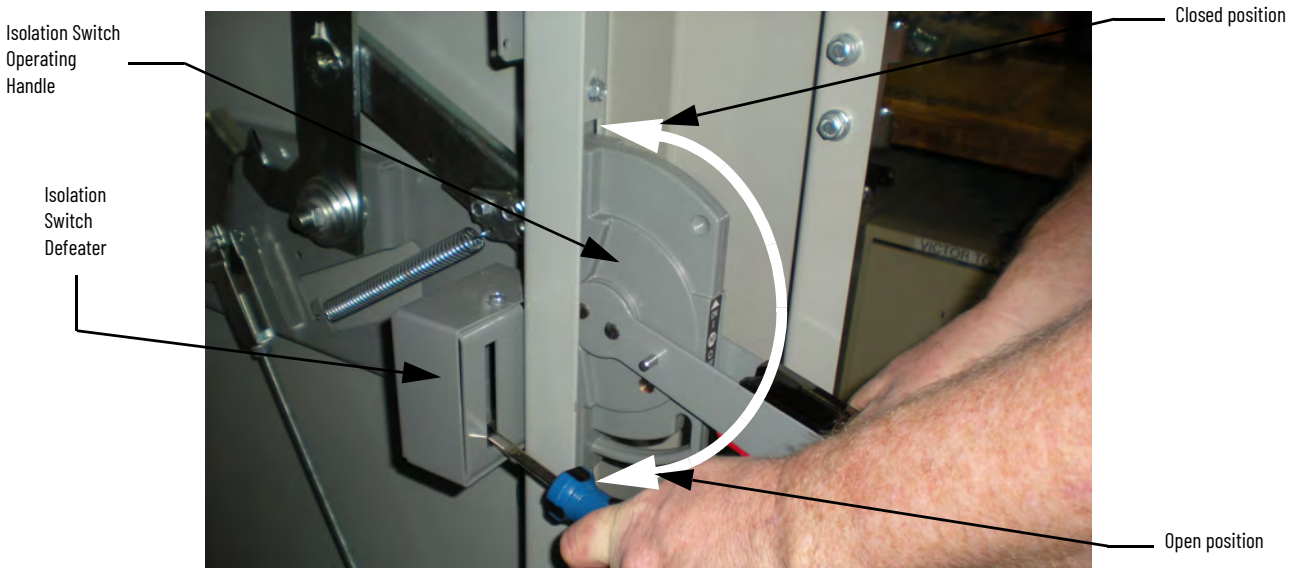
ATTENTION: Complete the Power Lockout procedure of the main power bus before servicing equipment. Verify with a hot stick or appropriate voltage measuring device that all circuits are voltage free. Failure to do so may result in severe burns, injury, or death.

WARNING: Use suitable personal protective equipment (PPE) per local codes or regulations. Failure to do so may result in severe burns, injury, or death.

1. Insert a screwdriver in the Isolation Switch Defeater, push down and hold at the bottom position.
2. Actuate the Isolation Switch Operating Handle from Open (black) to Closed (red) in a continuous movement.

   Do not use excessive force or speed in closing the switch. This will cause an incorrect test result.

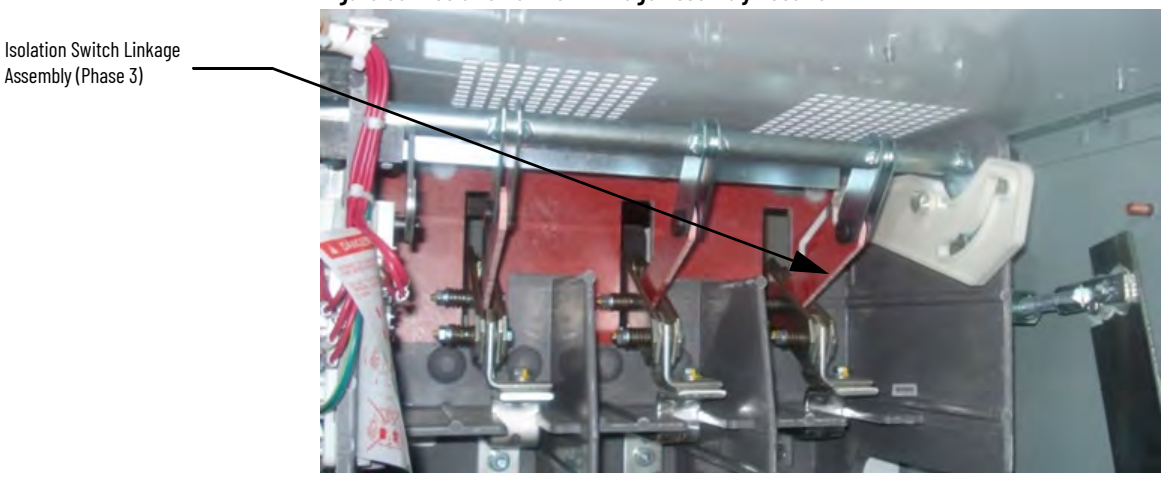
Figure 59 - Isolation Switch Defeater



3. Phase 3 (far right linkage) must be measured for overall travel.

   All three phases share the same main actuating shaft but the Phase 3 is the easiest to measure.

Figure 60 - Isolation Switch Linkage Assembly Location

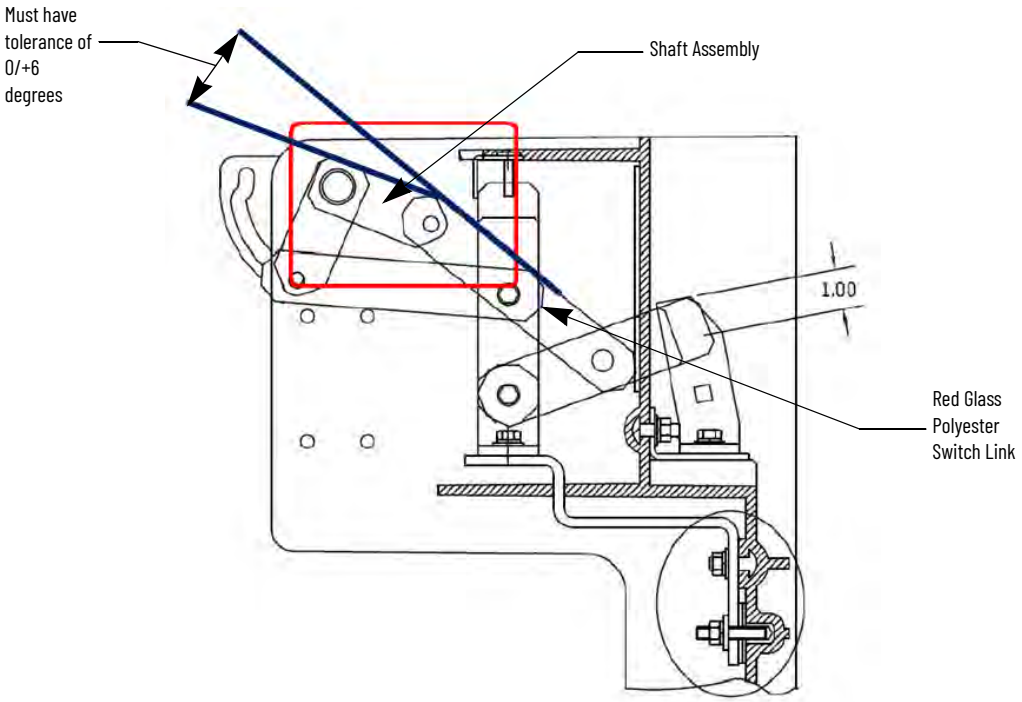


4. Rest the customer-supplied digital protractor on the bottom of the isolation switch linkage assembly.

   The angle of the linkage must be 180° or slightly higher, with a tolerance of 0/+6 degrees.

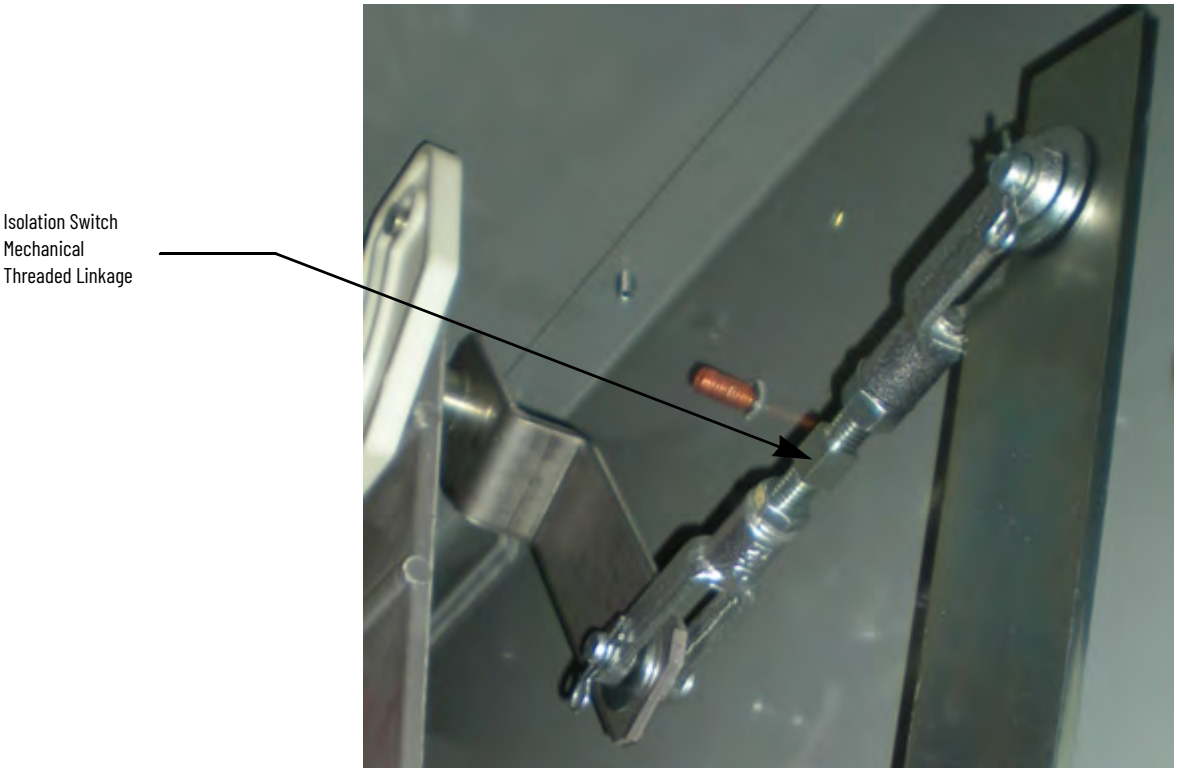
If a digital protractor is unavailable, lay a straight edge against the bottom of the steel lever on the operating shaft to check for parallel alignment of the red link.

Figure 61 - Isolation Switch Linkage Assembly Angle Location



5. Loosen the lock nuts at each clevis (Note: one is a left-handed thread).
6. Adjust the isolation switch mechanical threaded linkage with a wrench until the overall travel angle of the switch link is within the required tolerance.
7. Hold the position of the threaded linkage and tighten the lock nuts.

Figure 62 - Isolation Switch Mechanical Threaded Linkage



8. Actuate the Isolation Switch handle to verify the travel angle.

If the angle is incorrect, repeat steps 5 through 7 until desired travel angle is reached.

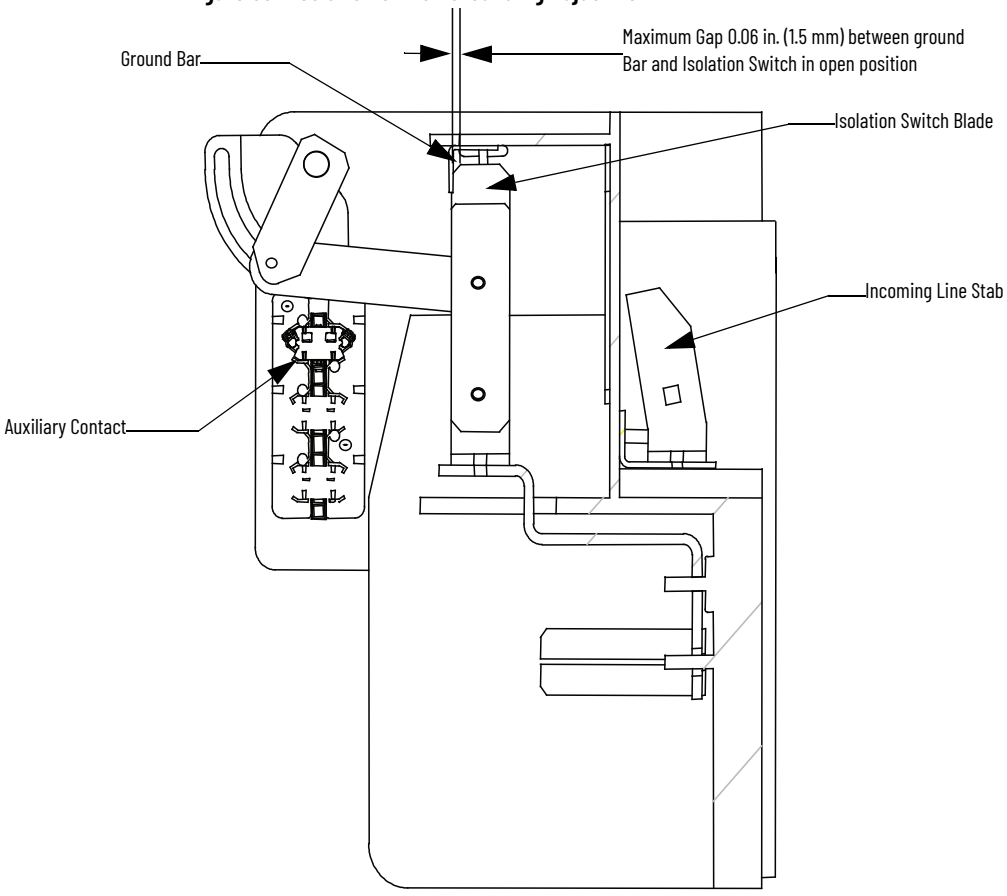
ATTENTION: All three isolation switch linkage assemblies must meet the angle tolerance requirements.

Isolation Switch Mechanism Grounding Adjustment

ATTENTION: To avoid shock hazards, lock out incoming power (refer to Power Lock-out Procedure on page 53) before working on the equipment. Verify with a hot stick or other appropriate voltage measuring device that all circuits are voltage free. Failure to do so may result in severe burns, injury or death.

1. Complete the Power Lock-out Procedure (refer to Power Lock-out Procedure on page 53).
2. Inspect the grounding of the isolation switch blades. When the isolation switch handle is in the OFF position, the isolation switch blades must fully engage the grounding pins and be within 1.5 mm (0.06 in.) of the ground bar (see Figure 63). When the isolation switch handle is in the ON position, the blades must fully engage the incoming line stabs.

Figure 63 - Isolation Switch Grounding Adjustment



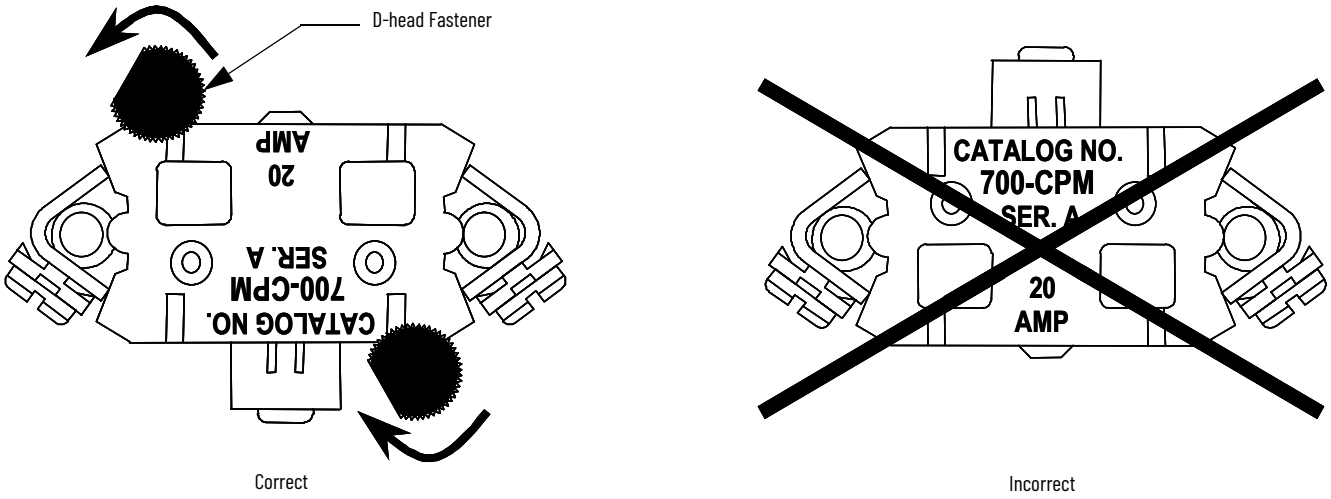
3. To adjust the distance from the blades to the bar, disconnect the threaded connecting rod at the handle operating lever.
4. Turn the threaded connecting rod to lengthen or shorten it. This will adjust the position of the isolation switch blades in the ON and OFF position.

Auxiliary Contacts Inspection and Replacement

ATTENTION: To avoid shock hazard, lock out incoming power (refer to Power Lock-out Procedure on page 53) before working on the equipment. Verify with a hot stick or appropriate voltage measuring device that all circuits are voltage free. Failure to do so may result in severe burns, injury or death.

1. Complete the Power Lock-out Procedure (refer to Power Lock-out Procedure on page 53).
2. Inspect the auxiliary contacts for wear, scorching or heat damage. Replace any damaged contacts. The contacts have a mean time between failure (MTBF) rating of 20 million operations if used within the operating specifications.
3. To remove the contact, turn both of the D-head fasteners until the flat sections are aligned with the edge of the contact (see Figure 64).
4. Remove the contact from the housing.
5. Disconnect the wires from the auxiliary contact.
6. Reverse the procedure to replace the auxiliary contact.
7. Ensure the contact is correctly positioned into the contact carrier (see Figure 64).

Figure 64 - Auxiliary Contact Orientation

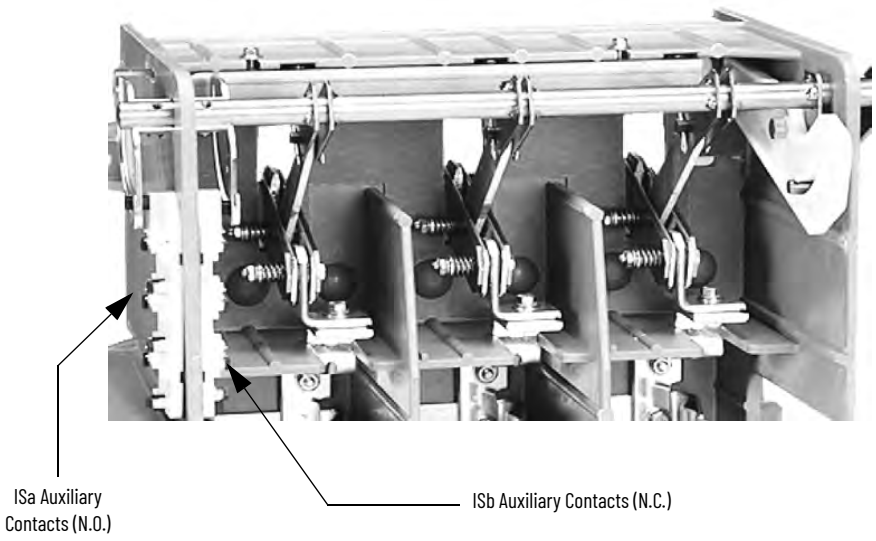


Isolation Switch Auxiliary Contacts

The auxiliary contacts are mounted on the left side of the isolation switch, slightly below the cams on the isolation switch shaft.

Normally open contacts (Isolation Switch a Contacts - ISa) are on the outside of the isolation switch housing, and normally closed contacts (Isolation Switch b Contacts - ISb) are on the inside of the housing.

Figure 65 - Location of ISa and ISb Auxiliary Contacts



ISa and ISb contacts are exactly the same (700 CPM). The cam controls the normally open or normally closed status of the contacts.

Refer to Figure 44 on page 49 and Figure 45 on page 50 for wiring diagrams.

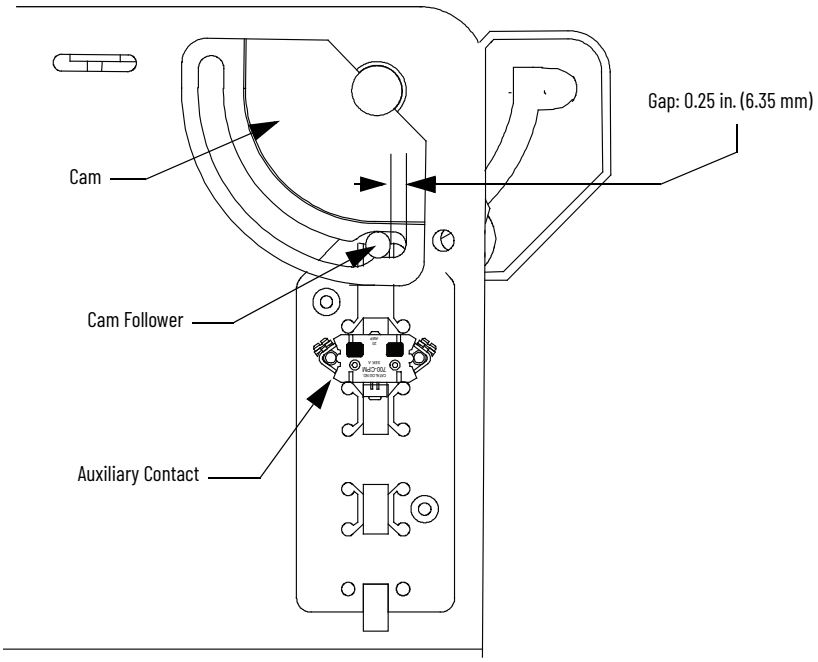
IMPORTANT	The Isolation Switch Ground Adjustment procedure (refer to Isolation Switch Mechanism Grounding Adjustment on page 67) must be completed before adjusting the auxiliary contacts to ensure proper synchronization of the assembly.

Adjusting the Normally Open (ISa) Contacts

ATTENTION: To avoid shock hazards, lock out incoming power (refer to Power Lock-out Procedure on page 53) before working on the equipment. Verify with a hot stick appropriate voltage measuring device that all circuits are voltage free. Failure to do so may result in severe burns, injury or death.

1. Move the isolation switch handle to the OFF (open) position.
2. Loosen the bolt holding the outside cam to the shaft. Do not loosen the bolt entirely. The cam should not be able to rotate freely on the shaft.
3. Move the isolation switch handle to the ON (closed) position and check that nothing prevents cam from rotating with the shaft.
4. Insert a 6.35 mm (0.25 in.) diameter pin into the cam groove between the cam follower and the end of the cam groove.

Figure 66 - Adjusting Auxiliary Contacts (ISa Auxiliary Contact Shown)



5. Adjust the cam on the shaft so that the gap from the cam follower to the end of the cam groove is the width of the pin – 6.35 mm (0.25 in.).
6. Move the isolation switch handle to the OFF (open) position and check that nothing prevents the cam from rotating with the shaft.
7. Tighten the 1/4-20 bolt holding the cam to the shaft (6 lb•ft [8 N•m]). Move the isolation switch handle to the ON position and recheck the gap using the pin.
8. Verify that auxiliary contact ISa is open when the isolation switch is open. Verify that ISa contact is closed when isolation switch is closed.

Adjusting the Normally Closed (ISb) Contacts

1. Move the isolation switch handle to the OFF (open) position.
2. Loosen the bolt holding the inside cam to the shaft. Do not loosen the bolt entirely. The cam should not be able to rotate freely on the shaft.
3. Insert a 6.35 mm (0.25 in.) diameter pin into the cam groove between the cam follower and the end of the cam groove.
4. Adjust the cam on the shaft so that the gap from the cam follower to the end of the cam groove is the width of the pin — 6.35 mm (0.25 in.).
5. Tighten the 1/4-20 bolt holding the cam to the shaft (6 lb•ft [8 N•m]). Move the isolation switch handle to the OFF position and recheck the gap using the pin.
6. Operate the handle several times, then recheck the 6.35 mm (0.25 in.) clearance between the end of the cam groove and the follower pin for both cams.
7. Verify that auxiliary contact ISb is closed when isolation switch is open. Verify that ISb contact is open when isolation switch is closed.

Adjusting the Change-of-State Point

IMPORTANT This procedure sets the secondary electrical interlock. When properly adjusted, the electrical interlock is designed to open the control power circuit before the isolation switch opens as the handle is moved to the OFF position.

1. Once the auxiliaries have been adjusted, move the isolation switch handle to the ON position.
2. Connect a conductivity measuring device across the closed auxiliary contacts.
3. Slowly move the isolation switch handle towards the OFF position and observe the point at which the movable isolation switch blades separate from the incoming line stabs. The auxiliary contacts must change state from the closed to open position before the isolation switch blades lose contact with the incoming line stabs. This prevents the isolation switch from being opened while the unit is energized and under load conditions.

ATTENTION: The auxiliary contacts must be properly adjusted to avoid opening the isolation switch under load conditions. Improper adjustment may result in damage to the equipment and/or severe burns, injury or death to personnel.

4. If the auxiliaries do not change state before the isolation switch opens, repeat the auxiliary contacts adjustment procedure (refer to Auxiliary Contacts Inspection and Replacement on page 68).

Emergency Circumvention Procedure for Power Cell Entry

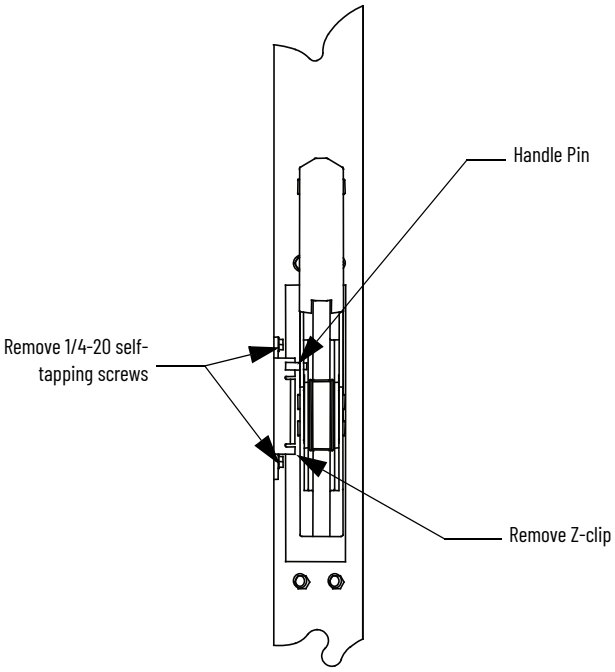
The interlocking mechanism of the medium voltage starter is designed to prohibit access to the power cell while the isolation switch handle is in the ON position and the isolation switch is closed.

IMPORTANT The following procedure is intended to be used only when the isolation switch cannot be opened as described in the Door Opening Procedure for either standard or ArcShield enclosures.

ATTENTION: This procedure may expose personnel to energized medium voltage components. Whenever possible, lock out incoming power before beginning this procedure. If you are unable to lock out incoming power, use the appropriate protective equipment and work practices to avoid shock hazards. Failure to do so may result in severe burns, injury or death.

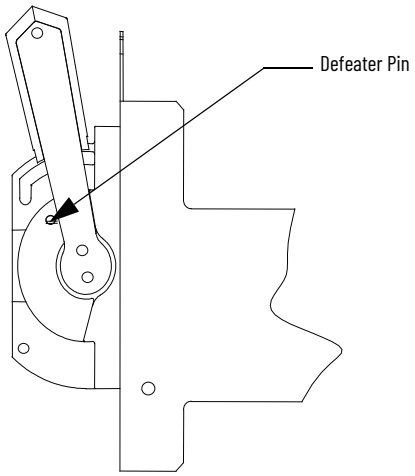
1. Remove the two #10-32 self-tapping screws (2.7 lb•ft [3.6 N•m]) from the Z-clip and remove the Z-clip from the edge of the MV door.

Figure 67 - Removing Z-clip



2. Unscrew the two locking 3/8-1.75 bolts for the MV door.
3. Use a flat-headed screwdriver to turn the defeater pin on the right side of the isolation switch handle (see Figure 67).
4. Open the power cell door.

Figure 68 - Defeater Pin



If it is possible to move the isolation switch handle to the OFF position for reassembly, follow steps 5...10.

If it is not possible to move the isolation switch handle to the OFF position for reassembly, follow steps 11...13.

ATTENTION: The Z-clip assembly must be reassembled to ensure the interlocking mechanism functions properly. Failure to do so will let personnel access live medium voltage parts and may cause severe burns, injury or death.

Installing Z-clip with Isolation Switch Handle in the OFF Position

5. Reattach the Z-clip using the self-tapping screws, but do not completely tighten them.
6. Move the isolation switch handle to the OFF position.
7. Swing the door closed and inspect the position of the Z-clip with respect to the handle pin.
8. Set the Z-clip so that it is just above the handle pin. Do not set the Z-clip more than 3 mm (0.125 in.) above the pin. Open the door and tighten the #10-32 bolts (2.7 lb•ft [3.6 N•m]).
9. Close the door and move the handle to the ON position. Verify that the handle pin overlaps the Z-clip and prevents the door from opening.
10. Move the handle to the OFF position and tighten the 3/8-1.75 door locking bolts.

Installing Z-clip with Isolation Switch Handle in the ON Position

11. Close the door and tighten the 3/8-1.75 door locking bolts.
12. Position the Z-clip as shown in Figure 68. Ensure the handle pin overlaps the top portion of the Z-clip.
13. Using the #10-32 self-tapping screws, reattach the Z-clip (2.7 lb•ft [3.6 N•m]).
14. Complete steps 5…10 at the earliest opportunity to confirm that the Z-clip assembly is correctly installed.

Notes:

Spare Parts

The following list of spare parts is valid for typical Bulletin 1512 and 1512BT units. Please contact your local Rockwell Automation office to ensure that the following part numbers are valid for your system.

Bulletin 1512 and 1512BT Units Parts List

Table 3 - Spare Parts List

Part Number	Description	Recommended Stocking Quantity
80154-991-59	LV Control Panel[2][3] (Electrically Held)	1
80154-991-61	LV Control Panel[2][3] (Mechanical Latch)	1
1503VC-BMC5	IntelliVAC (Electrically Held and Mechanical Latch)[4]	1
80174-902-14-R	Internal IntelliVAC fuse – 6.3A, 250 V (Littlefuse 21506.3)	1
Engineering Data[1]	Power Fuses[5]	3
Engineering Data[1]	Primary Fuses (CPT/PT)	2
Engineering Data[1]	LV Control Circuit Fuses	2
Engineering Data[1]	Heater Elements (if used)	3
40266-515-03	20 Amp Isolation Switch Auxiliary Contact Cartridge (700 CPM)	2
PN-620485	Isolation Switch Refurbishment Kit 400A (Series R or higher)	1
RU-8216	Dow Corning 55 O-ring Lubricant	1
80144-491-02	Fuse Extractor (For clip-on fuses only)	1

(1) Consult spare parts list in service manuals that are provided following delivery of equipment.
(2) The following is included with the LV Control Panel: CR1 relay, CR2 relay, rectifier, MOV assembly, test switch, test plug. **Note:** For mechanical latch assemblies, an additional CR1 relay is substituted for the CR2 relay.
(3) For starters with electro-mechanical control.
(4) For starters with IntelliVAC control.
(5) Power fuses are R rated for motor loads or E rated for non-motor loads. Power fuses are sized to the motor or transformer load data provided at the time the starter is ordered. Refer to dimensional drawings for specific fuse type and size. Bolt-on or clip-on fuses are available for various load sizes. Contact Rockwell Automation for details.

For 450A contactor spare parts, refer to publication 1502-UM060.

Notes:

ArcShield Unit Information

Overview

ArcShield™ units have a robust arc resistant enclosure design that has been tested per IEEE C37.20.7 (2001). Each ArcShield structure was tested to withstand the effects of an arc flash at 40 kA for 0.5 seconds. ArcShield units provide Type 2B Accessibility.

ArcShield Design

ArcShield units typically include a pressure relief vent on the roof of the structure (some incoming units may not have a pressure relief vent if top cable entry is required). Under arc flash conditions the pressure relief vent will open allowing hazardous flames and gases to exit the enclosure via the plenum or chimney system. The low voltage panel area is sealed to prevent flames and gases from entering; however, suitable personal protective equipment (PPE) must be used whenever working on live circuits.

ATTENTION: Do not connect Bulletin 1500 ArcShield arc-resistant products to motor control centers that are not arc-resistant.
Rockwell Automation has not tested or validated the mechanical or electrical interconnections between these two enclosures.

Connecting these two styles of equipment nullifies all arc-resistant ratings for the entire dissimilar equipment configuration. This type of configuration could pose electrical safety risks to site personnel and nullify some safety labeling already applied to the different styles of equipment.

ATTENTION: To ensure Arc resistant integrity, it is important to ensure that the following rules are followed:

- The pressure relief vent may not be tampered with, and it is not to be used as a step.
- No alterations can be made to the ArcShield structure.
- All covers and plates removed for installation or maintenance purposes must be re-installed and properly secured. Failure to do so voids the arc resistance integrity.
- Power cable entry points are to be treated as the boundary between a hazardous location and sealed accordingly. Failure to do so voids the arc resistant integrity.
- A plenum or chimney must be used to direct the arc flash energy to a suitable location. Failure to do so voids the arc resistant integrity. Refer to Appendix B for plenum installation instructions. Refer to Appendix C for chimney installation instructions.
- All wiring between the low voltage panel and the power cell must be routed through a suitable gland to ensure flames and gases are not transmitted into this area (as fitted from factory).
- The medium voltage power cell doors must be properly secured, using both the handle mechanism and the door bolts (refer to instruction label on the power cell door and refer to Opening the Medium Voltage Doors on page 30 of Chapter 1). Failure to do so voids the arc resistance integrity.

Exhaust Systems: Chimney or Plenum Option

Plenum Information

A plenum can be provided for each unit, and is to be field-mounted on the top of the unit structure (some incoming units may not have a plenum if top cable entry is required). The purpose of the plenum is to direct the hazardous flames and gases away from the top of the arc resistant enclosure. Unit plenums are secured to the top of the unit structure and to adjacent plenums, creating a continuous conduit for release of the arc flash energy. Refer to Appendix B for plenum installation instructions.

Each ArcShield line-up includes a plenum exhaust section that extends beyond either the left or right ends of the line-up. The other end of the plenum is capped with an end cover. Extensions can be added to the plenum to allow the arc flash energy to be directed further away from the ArcShield line-up to an area where safe venting of the plasma gases can occur.

Figure 69 - Elements of ArcShield Plenum

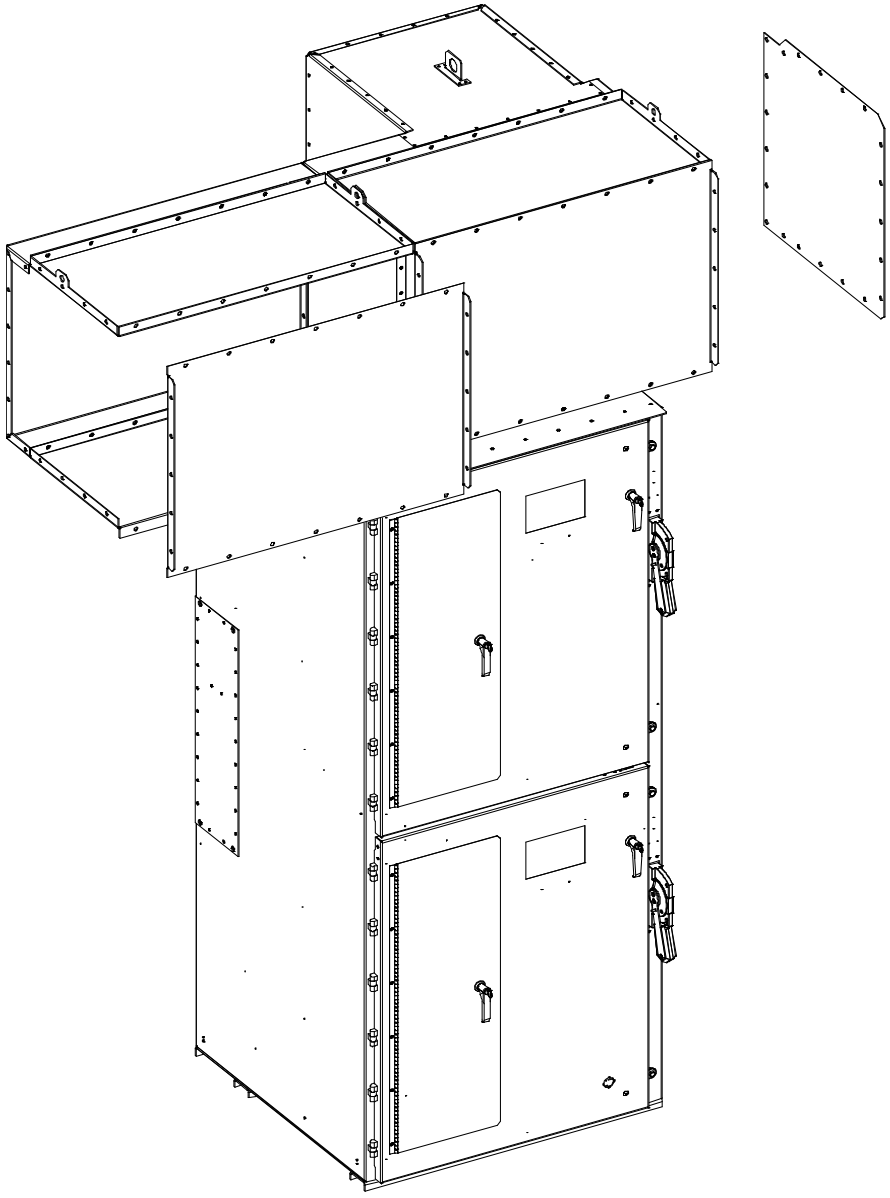
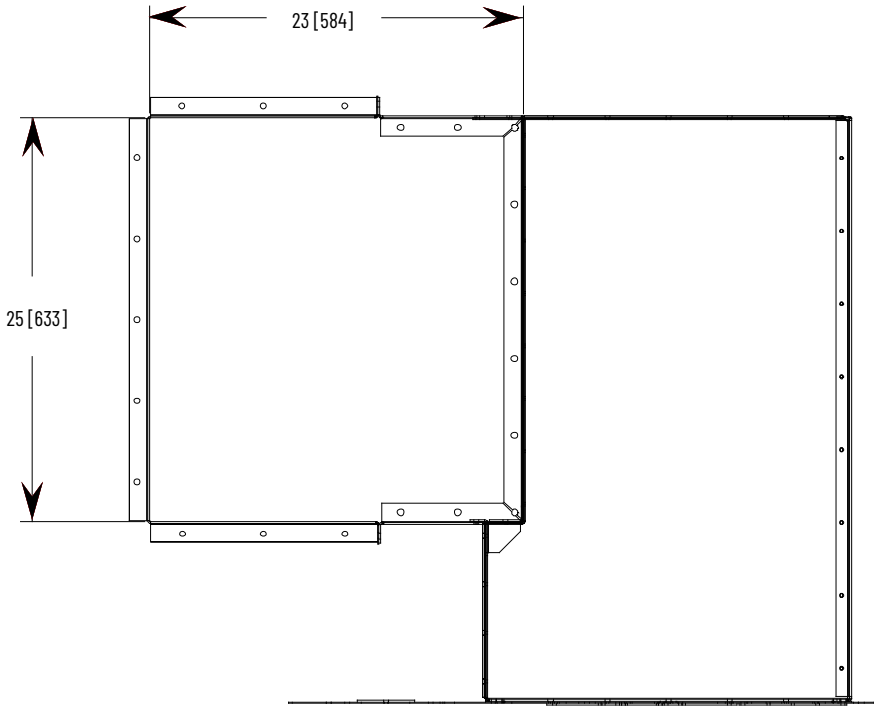


Figure 70 - Cross-section of Plenum Extension, dimensions in inches [mm]



Plenum Exhaust Considerations

The following options for locating the plenum exhaust are presented:

1. Plenum ducted to an area of the control room where arc gases are permitted to escape, with plenum extensions (see Figure 71, Figure 72 and Figure 73).
2. Plenum duct to outside of control room (see Figure 71 and Figure 72).

Plan the location where the plenum will exhaust. Ensure that:

- There is no access to personnel while equipment is energized.
- Area is free of flammable material or vapors

Ensure that adequate space is provided around the plenum exhaust, as outlined in Figure 71 through Figure 73.

IMPORTANT	Be aware that equipment in the area of the plenum exhaust point will be damaged or destroyed.

Figure 71 - Plenum Exit Left with Extensions to Internal Controlled Access Area (Top View)

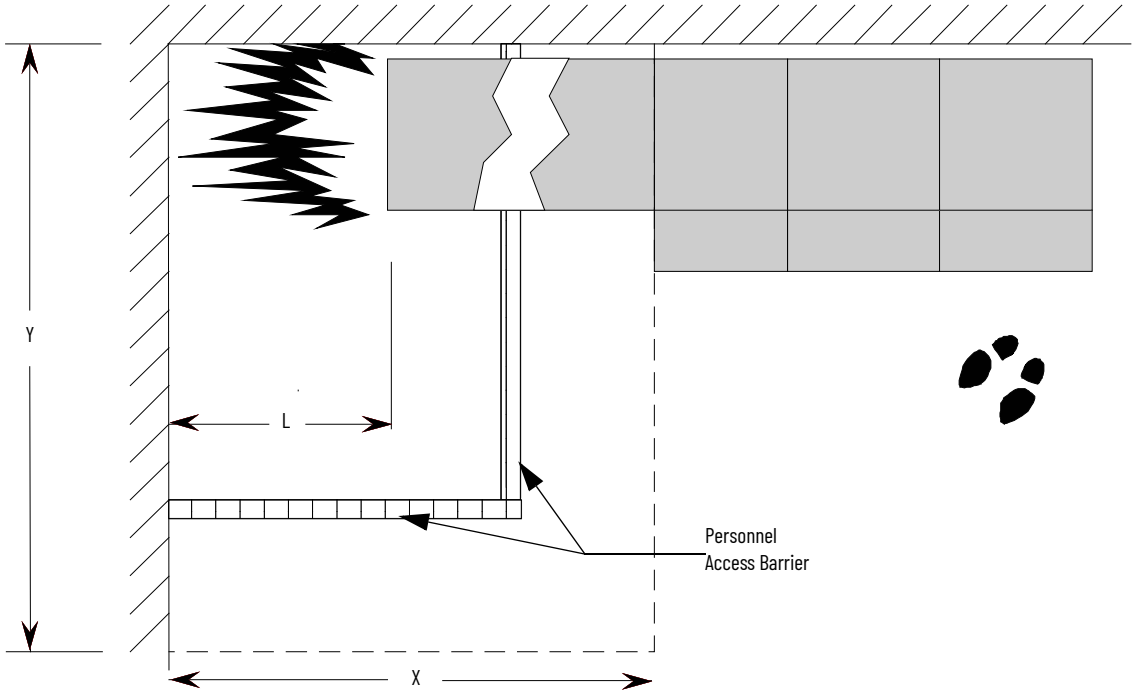
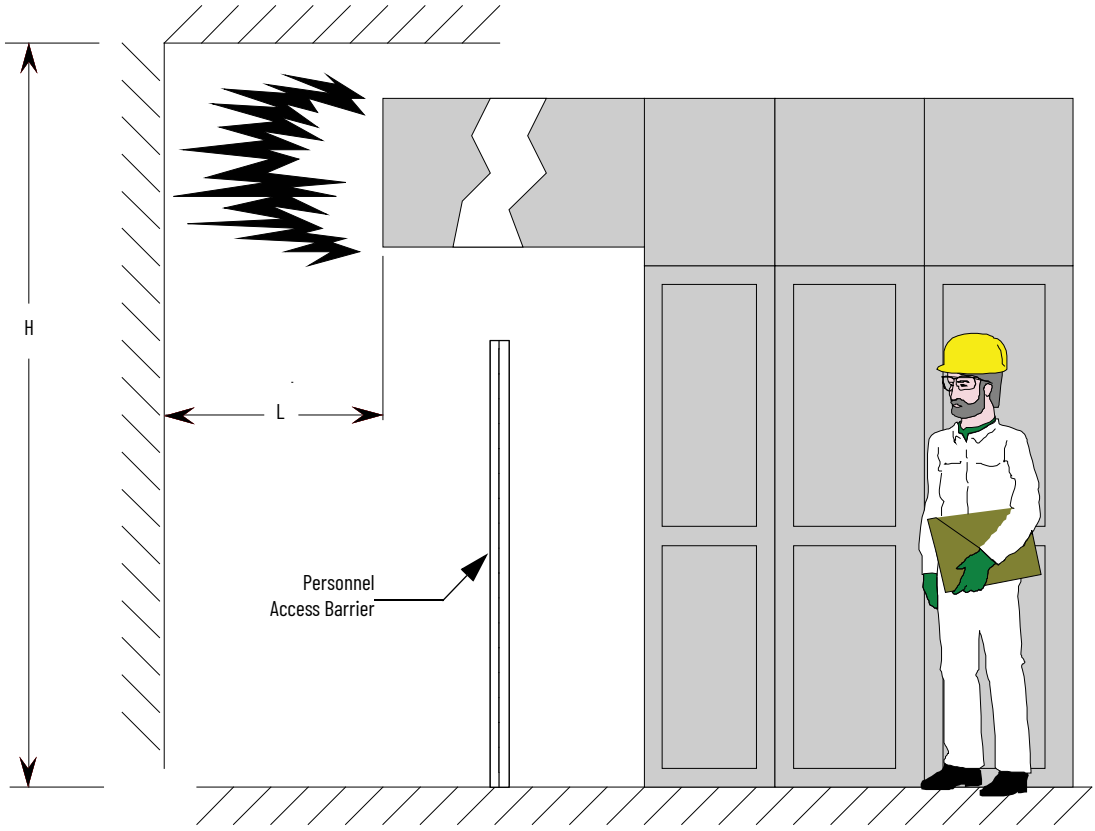
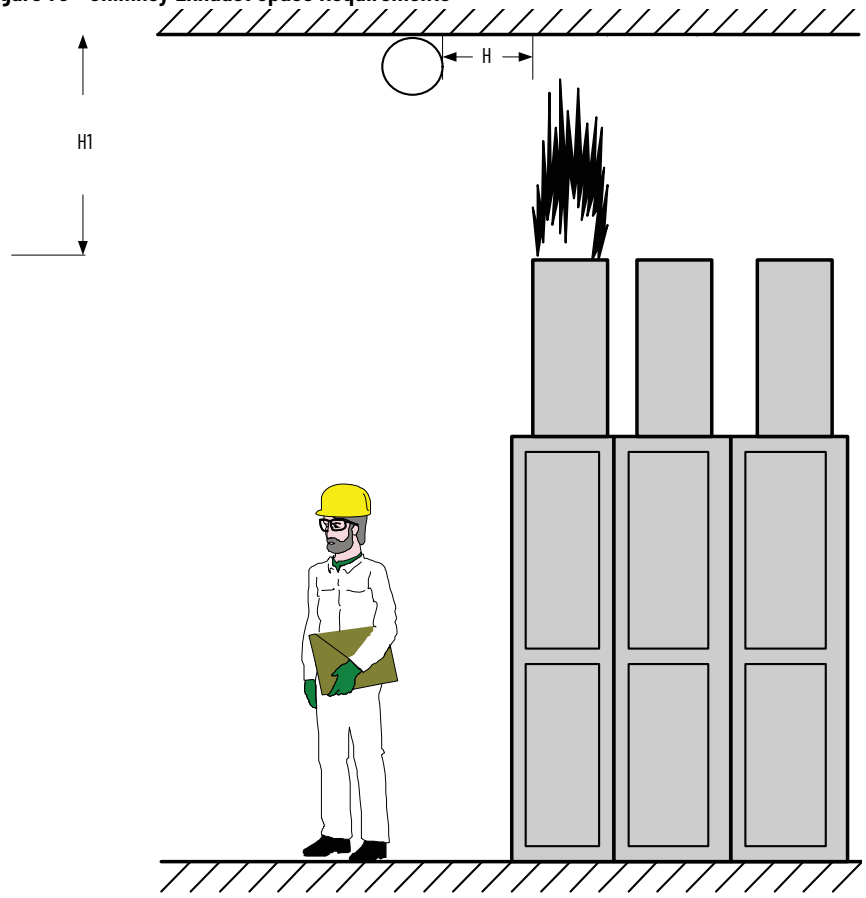


Figure 72 - Plenum Exit Left with Extension(s) to Internal Controlled Access Area (Front View)



Minimum H = 3.5 m (138 inches)
Minimum L = 1.2 m (47 inches)
Minimum Volume of space required for safe pressure relief: X * Y * H = 11 m^3 (390 cubic feet)

Figure 73 - Chimney Exhaust Space Requirements



Minimum H1: 1.7 m (67 inches)
Minimum H: 1 m (39 inches)

Additional Notes

- The walls of the plenum exit area must be capable of withstanding the pressure generated.
- Any painted surfaces which face direct contact with the arc products may ignite. Flame suppression is recommended.
- The exit point can also be outside the building. Ensure exit area can not be blocked by ice, snow, or vermin nests.
- Access barriers are recommended as a means of restricting access by personnel while the equipment is energized. Chain link fencing is a suitable barrier material.
- Equipment that consists of more than 4 vertical sections bolted together may require additional plenum exits. Rockwell Automation will provide guidance on requirements for additional plenum exits when required.

Chimney Information

A chimney can be provided for each unit, and is to be field mounted on top of the unit structure. The purpose of the chimney is to direct the hazardous flames and gases away from the top of the resistant enclosure. The chimney is secured to the top of each unit structure. Refer to Appendix C for chimney installation instructions.

Each ArcShield line-up includes a chimney exhaust section that extends vertically directly above the enclosure.

Chimney Exhaust Considerations

1. From the outlet of the chimney, there needs to be a minimum distance of 1.7 m (67 in.) from the top of the chimney to the ceiling, and 1 m (39 in.) on each side.
2. No obstructions (eg. piping) can be in the path of the exhaust within this 2 m (78 in.) height requirement.

Plan the location where the chimney will exhaust. Ensure that:

- There is no access to personnel while equipment is energized.
- Area is free of flammable material or vapors.
- Ensure that adequate space is provided around the chimney exhaust as outlined in Figure 73.

ArcShield Plenum Installation Instructions

The following instructions are provided to ensure the proper installation and function of plenum components supplied with ArcShield™ enclosures. Refer to Appendix A for additional information related to ArcShield plenums before attempting to follow these instructions.

Recommended Torque Values

1/4-20 Thread Fasteners – 15 N•m (12 lb•ft)

5/16-18 Thread Fasteners – 14.5 N•m (11 lb•ft)

Plenum Bracing

Bracing of the plenum must be able to withstand the dynamic forces of the arc fault as well as any other vibration or seismic effects associated with the installation. Most of this force will be in the direction opposite to where the relief vent exits. The amount of bracing will depend on how the plenum is supported at its exit as well as the distance from the end of the cabinets to the exit vent.

- A flange is available for installing hangers to support the plenum weight.
- The plenum extension has holes for mechanical support.
- Weight per unit length of Rockwell supplied plenum = 28 kg/m (19 lb/ft).
- Installer is responsible for ensuring that the plenum extension has sufficient support to resist the effect of vibrations and seismic effects.

IMPORTANT Plan the location where the plenum will exhaust (refer to Appendix A). Equipment in the area of the plenum exhaust will be damaged or destroyed. Mark the plenum exhaust area as a Hazardous Zone (Figure 74).

Figure 74 - Plenum Exhaust Label

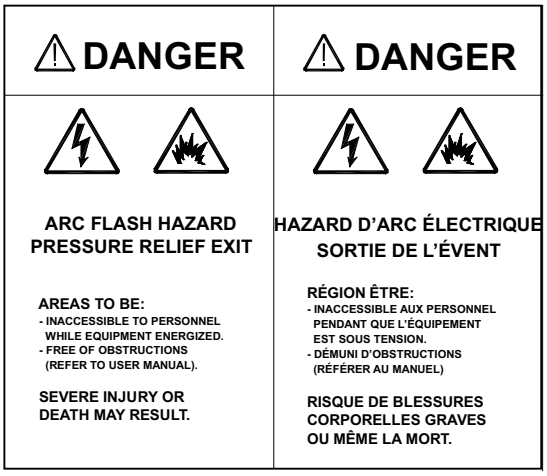
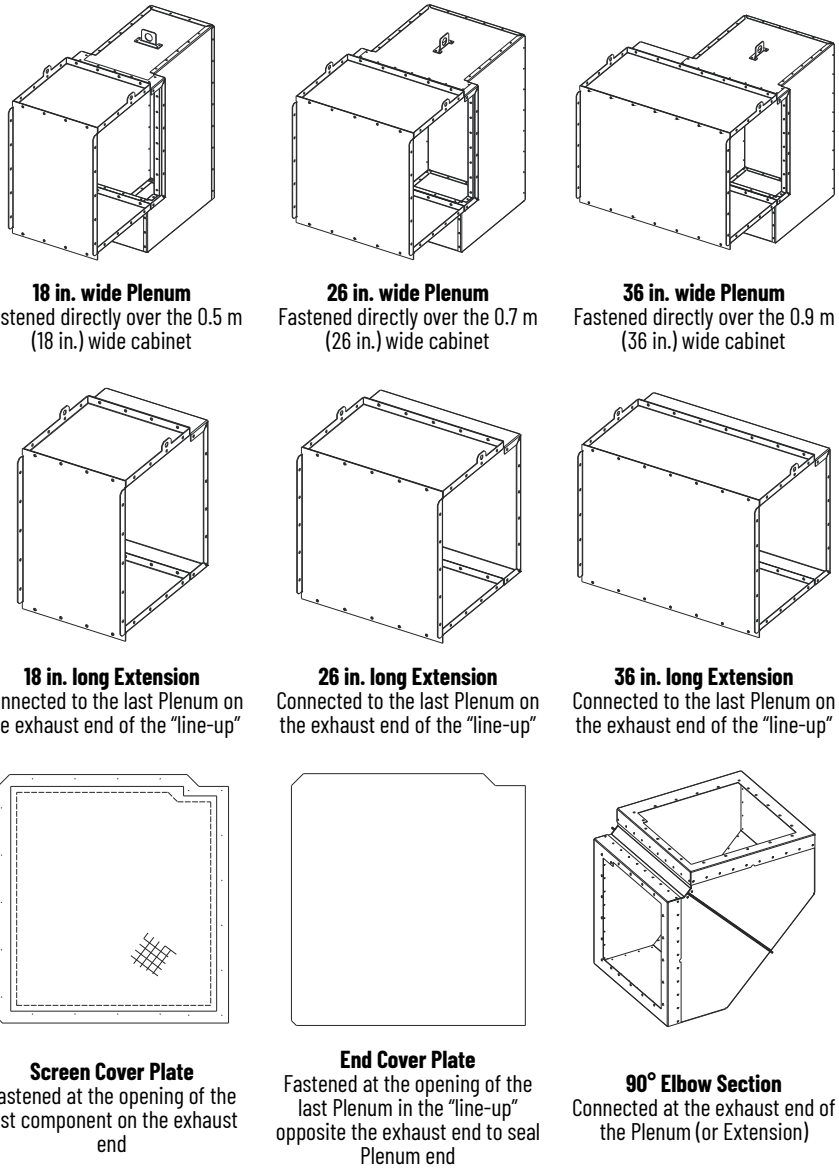


Figure 75 - Description of Plenums and Components



18 in. wide Plenum
Fastened directly over the 0.5 m (18 in.) wide cabinet

26 in. wide Plenum
Fastened directly over the 0.7 m (26 in.) wide cabinet

36 in. wide Plenum
Fastened directly over the 0.9 m (36 in.) wide cabinet

18 in. long Extension
Connected to the last Plenum on the exhaust end of the "line-up"

26 in. long Extension
Connected to the last Plenum on the exhaust end of the "line-up"

36 in. long Extension
Connected to the last Plenum on the exhaust end of the "line-up"

Screen Cover Plate
Fastened at the opening of the last component on the exhaust end

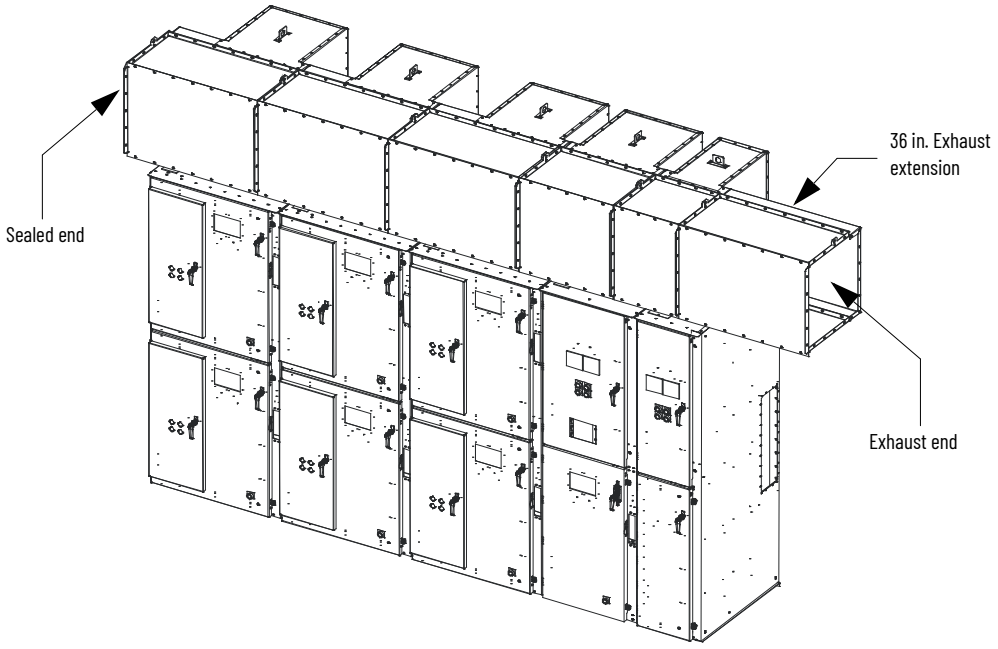
End Cover Plate
Fastened at the opening of the last Plenum in the "line-up" opposite the exhaust end to seal Plenum end

90° Elbow Section
Connected at the exhaust end of the Plenum (or Extension)

General Plenum Layout for ArcShield Line-up

An example of a general Plenum assembly configuration is shown in Figure 76. Plenums of varying widths are mounted directly over the MV enclosures of the corresponding width. A 0.9 m (36 in.) Exhaust extension assembly is shown mounted on the extreme right side Plenum of the equipment "Line-up" (can alternatively exhaust to the left).

Figure 76 - ArcShield Line-up



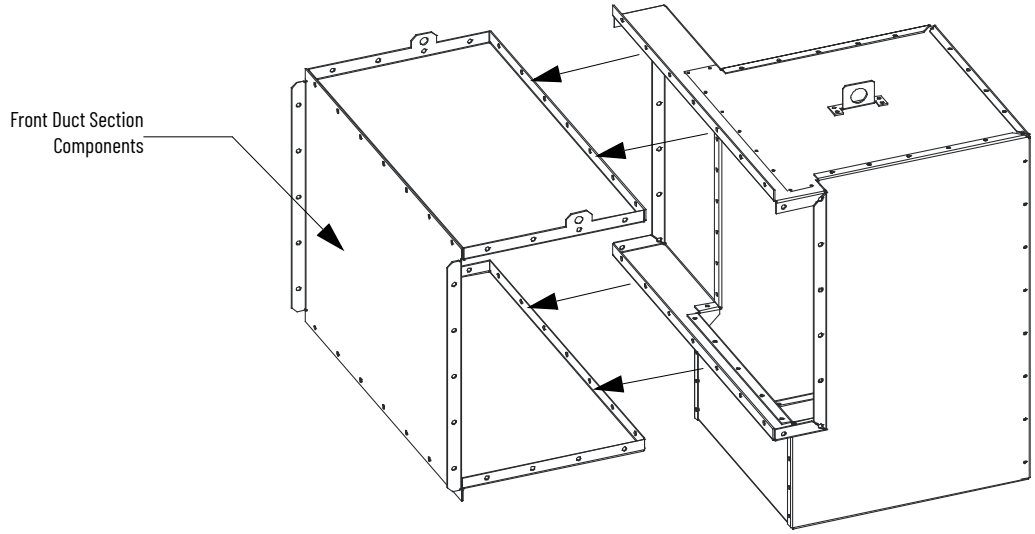
Plenum exhaust can be on the left or right hand end of the line up. Pictures and figures in this procedure are shown for a right hand exhaust exit direction. Also shown is an optional vertical (top) direction exhaust extension (see Figure 88).

IMPORTANT Plenum components not directly mounted to the tops of the MV enclosures, must have additional mounting support. This includes the Extension components and 90° Elbow Sections (refer to STEP 7 – Additional Mounting Support on page 92).

STEP 1 – Mounting a Single Plenum

Before mounting a single Plenum over an MV enclosure, the front duct section must first be removed. This is shown in Figure 77.

Figure 77 - Removing Front Duct Section



Cabinet Preparation

In preparation to mount the plenum:

1. Remove the cabinet lifting means (slips of lifting angles).
2. Reinstall the 5/8-11 bolts retaining the lifting means in the holes from where they came (11 lb•ft [14.5 N•m]). Failure to install the bolts negates the cabinets ability to control any arc gases properly.
3. After the lifting angles or clips are removed, remove 1/4-20 fasteners from the relief vent on the top of the MV enclosure. Leave the (4) corner fasteners in place.

ATTENTION: Hardware used to retain the lifting provision hardware must be reinstalled in the same holes. Failure to replace this hardware will make the arc resistance of the cabinet ineffective and could subject personnel to the possibility of severe burns, injury, or death.

IMPORTANT Do not remove the four corner fasteners (Figure 79)

Figure 78 - Relief Vent Fasteners (top view)

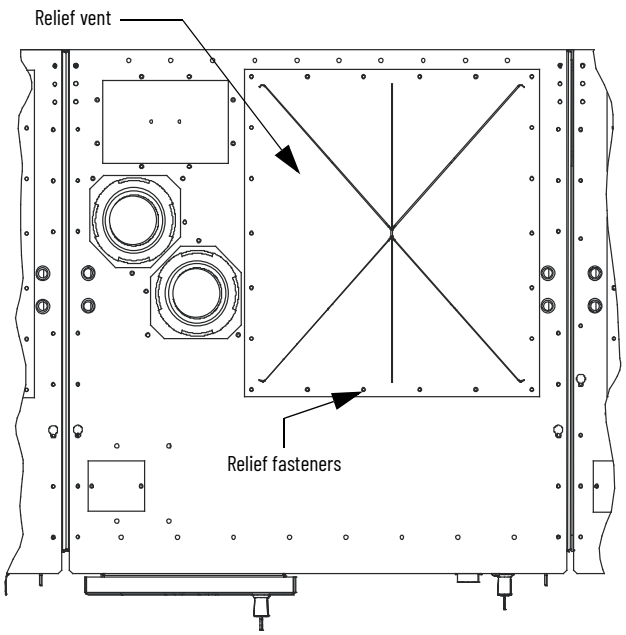
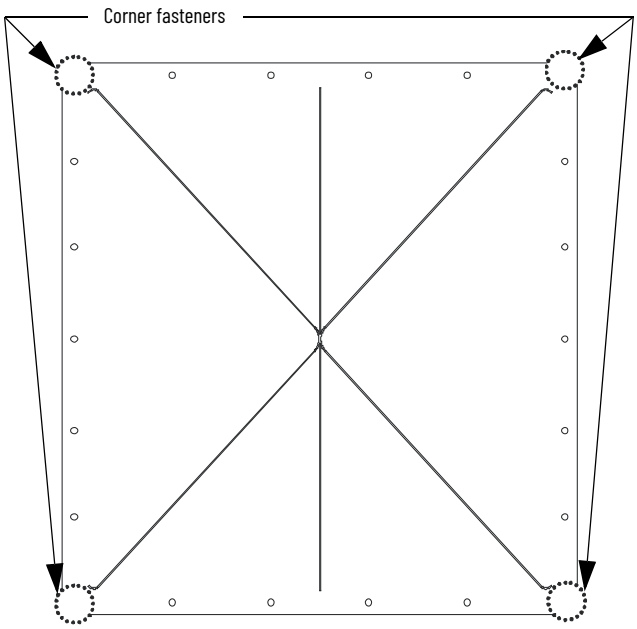


Figure 79 - Relief Vent

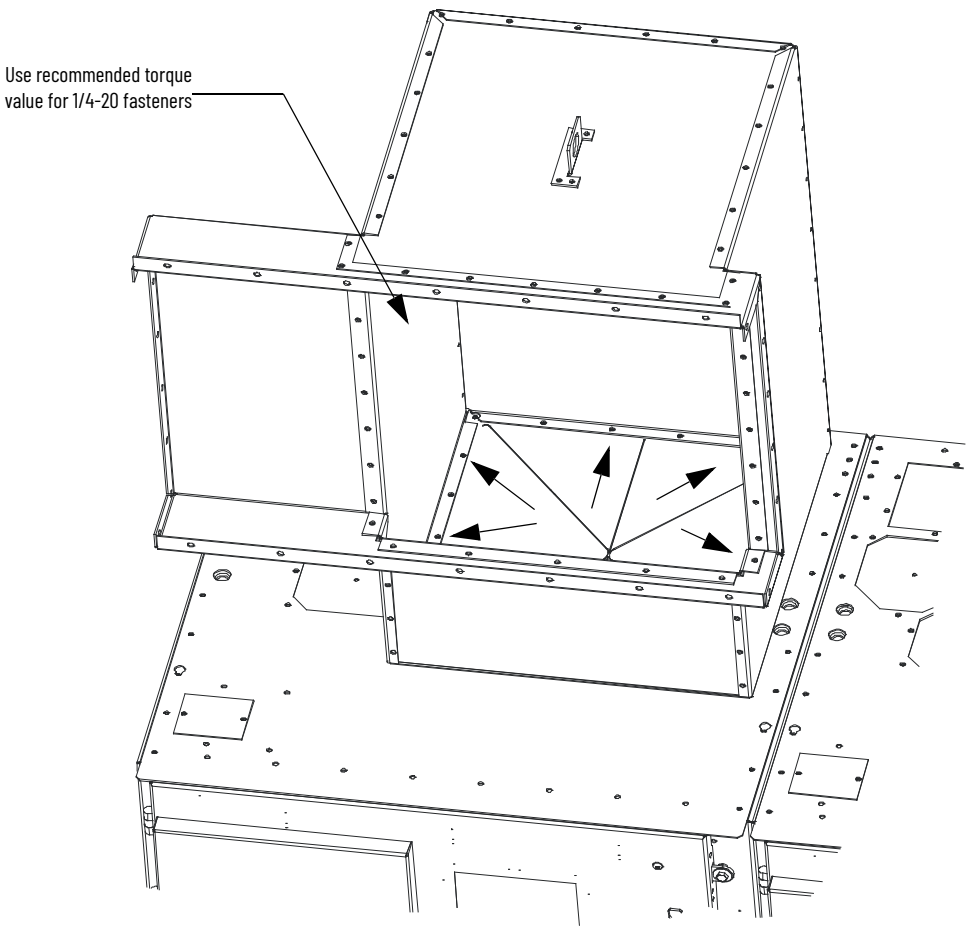


The plenums are designed to fit over the fastener heads at the (4) corners of the relief vent. The corner fasteners are required to secure the relief vent during installation.

Plenum Placement on Structure

Once the plenum has been lifted in place directly over the relief vent (shown in Figure 80), all 1/4-20 fasteners (15 N•m [12 lb•ft]), removed in Cabinet Preparation above, are replaced to attach the plenum to the top of the enclosure. Use hand tools only.

Figure 80 - Plenum Placement

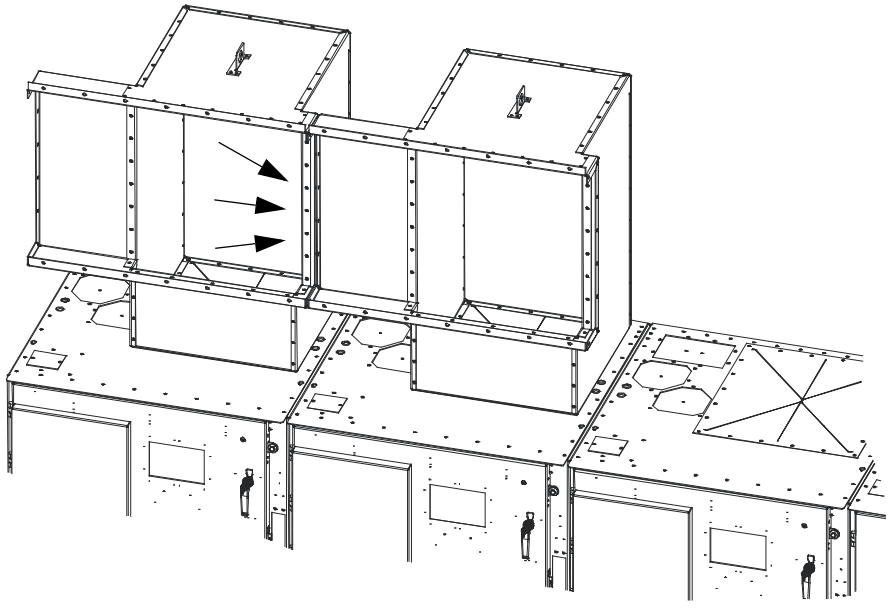


Use silicone caulking generously to fill any air gaps once the Plenum has been securely mounted in place.

STEP 2 – Alignment of Side-by-Side Plenums

Plenums mounted side-by-side must be fastened together through the aligning holes using 5/16-in. supplied hardware (see Figure 81).

Figure 81 - Aligning "Side-by-Side" Plenums

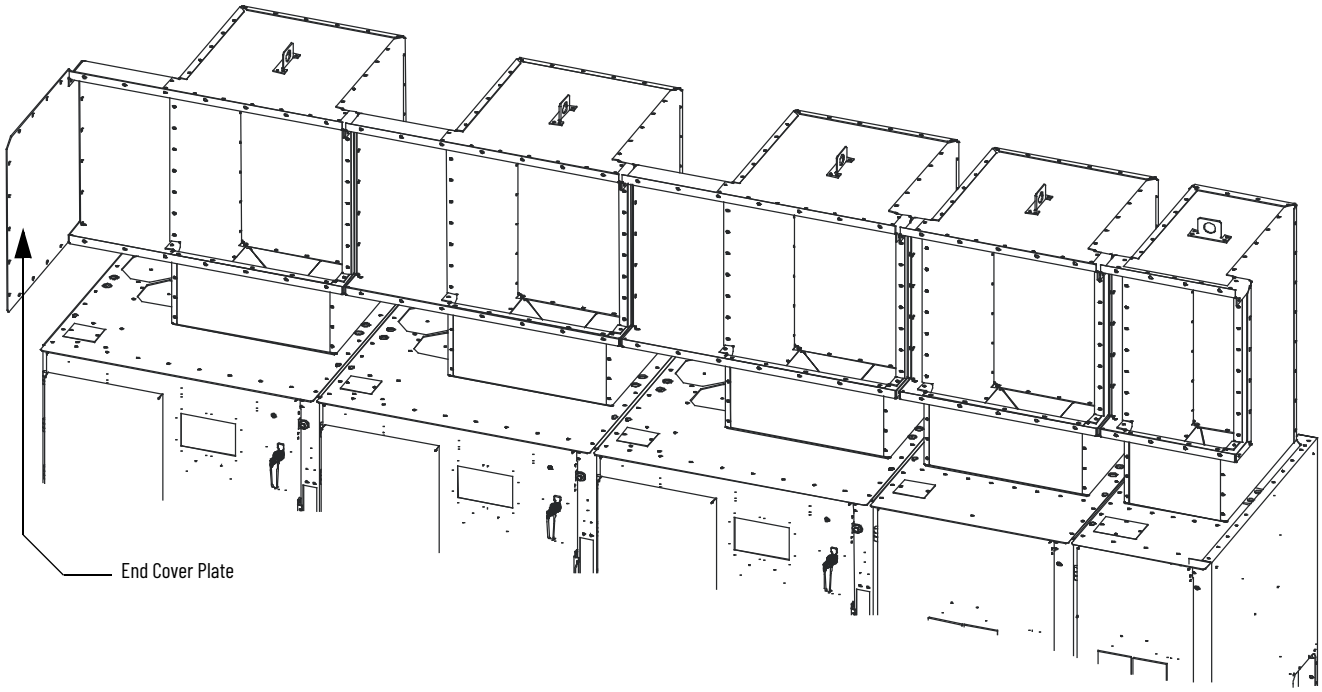


IMPORTANT Any unused holes must be filled with thread forming screws. i.e.: "Lifting Lug holes".
All Gaps must be sealed and filled with silicone.

STEP 3 – Sequence of Final Assembly

All Plenums in a Line-up must be mounted to the top of each enclosure and to the Plenum directly beside it before the front duct sections are re-attached (see Figure 77).

Figure 82 - Sequence of Final Assembly

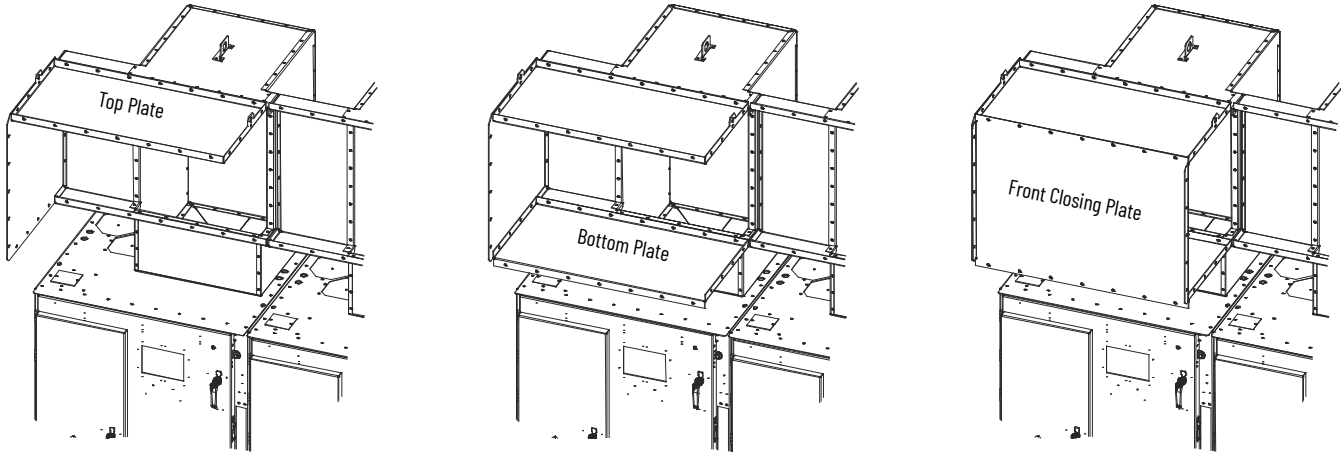


The "End Cover Plate" must be mounted on the closed end of the Line-up at this time during the assembly using 5/16-in. hardware (see Figure 82 Left side).

STEP 4 – Closing the Front of the Plenum Sections

After the first stage of the Plenum assemblies have been mounted, the Plenums can then be "closed-up" by replacing the front duct sections as shown in Figure 83.

Figure 83 - Plenum Sections



IMPORTANT	Do not re-install the front duct section of the last Plenum on the exhaust side of the Line-up at this time (refer to STEP 6 – Mounting Extension/Elbow to Plenum Line-up on page 90 for more information).
	Use silicone caulking generously to fill any air gaps once the Plenum has been securely mounted in place.

STEP 5 – Extension and Elbow Assembly

The 36 in. extension components and 90° elbow section are to be attached using 5/16-in. hardware in the following sequence:

Step 5A – See Figure 84

Step 5B – See Figure 85

Step 5C – See Figure 86

The Screen Cover Plate is attached in Figure 85.

Figure 84 - 90° Elbow Section Assembly, Step 5A (Front View)

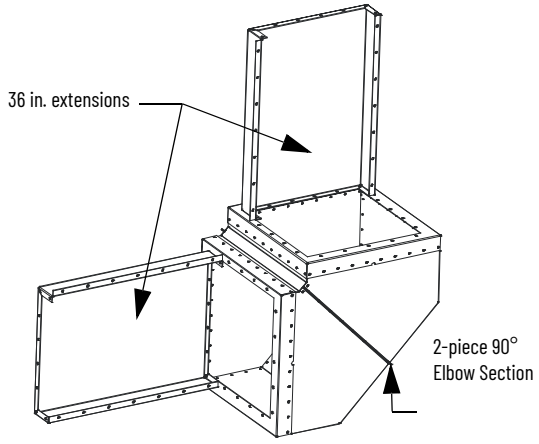
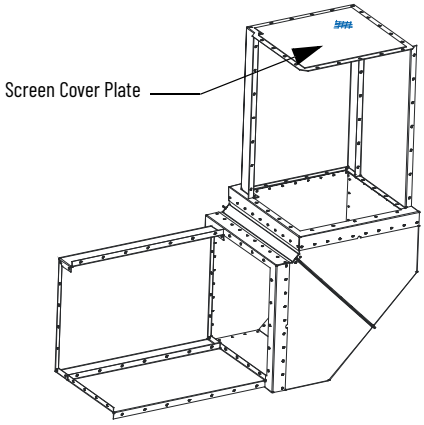


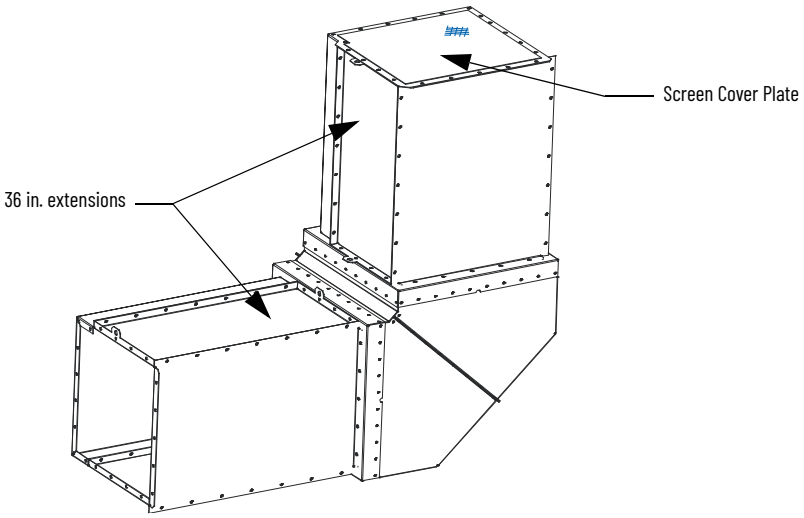
Figure 85 - 90° Elbow Section Assembly, Step 5B (Front View)



The Extension components are attached to the Elbow Section using 5/16-in. Hardware.

Figure 86 illustrates what the Extension/Elbow Assembly should resemble when finished.

Figure 86 - 90° Elbow Section Assembly, Step 5C (Front View)

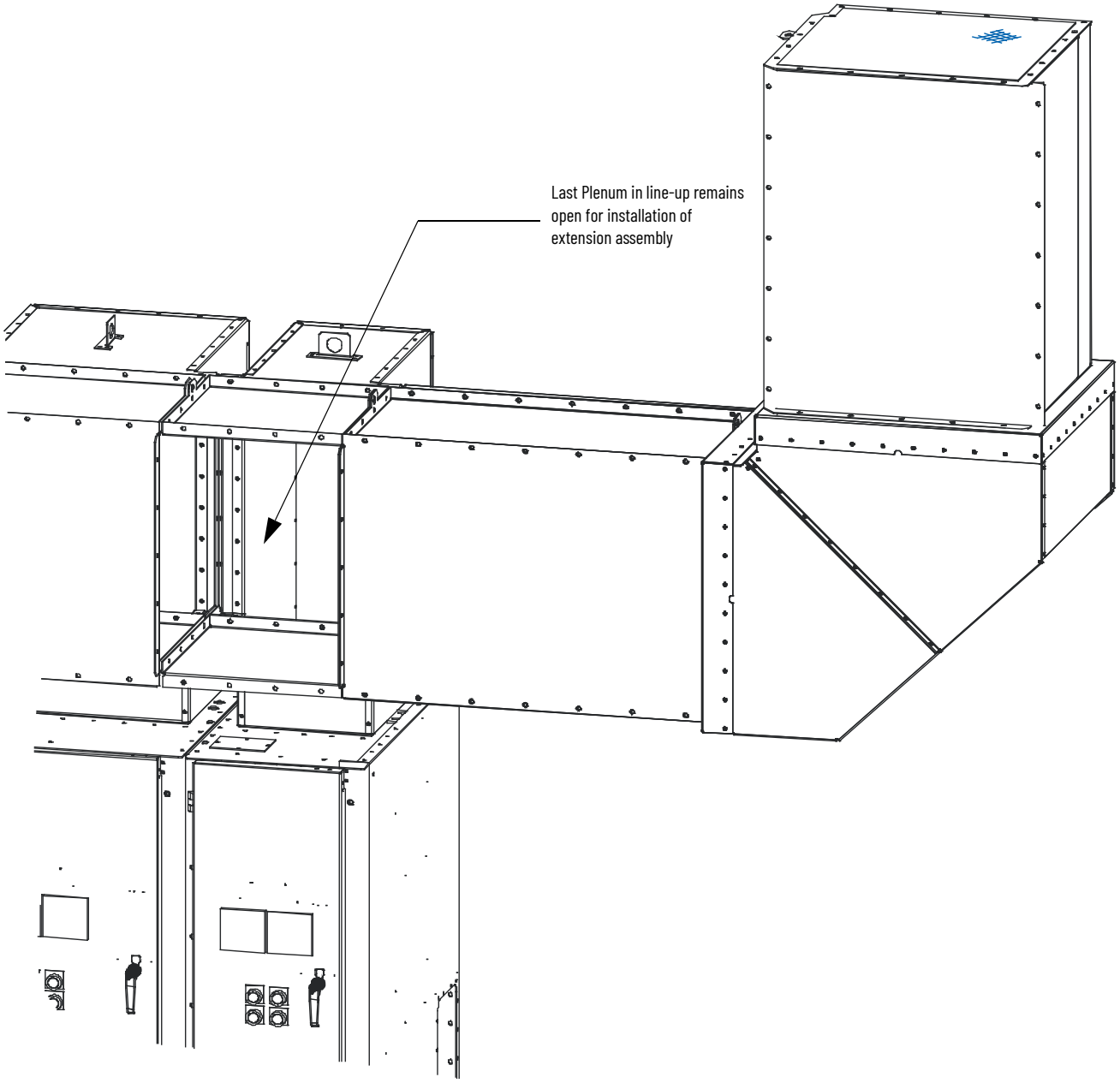


Use silicone caulking generously to fill any air gaps once the Plenum has been securely mounted in place.

STEP 6 – Mounting Extension/Elbow to Plenum Line-up

As referred to in STEP 4 – Closing the Front of the Plenum Sections on page 88, the last Plenum at the exhaust side of the line-up has the front duct section removed. This allows access to fastener holes in order to mount the Extension/Elbow components (see Figure 87).

Figure 87 - Optional Extension/Elbow with Vertical Extension (Right Side Exit)



After the Extension/Elbow assembly is attached through the fastener holes on the inside flange of the Plenum, the front duct section can be replaced and fastened through the holes on the outside flanges.

STEP 7 – Additional Mounting Support

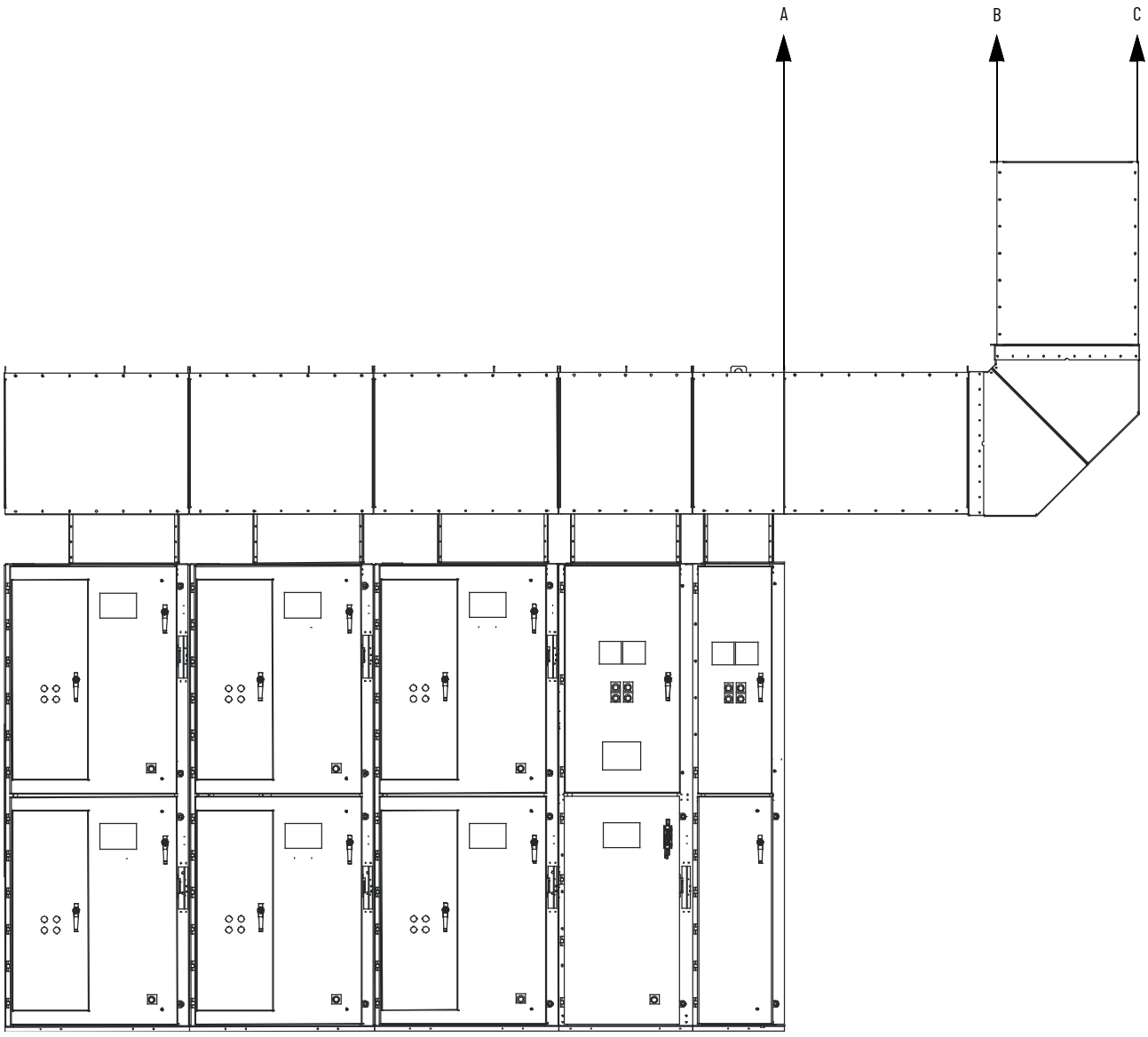
The Extension/Elbow Assembly must have additional mounting support.

90° Elbow Section: Approximate weight 64 kg (142 lbs)

36" Extension Assembly: Approximate weight 51 kg (112 lbs)

Figure 88 shows an example of how the Extension/Elbow Sections can be supported by suspension from a high ceiling. Points **A**, **B** & **C** show where chains or high tension cables may be connected.

Figure 88 - Completed Assembly for optional vertical exit Plenum (Right hand exit)



During an arc fault, the plenum will be subjected to a brief high pressure shock wave. The Extension/Elbow assembly may experience dynamic loading. It is important to account for dynamic loading when selecting supporting means and materials.

ArcShield Chimney Installation Instructions

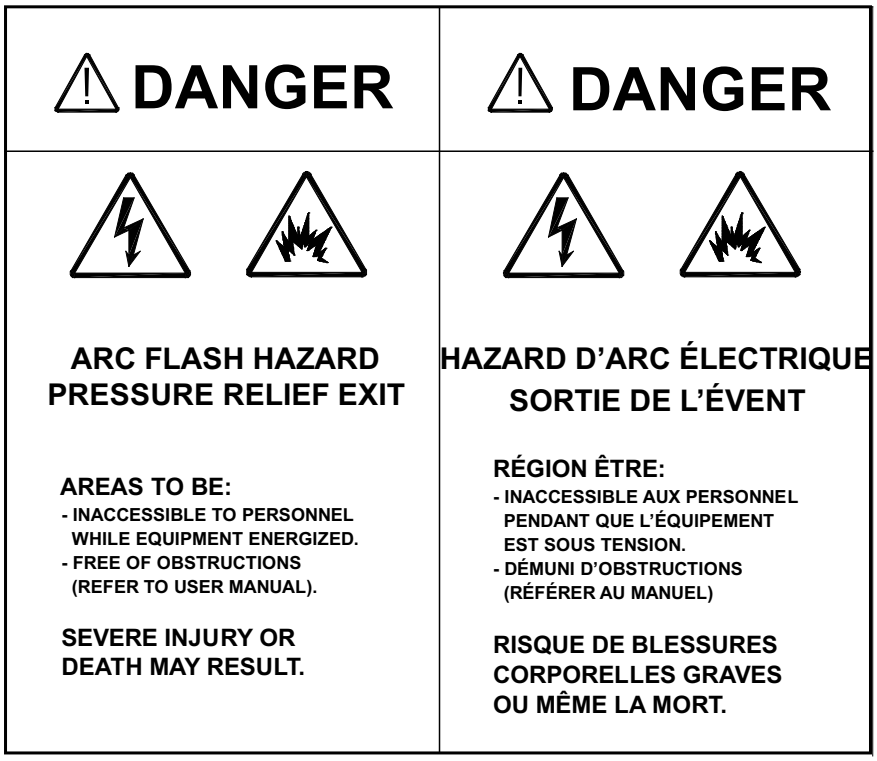
The following instructions are provided to ensure the proper installation and function of chimney supplied with ArcShield enclosures. Refer to Appendix A for additional information related to ArcShield chimney before attempting to follow these instructions.

Recommended Torque Values

1/4 -20 Thread Fasteners – 15 N•m (12 lb•ft)

5/16 -18 Thread Fasteners – 14.5 N•m (11 lb•ft)

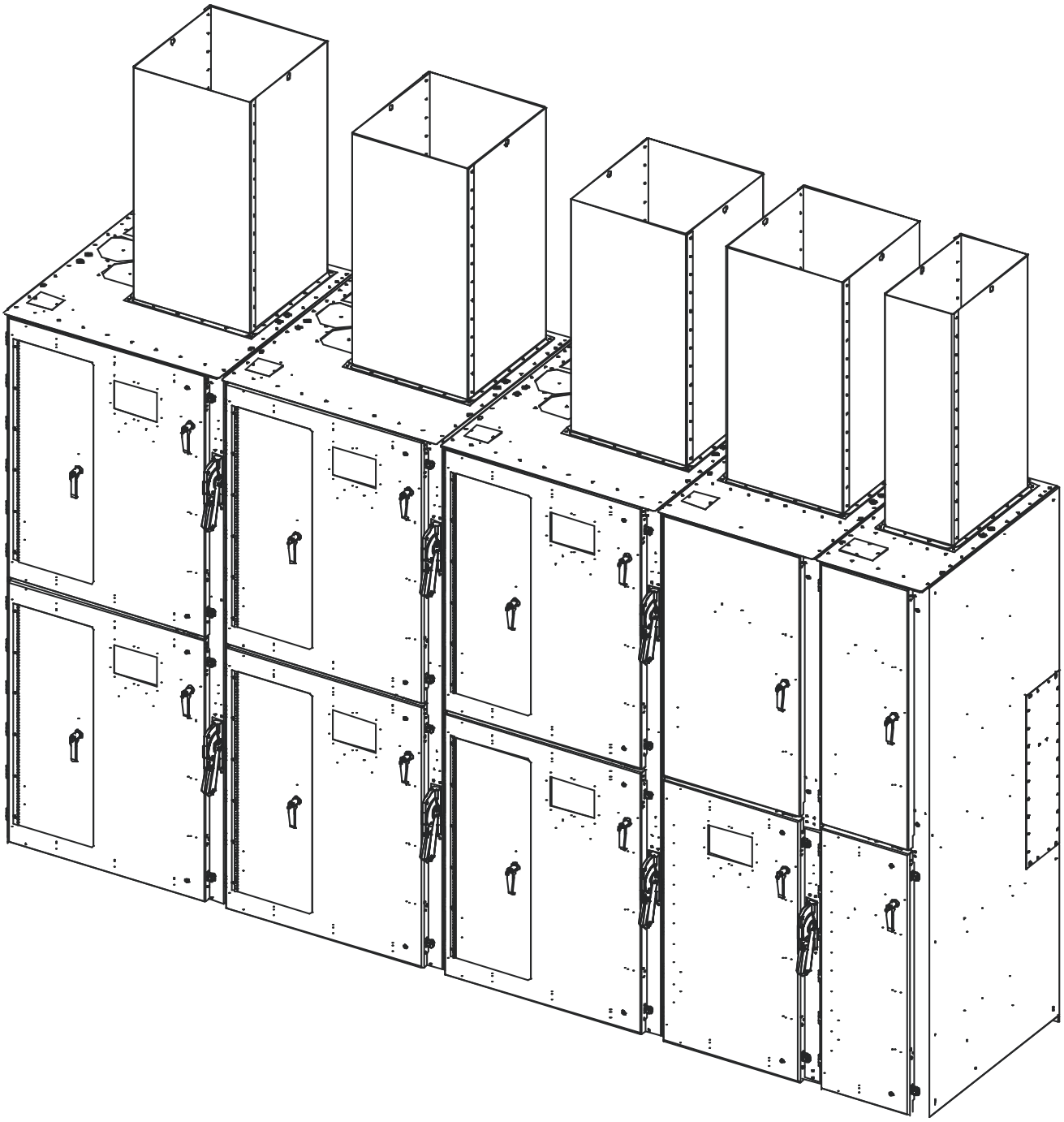
Figure 89 - Chimney Exhaust Label



General Plenum Layout for ArcShield Line-up

An example of a general chimney assembly configuration is shown in Figure 90. Chimneys of varying widths are mounted directly over the MV enclosures of the corresponding width.

Figure 90 - ArcShield Line-up with Arc Chimneys



Cabinet Preparation

In preparation for mounting a chimney:

1. Remove the cabinet lifting means (slips of lifting angles).
2. Reinstall the 5/8-11 bolts retaining the lifting means in the holes from where they came (11 lb•ft [14.5 N•m]). Failure to reinstall the bolts negates the cabinets ability to control any arc gases properly.
3. After the lifting angles or clips are removed, remove 1/4-20 fasteners (12 lb•ft [15N•m])from the relief vent on the top of the MV enclosure.

ATTENTION: Hardware used to retain the lifting provision hardware must be reinstalled in the same holes. Failure to replace this hardware will make the arc resistance of the cabinet ineffective and could subject personnel to the possibility of severe burns, injury, or death.

IMPORTANT Do not remove the four corner fasteners (Figure 92)

Figure 91 - Relief Vent Fasteners (top view)

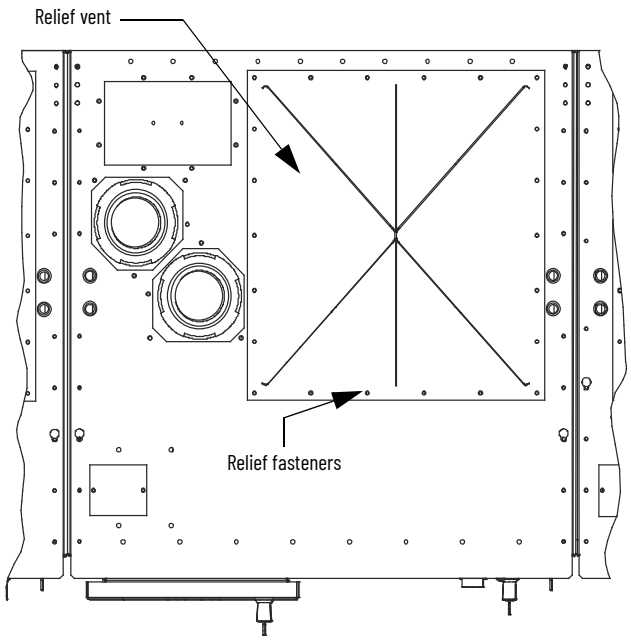
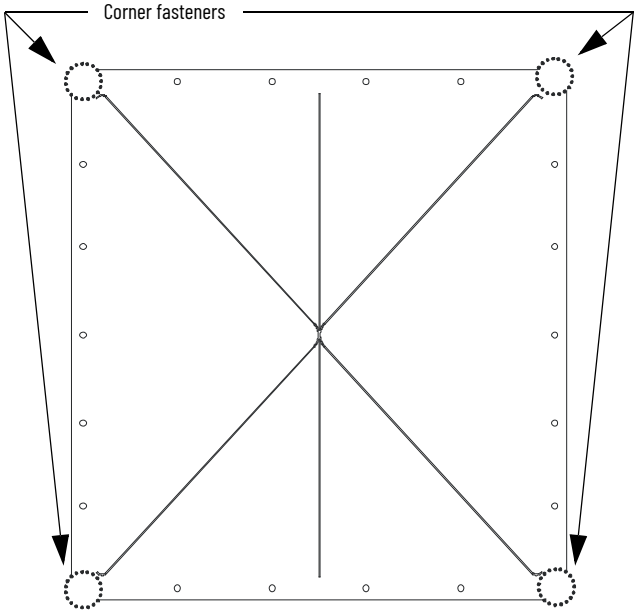


Figure 92 - Relief Vent

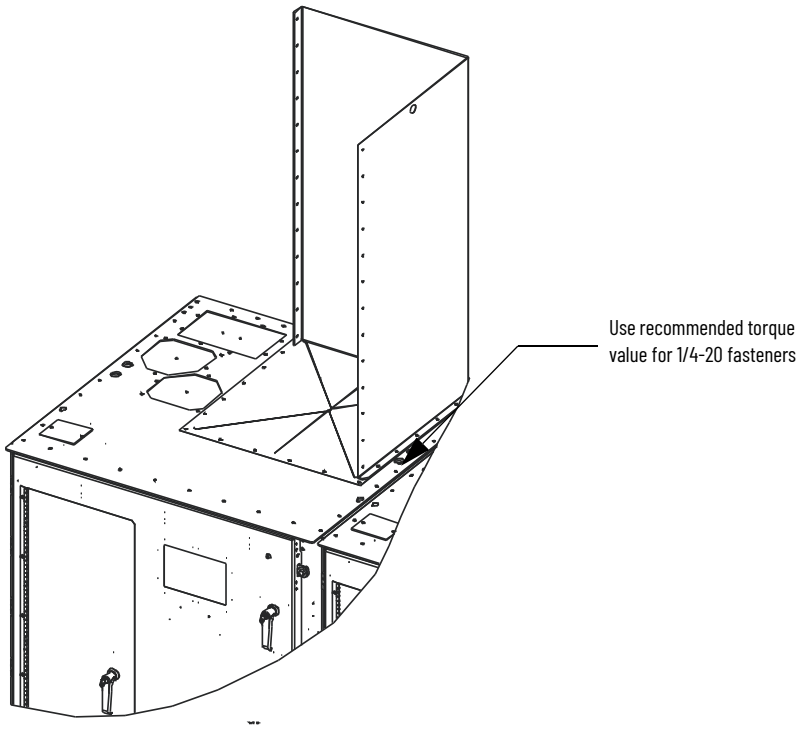


The chimneys are designed to fit over the fastener heads at the four corners of the relief vent. The corner fasteners are required to secure the relief vent during installation.

Chimney Placement on Structure

Once the chimney has been lifted in place directly over the relief vent (shown in Figure 93 on page 96), all 1/4-20 fasteners (12 lb•ft [15N•m]), removed in Cabinet Preparation on page 95, are replaced to attach the chimney to the top of the enclosure.

Figure 93 - Chimney Placement



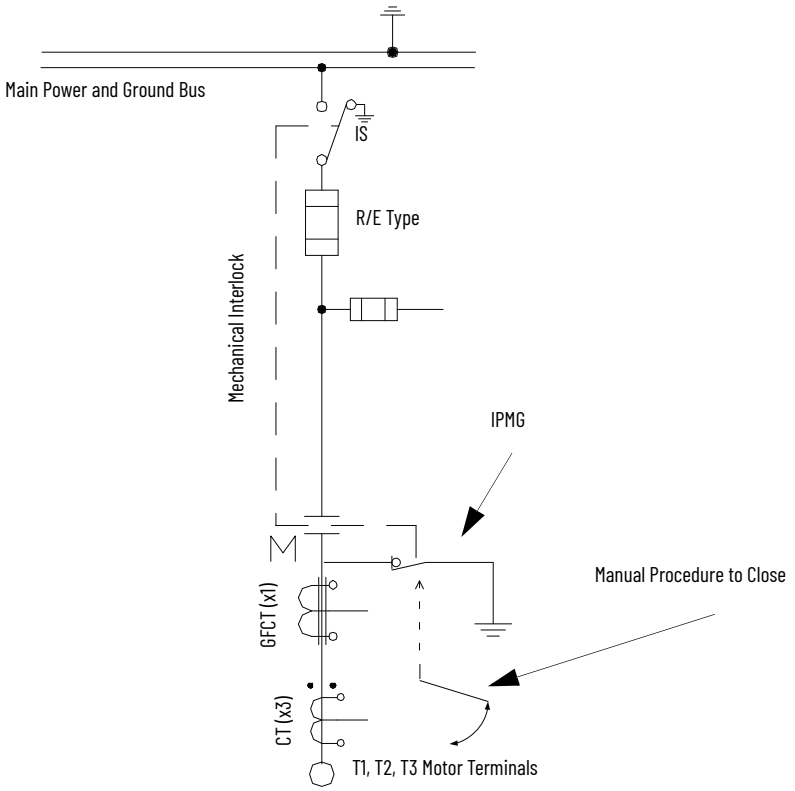
Use silicone caulking generously to fill any air gaps once the chimney has been securely mounted in place.

Integrated Protective Maintenance Grounding Device

Overview

The Integrated Protective Maintenance Grounding device (IPMG) is an optional feature that provides an over-center, spring loaded, snap action device that provides a low impedance grounding path for all load connections on CENTERLINE™ Bulletin 1500/1900 medium voltage motor controllers. The IPMG device can make and withstand short-circuit currents within its capabilities, from both feeding directions within the motor controller, without any latching mechanism. It is applied to safely ground/earth the load connections to three-phase motors, power transformers, and power capacitors ensuring that no harmful voltages are left or become present on the load connections before maintenance personnel enter the motor controller or service the equipment at the end of the load cable connections.

Figure 94 - Typical Controller Single Line showing the optional IPMG



The compact design of the IPMG device does not compromise its rugged construction and proven performance under industrial operating conditions. Requiring minimal maintenance, this manually operated device is controlled from the outside of the standard and arc-resistant (ArcShield™) medium voltage controllers. It is mechanically interlocked to both the main vacuum contactor and our non-load break isolation switch. These features, along with its high electrical and mechanical endurance capabilities, provide a long-life and dependable maintenance free operation.

To enhance your safety program requirements, a visual indication of the blade positions of the IPMG device (OPEN or CLOSED) is available through the standard viewing window on the medium voltage compartment door.

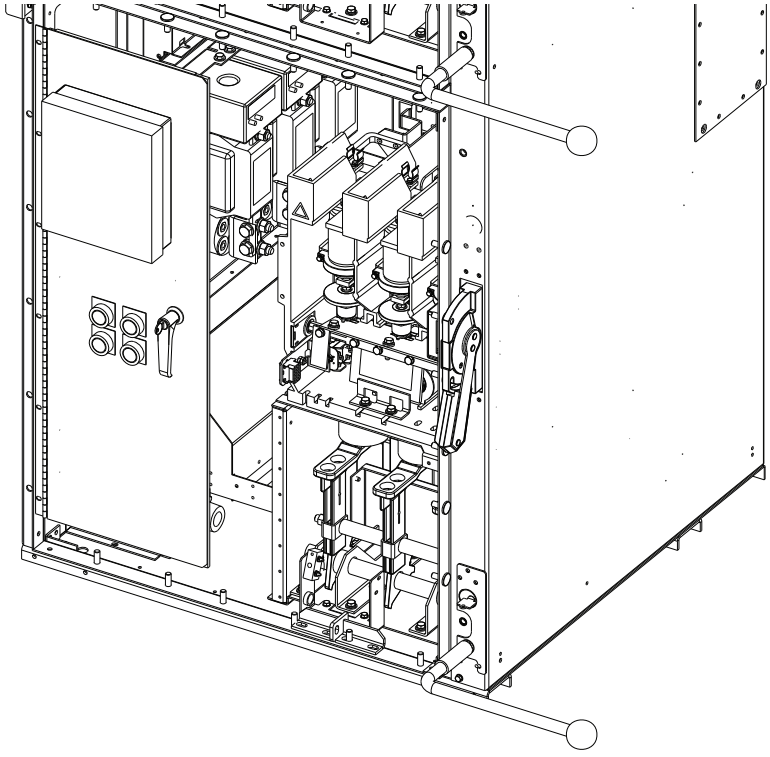
The IPMG device is mounted on the controller floor plate or on the top of the main medium voltage vacuum contactor (for 600/800 A controllers). It is connected to the three load phases within the main controller using copper bus bars. Redundant, flexible grounding conductors ensures the lowest impedance path to ground is maintained when the IPMG device is closed. Flexible grounding conductors provide low impedance back to the main ground bus to complete the grounding (earthing) process.

IPMG Operation

The IPMG device is a manually operated earthing device that is controlled by a direct drive system that is engaged from the exterior of the controller. A removable operating handle engages or disengages the IPMG device from an OPEN to CLOSED or CLOSED to OPEN position.

The rotational angle of the switch handle is approximately 180° to engage or disengage the grounding action of the IPMG device.

Figure 95 - 1512B Cabinet with 400 A IPMG Device Showing the Operating Handle Engaged in Drive Mechanism



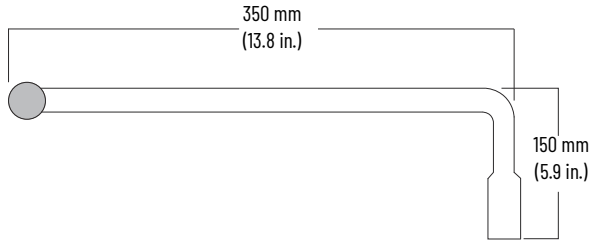
Operating Handle

IMPORTANT There must be a minimum clearance of 25.5 mm (12 in.) on the side of the cabinet where the operating handle is located.

The separate operating handle is suitable for use only for the hex splined interface shaft of the IPMG device. The handle includes an ergonomic insulated grip to aid in the operation of the IPMG device. Significant rotational force is required to engage or disengage the IPMG device.

A 17 mm hexagonal socket with a socket wrench of equal length can also be used to operation the switch,.

Figure 96 - IPMG Operating Handle (Removable)



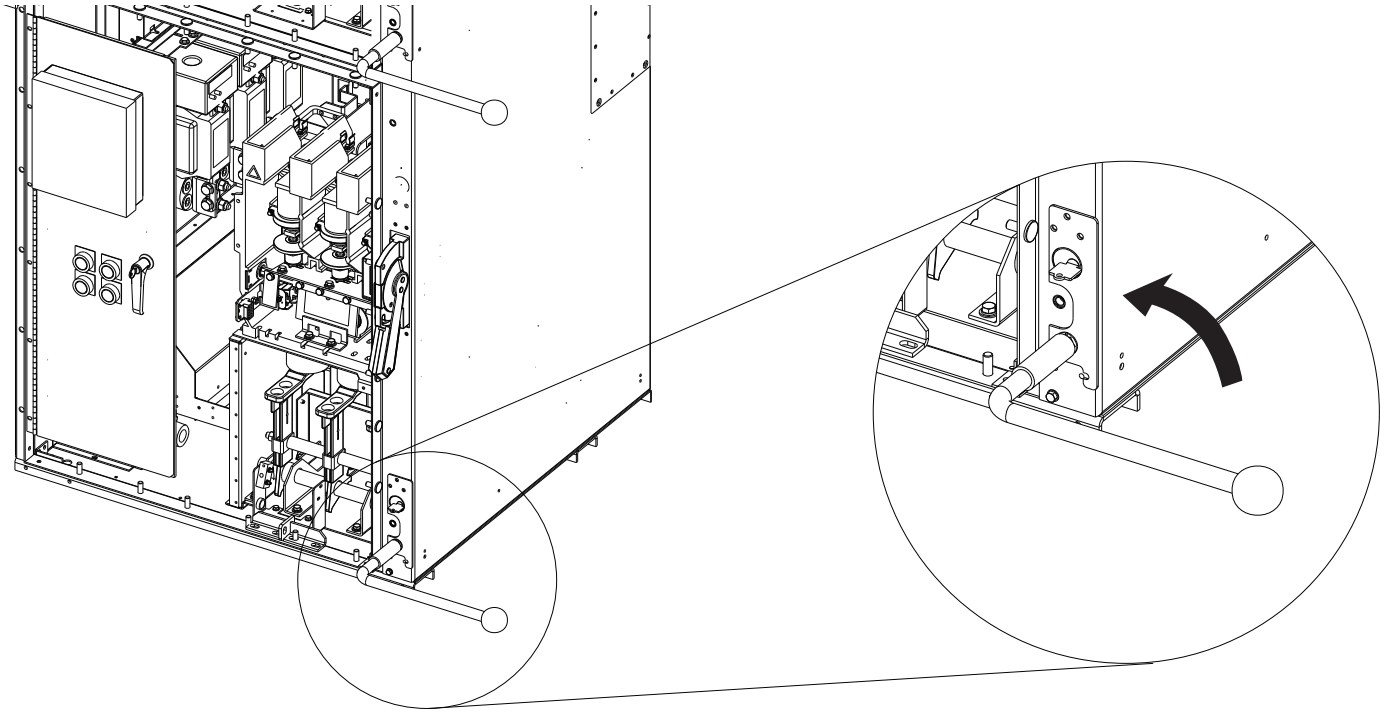
ATTENTION: Before opening or closing the IPMG device, confirm that:
- the isolation switch is in the OFF position
- the main vacuum contactor is OPEN
- the medium voltage compartment door of the controller is closed and bolted tight
- the motor is in a standstill condition before closing the IPMG

ATTENTION: The IPMG device can only be closed when the load has no energy.

Close the IPMG Device from an OPEN Position

1. Insert the operating handle and hex shaft, through the hole in the front of the structure. Place the handle to accommodate at least 180° of counterclockwise motion. The hexagon-shaped shaft must fully mate to the connection of the IPMG operating shaft.
2. Rotate the operating handle, in one motion, approximately 180° counterclockwise until the switch flips into its CLOSED position (there is a significant sound as the IPMG device engages).
3. Remove the handle.
4. Verify the CLOSED position of the IPMG device by viewing the blade positions through the standard viewing window.
5. Verify the position of the indication arrow (Figure 98) and adjust if necessary before operating the isolations switch handle.

Figure 97 - Close the IPMG Device from an Open Position (1512B Cabinet with 400 A IPMG Device)



Opening the IPMG Device from a Closed Position

1. Insert the operating handle and hex shaft, through the hole in the front of the structure. Place the handle to accommodate at least 180° of clockwise motion. The hexagon-shaped shaft must mate with the connection of the IPMG operating shaft.
2. Rotate the operating handle, in one motion, approximately 180° clockwise until the switch flips into an OPEN position (there is a significant sound as the IPMG device disengages).
3. Remove the handle.
4. Verify the OPEN position of the IPMG device by viewing the blades position through the standard viewing window.
5. Verify the position of the indication arrow (Figure 98) and adjust if necessary before operating the isolations switch handle.

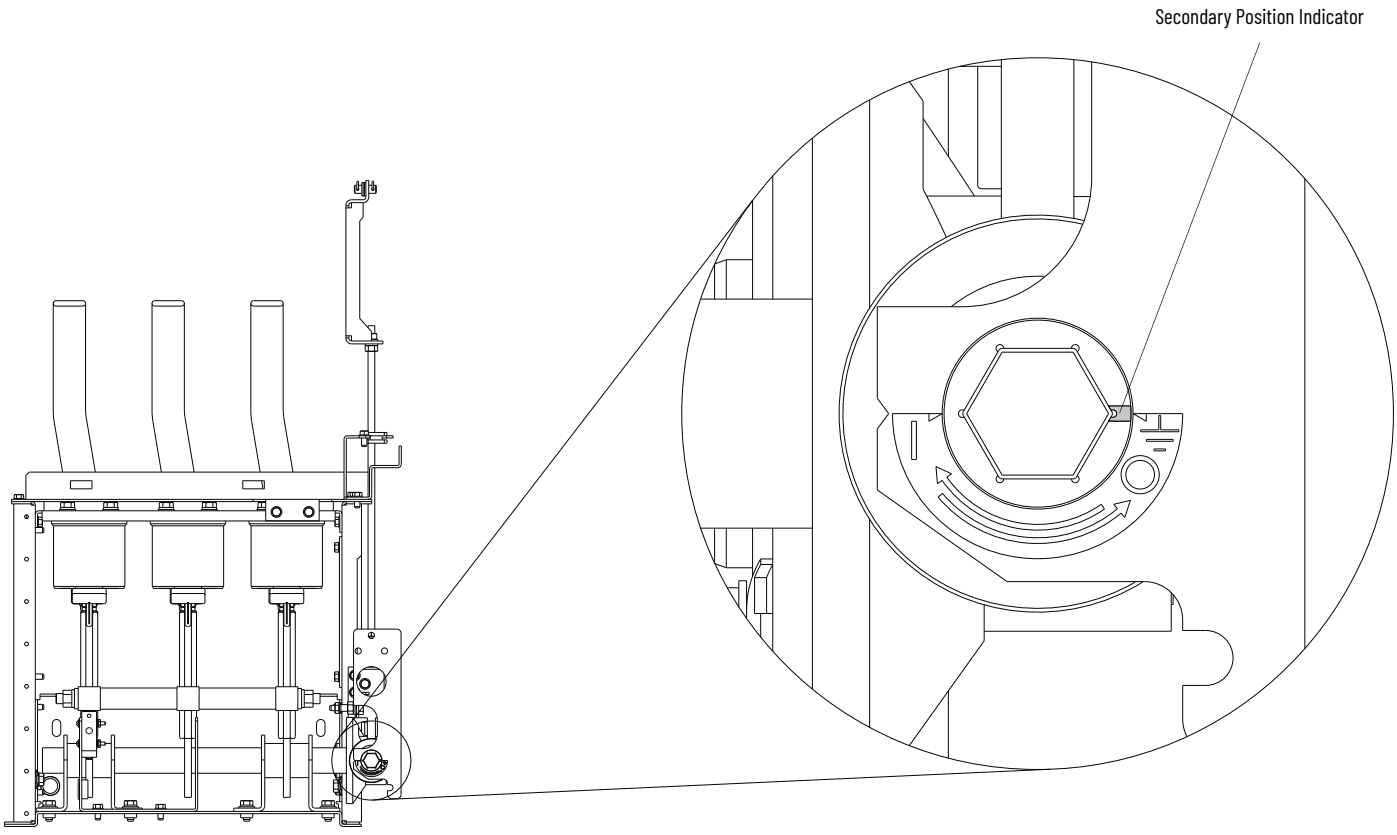
IPMG Positioning Indicators

In compliance with many safety standards, such as NFPA 70E, the position of the IPMG device is seen through a standard viewing window. The Lexan viewing window is on the lower half of the main medium voltage power cell door. The switch is in the CLOSED or GROUNDED position when the blades are in a vertical position. If the blades are not readily visible and/or if they are in a more horizontal position, the IPMG device is in the OPEN position.

There is a secondary position indicator where the operating handle is used. The graphic below details the location of the indicator that shows you what position the IPMG device is in.

ATTENTION: After operating the IPMG device, verify the position indicator matches the label. Adjust if necessary before operating the isolation switch handle.

Figure 98 - Secondary Position Indicator



Key Interlocking

An optional mechanical key interlock is available to lock the IPMG device in the CLOSE or OPEN positions. Contact the factory for further details.

Auxiliary Switches

The IPMG device comes standard with either 2-Form C auxiliary contacts or with an optional 4-Form C auxiliary contact configuration. These auxiliary contacts indicate the mechanical and electrical position of the IPMG device. OPEN (ungrounded load connections) or CLOSED (grounded load connections). These auxiliary switches can be incorporated into the controller's control circuit. Their electrical ratings are shown Table 4 on page 102.

Figure 99 - 400 A IPMG showing Auxiliary Contact

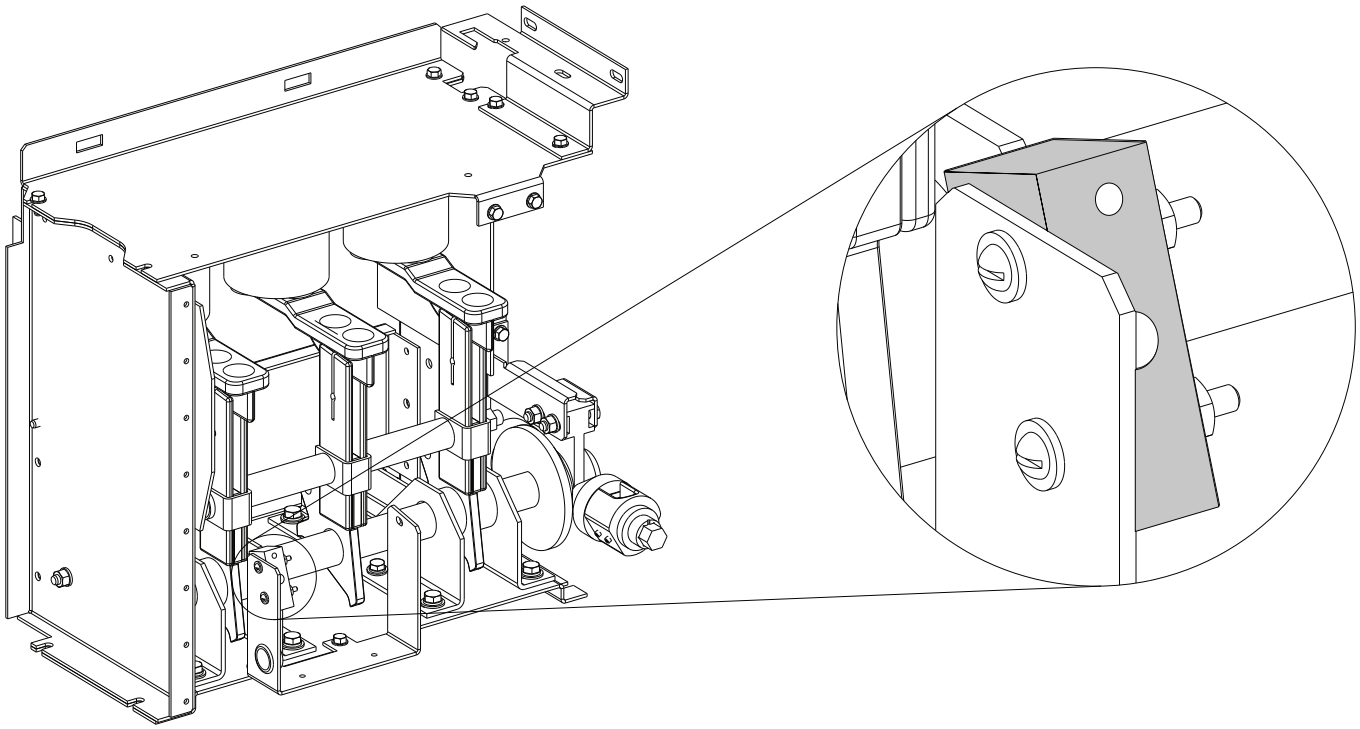


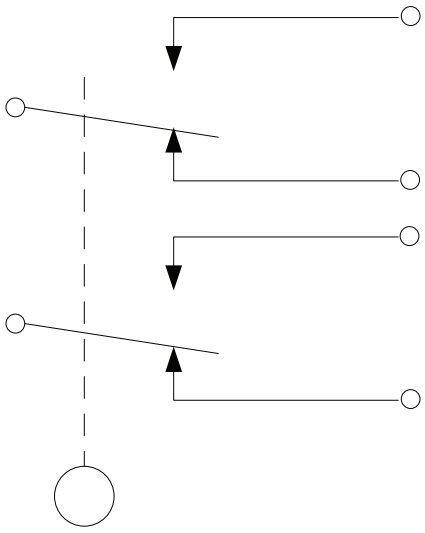
Table 4 - Auxiliary Switch Specifications

Description		Value
Rated voltage (V AC/V DC)		250
Maximum continuous current (A)		10
Contact configuration		DPDT
Contacts available (standard)		2-Form C
Contacts available (optional)		4-Form C
Breaking capacity >5000 electrical operations[1] (A)	110/120V AC	10
	220/240V AC	10
	125V DC	0.3
	250V DC	0.15
UL code		L59
Mechanical life (operations)		3,000,000

(1) When time constant is < 40 ms.

The auxiliary contacts are factory adjusted and should not require readjustment in the field. The electrical configuration of the auxiliary contacts is shown below.

Figure 100 - Standard, 2- Form C Auxiliary Contact Configuration



IPMG Specifications

Specifications

Description	Rating
Maximum operating voltage	7.2 kV (±5%)
Operating frequency	50/60 Hz
Rate impulse voltage withstand (BIL)(1)	60 kV
Rate 1-second voltage withstand	22 kV
Rate 1-minute voltage withstand	20 kV
Rated short time withstand current	31.5 kA rms
Short time withstand duration	4 s
Rate peak current	80 kA rms
Mechanical duration grade	M1
Mechanical endurance (operations)	2000
Torsional strength	1600 N
Mean time to failure (MTTF)	>20 years
Clearance between open contacts	>125 mm (4.9 in.)
Contact pressure	400±30 N
Movable blade and ground electrode center-center distance	116.5 mm (4.6 in.)
Approximate handling close operation force (<1°)	≤250 N
Approximate handling open operation force (<1°)	≤250 N
Approximate handling close operation force (<15°)	≤450 N
Approximate handling open operation force (<15°)	≤450 N
Loop resistance	≤75 µΩ
Method of operation	Rotational, snap action
Rotational degrees for change of state	90º ±5
Maximum difference between all three-phase closing	≤3 mm (0.12 in.)
Quantity of mounting holes	8
Mounting hole (slotted) diameter	9 x 18 mm (0.4 x 0.7 in.)

(1) The wave-shape must be 1.2/50 µs similar to those as defined in IEC 60060-1 and UL 347.

Maintenance

The IPMG device is virtually maintenance free. All contacts are lubricated in the factory at the time of shipment. General annual inspections should include that the main drive line operates smoothly and does not stick or bind due to possible misalignment that is caused by the mechanical interlocks and interfacing to the main contactor and isolation switch. The grounding (earthing) process is achieved through the movable blades and the fixed terminal points within the frame of the IPMG device. Verify that these connections are intact and that the flexible grounding conductors, are attached to the common shaft of the IPMG device, and are not broken, distressed, or frayed.

Spare Parts

Spare Parts

Part	Part No.
Replacement auxiliary switch (two form C contacts)	PN-125139
Operating handle	PN-612406
Nyogel 759G/760G contact lubricant	80158-357-51

History of Changes

This appendix contains the new or updated information for each revision of this publication. These lists include substantive updates only and are not intended to reflect all changes. Translated versions are not always available for each revision.

Publication 1500-UM055H-EN-P - February 2015

Topic
Replaced Typical Structure and Typical Nameplate graphics
Added Environmental Conditions
Transposed step 3 and 4
Added Attention table
Added step to procedure for Joining Sections
Modified Attention table
Replaced Typical Ground Bus Splicing Configuration graphic
Added Isolation Switch Kit and stocking quantity
Added (Series R or higher) to 80158-707-53
Added 50 kA to Overview
Added Attention table
Added instructions to Cabinet Preparation
Added Attention table
Added instructions to Cabinet Preparation

Notes:

Rockwell Automation Support

Use these resources to access support information.

Technical Support Center	Find help with how-to videos, FAQs, chat, user forums, and product notification updates.	rok.auto/support
Knowledgebase	Access Knowledgebase articles.	rok.auto/knowledgebase
Local Technical Support Phone Numbers	Locate the telephone number for your country.	rok.auto/phonesupport
Literature Library	Find installation instructions, manuals, brochures, and technical data publications.	rok.auto/literature
Product Compatibility and Download Center (PCDC)	Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes.	rok.auto/pcdc

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Waste Electrical and Electronic Equipment (WEEE)

At the end of life, this equipment should be collected separately from any unsorted municipal waste.

Rockwell Automation maintains current product environmental information on its website at rok.auto/pec.

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