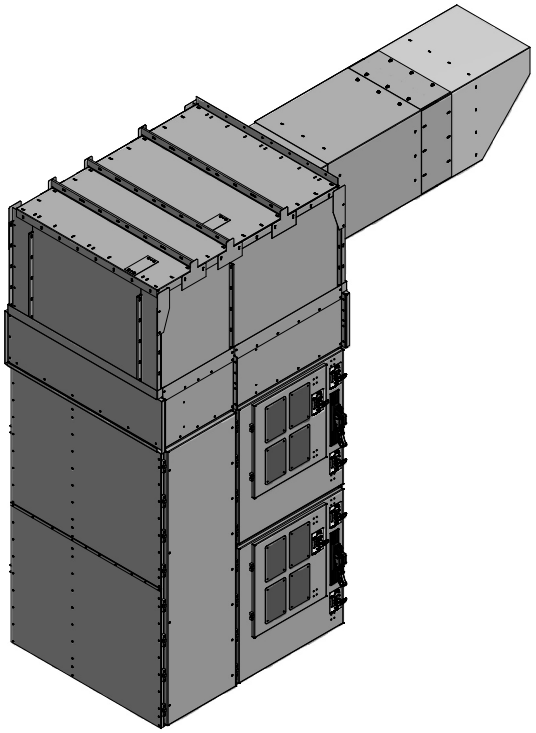
Instruction Booklet IB**48076** Effective August 2011

Instructions for Eaton 7.2kV AMPGARD Arc Resistant Motor Control Centers



Contents

Powering Business Worldwide

Read and understand these instructions before attempting installation, operation, or maintenance of this equipment. This equipment must be installed and serviced only by qualified electrical personnel. Retain this document for future use.

⚠WARNING

HAZARD OF ELECTRICAL SHOCK OR BURN. OPERATING THE EQUIPMENT OUTSIDE OF ITS RATINGS MAY CAUSE FAILURE RESULTING IN PROPERTY DAMAGE, SEVERE PERSONAL INJURY, OR DEATH. THE EQUIPMENT MUST BE OPERATED WITHIN ITS NAMEPLATE RATINGS.

⚠DANGER

ALL APPLICABLE SAFETY CODES, SAFETY STANDARDS, AND SAFETY REGULATIONS MUST BE STRICTLY ADHERED TO WHEN INSTALLING, OPERATING, OR MAINTAINING THIS EQUIPMENT.

Section 1: Introduction

1.1 Purpose

This instruction bulletin covers the installation of the plenum and operation of AMPGARD arc resistant medium voltage motor control centers. It does not cover all possible contingencies, variations, and details that may arise during installation of this equipment.

1.2 Application and Description

Eaton's AMPGARD arc resistant Medium Voltage Control (MVC) provides centralized control and protection of medium voltage power equipment and circuits in industrial, commercial, and utility installations involving motors, transformers, and feeder circuits. Arc resistant MVC provides additional protection in the event of an internal arcing fault. Eaton's arc resistant equipment meets or exceeds UL 347 and UL 50E as they apply to metal-enclosed medium voltage industrial equipment and ANSI/IEEE C37.20.7 for arc resistant type 2B. The assemblies also exceed all seismic requirements contained in the International Building Code and the California Building Code. See Table 2 for arc ratings.

Table 1. AMPGARD Electrical Ratings

	Ratings per UL 347						
				Insulation Level			
Rated Maximum Voltage	Starters per structure	Starter Frame Size	Maximum Current per starter	Dielectric Withstand	Lightning Impulse	Rated Main Bus Continuous Current	Rated Short Time Short-Circuit Current Withstand (2 second)
kV rms	#	Amperes	Amperes	kV rms	kV peak	Amperes	kA rms Sym
7.2	1	400	350	18.2	60	1000, 1200, 2000, 3000	50
7.2	2	400	320 top 320 bottom	18.2	60	1000, 1200, 2000, 3000	50
7.2	2	400	210 top 350 bottom	18.2	60	1000, 1200, 2000, 3000	50
7.2	1	800	600	18.2	60	1000, 1200, 2000, 3000	50

Table 2. AMPGARD Arc Resistant Ratings

Ratings per IEEE C37.20.7			Plenum and Duct Style
Accessibility Type	Rated Arc Short Circuit Withstand Current kA rms Sym	Rated Arc Duration sec.	
2B	30	0.5	original
2B	49	0.5	common with VacClad
2B	50	0.5	original

1.3 Documentation Reference

Refer also to the following instructions to install the plenum and exhaust ducts on arc resistant equipment:

IB 48077: Plenum and Duct Installation

These instructions cover aspects of the equipment particular to its arc resistant enclosure. This document must be used in conjunction with the following instructions specific to the type of starter being installed:

IB48041: AMPGARD 400A Motor Starters (not arc resistant)

IB48043: AMPGARD 800A Motor Starters (not arc resistant)

IB48068: AMPGARD RVSS Soft Starters

You may also wish to refer to one of the following documents:

IB48042: AMPGARD Seismic Instructions

IB02201001E : VCP-W Arc Resistant Switchgear

For further information on installation and application, refer to the applicable technical data, publications, and/or industry standards. Download Eaton electronic information from www.eaton.com/electrical.

1.4 Eaton Contact Information

For the location of your nearest Eaton sales office or distributor, call toll-free 1-800-525-2000 or log onto www.eaton.com/electrical. Eaton Services and Systems (EESS) can be reached at 1-800-498-2678.

1.5 Modifications to Equipment

Any modifications to the equipment outside of the assembly instructions in Eaton documentation compromises compliance with ANSI/IEEE C37.20.7. Please contact the factory with any related questions.

MODIFICATIONS TO THE EQUIPMENT ENCLOSURE CAN COMPROMISE ITS ARC RESISTANT PROPERTIES. Low Voltage Doors are the only parts that may be modified in an arc resistant lineup. Medium voltage cell doors, side covers, or rear covers must not be modified.

1.6 Safety Precautions

Only qualified electrical personnel with training and experience on high-voltage apparatus shall be permitted to work on this equipment. They shall be familiar with the work to be performed, as well as industry and local safety procedures and standards.

1. Read and understand these instructions before attempting installation, operation, or maintenance of the equipment.
2. Disconnect all low voltage and medium voltage power sources before working on the equipment per Occupational Safety and Health Act (OSHA) and lockout procedures. Verify that the voltage has been removed. Observe National Electrical Code (NEC), OSHA, and local procedures and standards. This includes visual inspections while the door is open, making any adjustments inside or outside the enclosure, performing maintenance, or installing replacement parts.
3. Never leave the isolation switch in an intermediate position. Always move the handle to the fully open or fully closed position.
4. The user is responsible for conforming to all applicable code requirements with respect to grounding the equipment.
5. Use adequate fall protection when working above ground level.

⚠CAUTION

THE ARC RESISTANT RATING OF THE EQUIPMENT IS ONLY VALID WHEN ALL COVERS AND DOORS ARE PROPERLY SECURED (EXCEPT FOR LOW VOLTAGE DOORS) OVER THE ENTIRE LENGTH OF ANY GIVEN LINEUP. WHEN WORKING INSIDE A MEDIUM VOLTAGE COMPARTMENT, EVEN THOUGH THE COMPARTMENT IS ISOLATED ELECTRICALLY, PERSONNEL WILL NOT BE PROTECTED AGAINST AN ARC FAULT AND MUST WEAR APPROPRIATE PPE.

⚠CAUTION

BEFORE ENERGIZING THE EQUIPMENT, ENSURE THAT:

- **THE EQUIPMENT IS SECURED ON A TRUE AND LEVEL SURFACE.**
- **CONFIRM ALL HARDWARE IS IN PLACE AND TORQUED PER SPECIFIED VALUES.**
- **CONFIRM NO TOOLS OR OBJECTS ARE LEFT INSIDE THE ENCLOSURE**
- **CONFIRM ALL DEVICES, COVERS, DOORS, PANELS, ETC., ARE SECURED.**

1.7 Sound Levels

The sound developed during an arc fault event is significant and is not completely predictable due to the nature of the arc fault. Sound is dramatically affected by surrounding structures, buildings, and equipment, so testing can't be done for all possible circumstances. Sound levels were measured at various distances from the end of a 2-meter-long duct during 50kA arc fault events, and used to generate the guidelines tabulated below. Please review the table and determine the correct PPE required by personnel in the vicinity of the equipment for your installation.

Table 3. Sound Pressure Levels (SPL)

Distance from end of duct (ft.)	0	50	100	200
Minimum expected SPL (dB)	120	110	100	100

Section 2: Receiving, Handling, and Storing AMPGARD Equipment

2.1 Receiving

The equipment is shipped assembled in shipping splits. Depending on the length of the lineup, it may be necessary to ship the equipment in several shipping sections to facilitate handling.

Each shipping section ships bolted to wooden skids and covered with protective material. A box labeled "Installation Parts" is also included. This box contains the packing list. The packing list identifies all cartons and crates. Each carton and crate is labeled with the shop order number and a shipping weight.

Accept items from shipping carrier if all items described on the packing list have been received. If the equipment has been damaged, file a claim as soon as possible with the carrier and notify the nearest Eaton representative.

If the plenum and duct are to be installed upon receipt, unpack and handle according to Section 2.2. If the plenum and duct are to be stored, see Section 2.3.

2.2 Handling

Refer to Table 4 for the approximate weights of the various AMPGARD equipment configurations.

Table 4. Typical Section Weights

	Arc Resistant Rating			
	Main Bus Rating	30 kA	50 kA	49 kA
Equipment Type	Amperes	Lbs (kg)	Lbs (kg)	Lbs (kg)
2-high 400A starter 36in. (915mm) wide	1000 1200 2000 3000	1630 (740.9) 1640 (745.5) 1650 (750) 1670 (759.1)	1680 (763.6) 1690 (768.2) 1700 (772.7) 1720 (781.8)	1680 (763.6) 1690 (768.2) 1700 (772.7) 1720 (781.8)
1-high 800A starter 36in. (915mm) wide	1000 1200 2000 3000	1580 (718.2) 1590 (722.7) 1600 (727.3) 1620 (736.4)	1630 (740.9) 1640 (745.5) 1650 (750) 1670 (759.1)	1630 (740.9) 1640 (745.5) 1650 (750) 1670 (759.1)
Incoming Line 24in. (610mm) wide	1000 1200 2000 3000	1090 (495.5) 1090 (495.5) 1100 (500) 1110 (504.5)	1140 (518.2) 1140 (518.2) 1150 (522.7) 1160 (527.3)	1140 (518.2) 1140 (518.2) 1150 (522.7) 1160 (527.3)
Arc plenum lineup per 1 in. (25mm) of width	n/a	5.6 (2.5)	6 (2.7)	4.2 (1.9)
Exhaust duct per 1 in. (25 mm) of length	n/a	5 (2.3)	6.4 (2.9)	1.7 (0.8)
Dual-exhaust manifold	n/a	n/a	n/a	150 (68.2)
Transition section to VacClad Switchgear 4in. (100mm) wide	n/a	30 (13.6)	30 (13.6)	162 (73.6)

The preferred method of lifting and maneuvering the shipping sections into their final position is with an overhead crane. Lifting members are bolted to the top of each shipping section. Attach a bridle sling to all 4 lifting points to lift or move the section. Refer to 25A4312H01, included with each shipping section for handling instructions. After the section has been moved into installation position, remove the lifting members and discard them.

If a crane is not available, safeguards need to be put in place to assure that the equipment is not deformed during maneuvering. Move the shipping section by use of rollers.

2.3 Storing Indoor Equipment

AMPGARD equipment contains insulating materials, electrical contacts, and operating mechanisms which must be protected against dirt, moisture, dust, foreign materials, corrosive atmospheres, and extreme temperature changes. If it is necessary to store the equipment before installation, place the equipment on a true and level surface in order to reduce strain and distortion in the equipment. Cover it and keep it in a clean and dry location with ample air circulation and heat to prevent condensation.

Note: Storing the equipment outdoors is not recommended.

Section 3: Installation

3.1 Installation Procedure

To install AMPGARD arc resistant equipment, first follow the installation instructions outlined in IB48041 or IB48043. Refer to the following figures and tables for information specific to the arc resistant product:

Note: The hinged exhaust flaps on top of the equipment are secured with screws in tear-away slots. These screws are intended to remain in place and should not be removed.

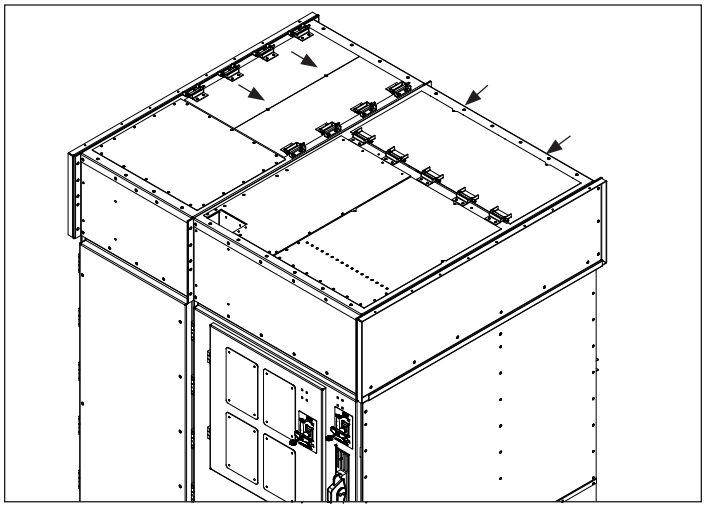


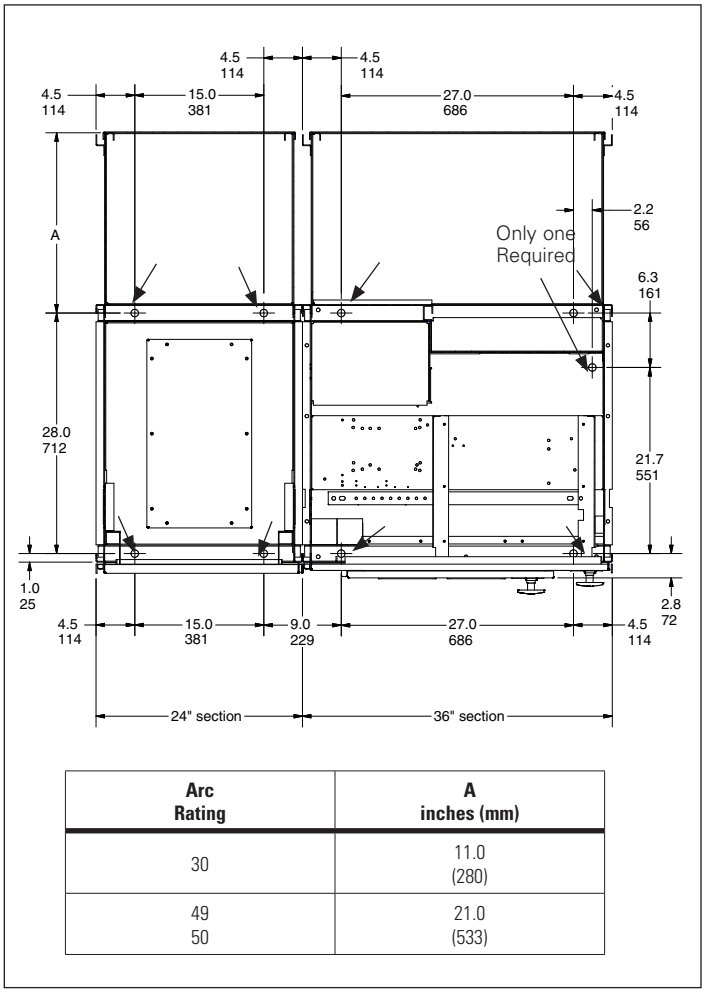
Figure 1. Bus Enclosure Flap Screws - Do Not Remove.

Table 5. Fastener Torque Requirements

Bolt size in mm	0.25 (6.35)	0.31 (7.87)	0.38 (9.65)	0.50 (12.7)	0.62 (15.75)
Bolt Material	**Torque in Foot-Pounds (N-m)**				
High Strength Steel	5 (6.78)	12 (16.27)	20 (27.12)	50 (67.8)	95 (128.82)

Table 6. Minimum Installation Clearances

Arc Rating	Exhaust Duct Configurations	Minimum clearance to obstructions (in)				Minimum ceiling height (in)
		Non-seismic		Seismic		
		Size	Rear	Sides	Rear	
30 kA	Open Top	40 (1016)	40 (1016)	40 (1016)	40 (1016)	144 (3658)
	Side, Front, Rear	4 (102)	4 (102)	6 (152)	6 (152)	124 (3150)
50 kA	Open Top	80 (2032)	80 (2032)	80 (2032)	80 (2032)	144 (3658)
	Side, Front, Rear	4 (102)	4 (102)	6 (152)	6 (152)	124 (3150)
49 kA	Side, Front, Rear	3 (76)	3 (76)	6 (152)	6 (152)	146 (3708)



Arc Rating	A inches (mm)
30	11.0 (280)
49 50	21.0 (533)

Figure 2. Footprint and lag-down bolt locations.

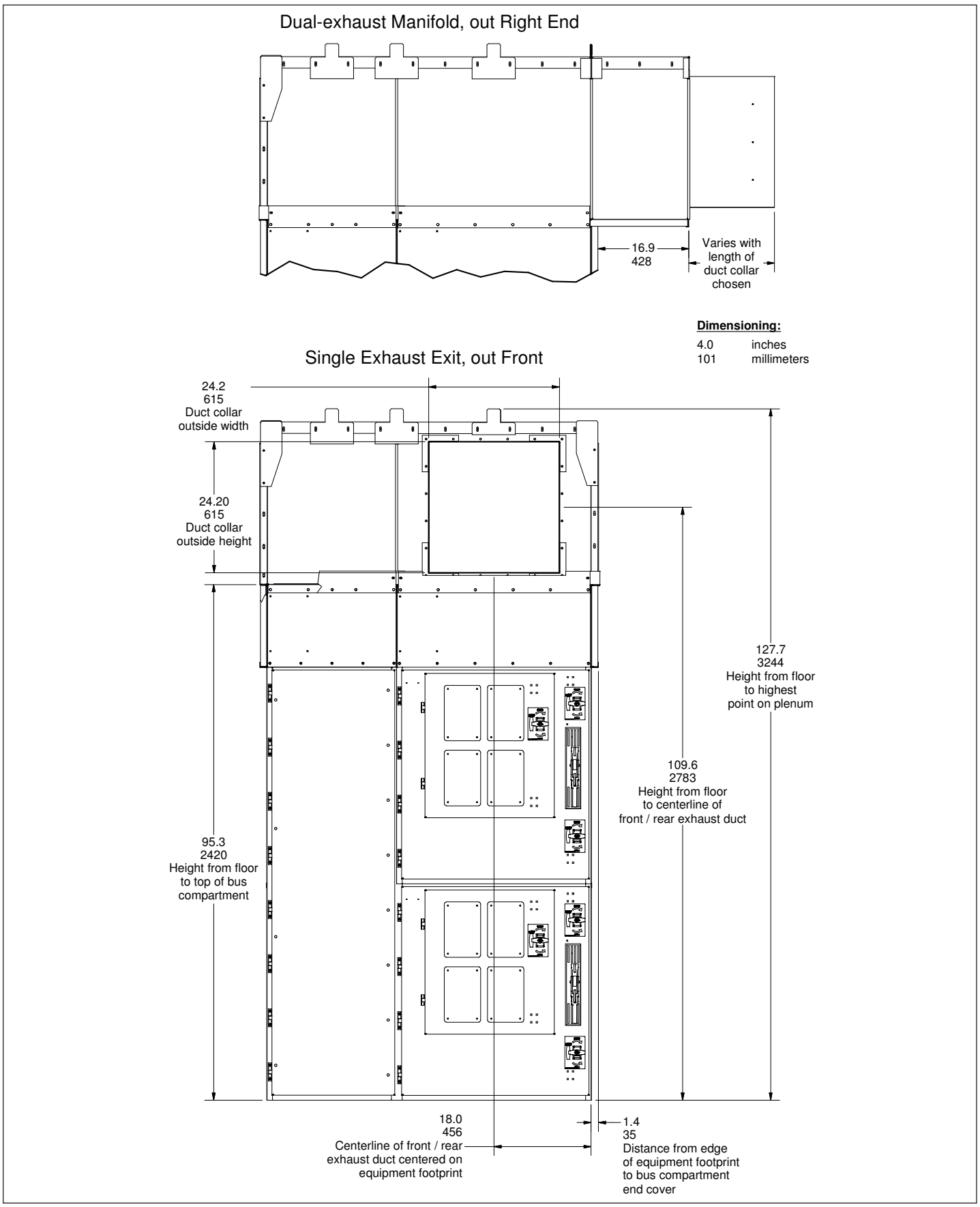


Figure 3. 49 kA Front View.

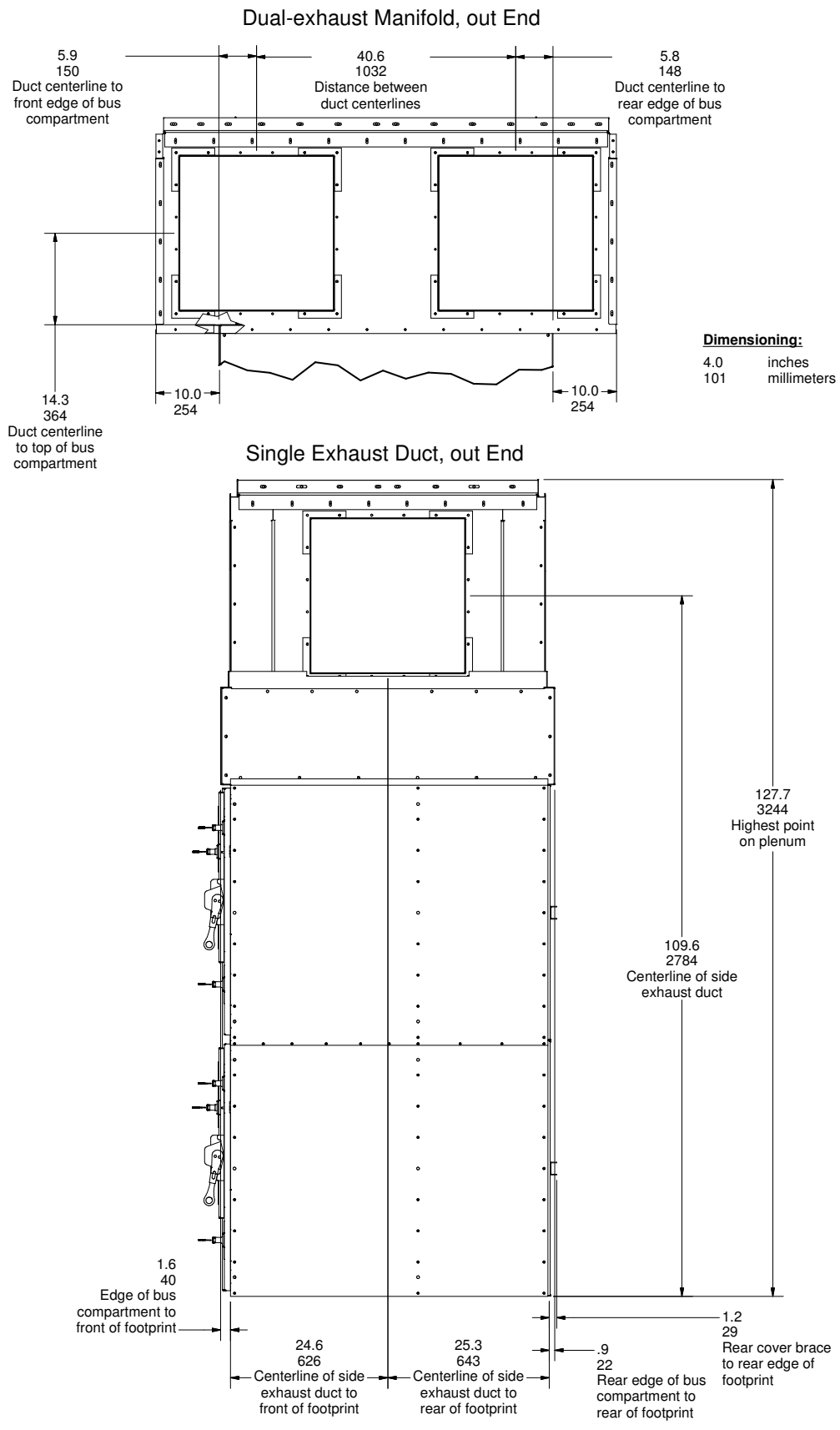
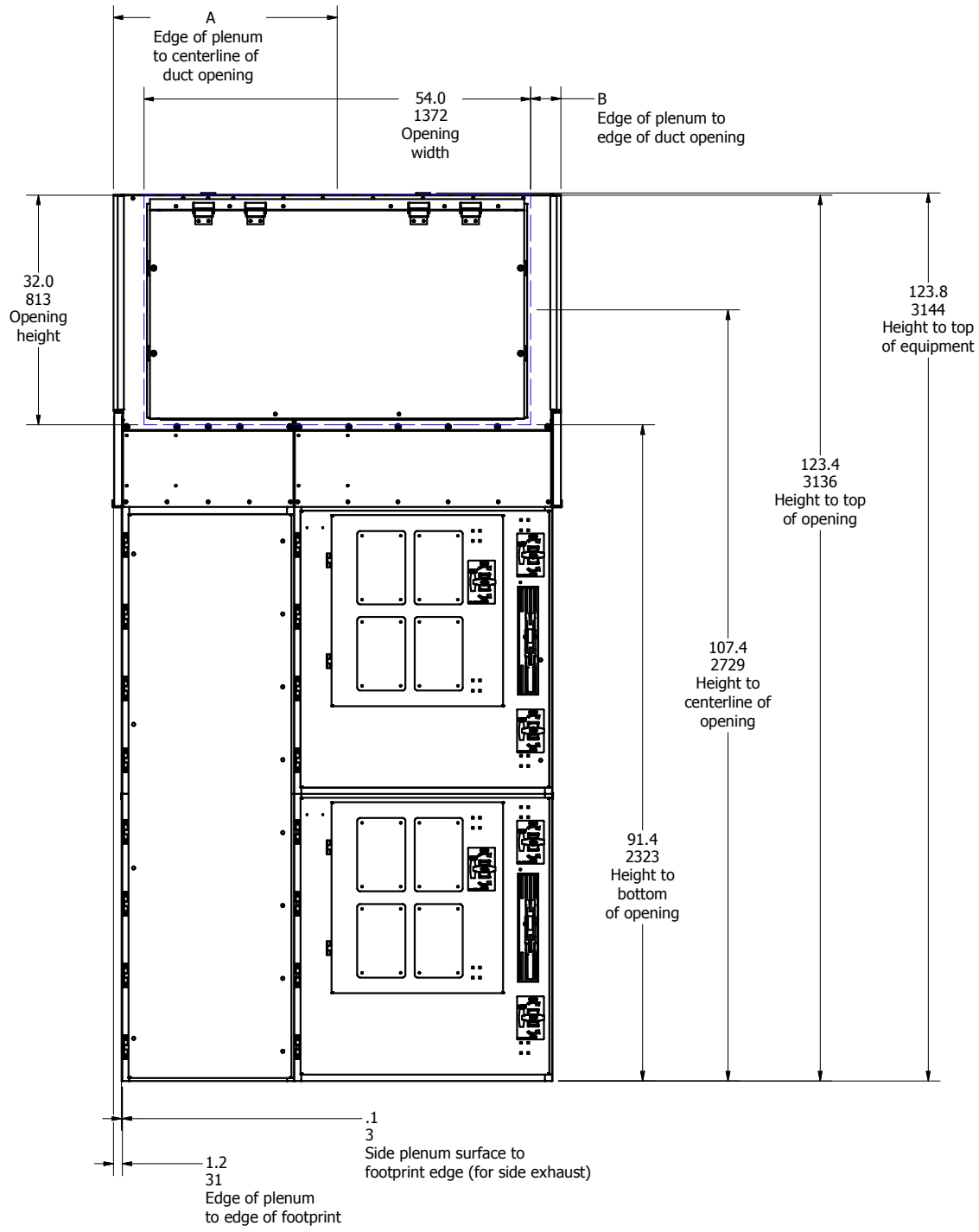


Figure 4. 49 kA Side View.



Dimensions by lineup composition		
Structures in lineup	A	B
24" + 36" (shown)	31.24	4.24
36" + 36"	37.24	10.24

Figure 5. 30 kA/ 50 kA Front View.

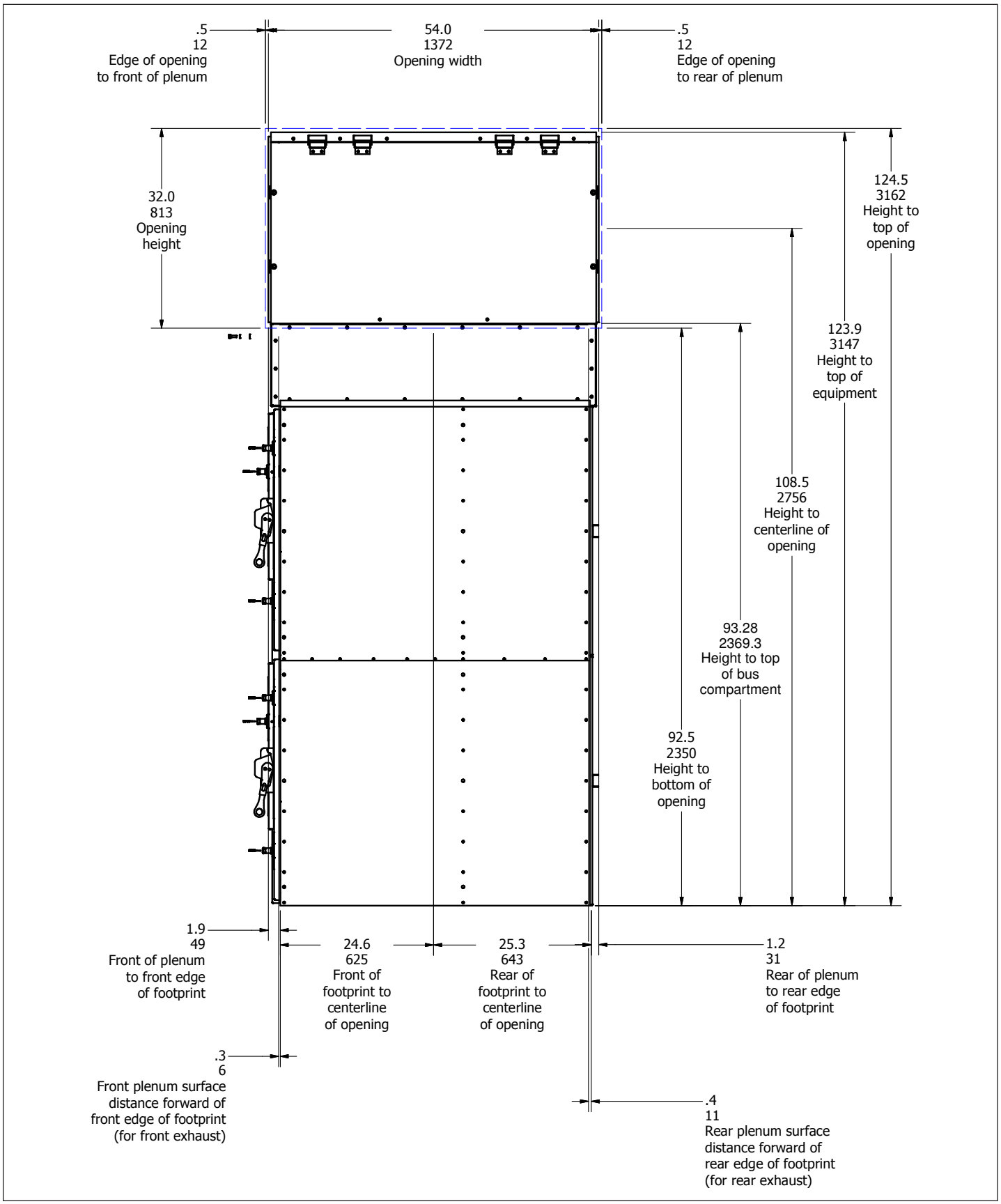


Figure 6. 50 kA Side View.

3.2 Close-coupling AMPGARD MVC and Eaton Switchgear

AMPGARD arc resistant MVC can be close-coupled to arc resistant VacClad switchgear in a single lineup. For these configurations, the AMPGARD section which is adjacent to the switchgear will be provided with a 4" wide filler section attached. When installing the lineup, the AMPGARD section must be attached to the switchgear BEFORE plenums are installed. Follow these instructions for coupling the AMPGARD lineup to the Switchgear.

1. Position the AMPGARD lineup next to the Switchgear, lining up the threaded holes in the AMPGARD filler section with the mating holes in the side sheet of the switchgear.
2. Ensure the two structures are level relative to each other and are mated together firmly. From inside the switchgear section, the threaded holes in the AMPGARD filler should be clearly visible and well-aligned.

⚠WARNING

ENSURE THAT THE CLOSE-COUPLED SECTIONS ARE ADEQUATELY ALIGNED AND LEVELED TO EACH OTHER BEFORE INSTALLING MATING HARDWARE. DO NOT USE THE MATING HARDWARE TO "JACK" THE EQUIPMENT INTO POSITION. THIS CAN CAUSE AN OVER-STRESSED CONNECTION, WHICH MAY REDUCE ARC-RESISTANT CAPABILITIES OF THE EQUIPMENT.

3. Install 3/8" hardware with lock washers and 3/8" extra-wide (1.5" O.D.) feider washers into each of the threaded holes, 12 places total. Torque per Table 5.

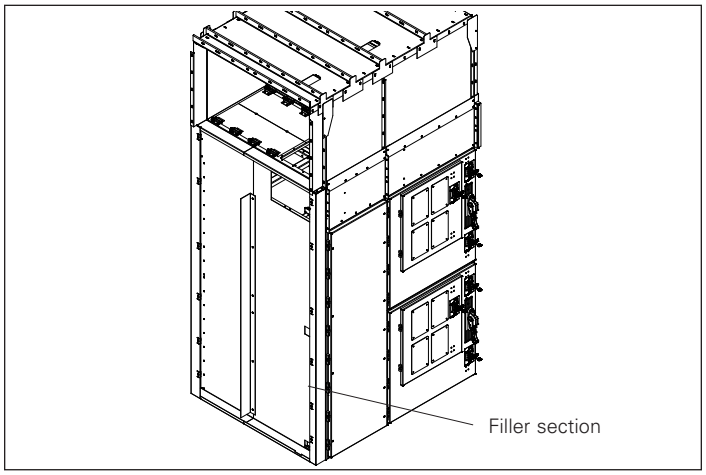


Figure 7. AMPGARD with 4" filler for close-coupling to VacClad.

3.3 Seismic Installations

For seismic rated equipment, refer to Eaton drawing 25A4254 for additional instructions on mounting in these special locations. It is the user's responsibility to insure the mounting pad is sufficiently strong to properly anchor and support the equipment.

3.4 Adjustments

Each controller is properly adjusted at the factory before shipment. However, vibration and mechanical stresses imposed by transit and installation can adversely affect mechanical interlocks and other adjustments; therefore, a final inspection is essential before energizing. If this inspection reveals any portion of the controller has come out of adjustment, the controller should be re-adjusted according to information in the instruction book or by a qualified Eaton service engineer.

Section 4: Plenum and Duct Installation

AMPGARD arc resistant equipment is only complete when a plenum and arc exhaust system (typically ducts) are correctly installed.

4.1 Access to equipment

Installation of plenums and ductwork requires access to all sides of the equipment. If access to the back and sides would be restricted in the final location, this installation should be done before permanently installing the lineup. 18" of clearance above the finished plenum (144" from ground) is recommended for ease of installation.

4.2 Installation

There are two different styles of arc plenum and duct used on the AMPGARD AR product. They are delivered in a partially-assembled state, and are easily distinguished from each other by comparing their construction. Refer to the figures below to determine if you will be installing the 49kA style or the 30/50kA style.

Installing the plenums will obscure access to the main bus. Before installing any plenum or duct, ensure the MVC equipment is bolted in place and all bus splices are complete.

4.2.1 49kA style plenum installation

Installation instructions for this style plenum and duct are found in IB 48077.

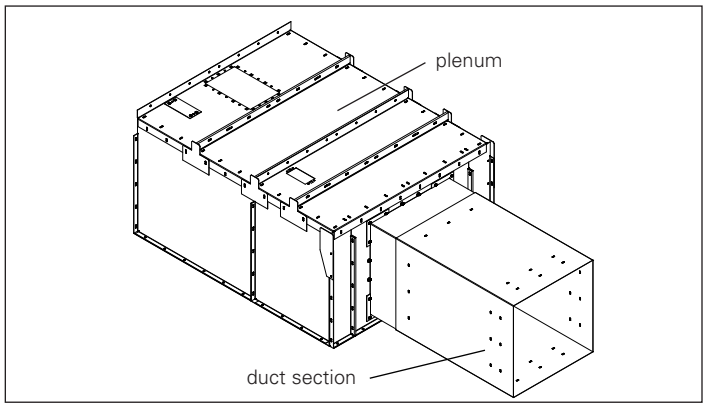


Figure 8. Identifying Plenum Style: 49kA.

4.2.2. 30/50kA style plenum installation

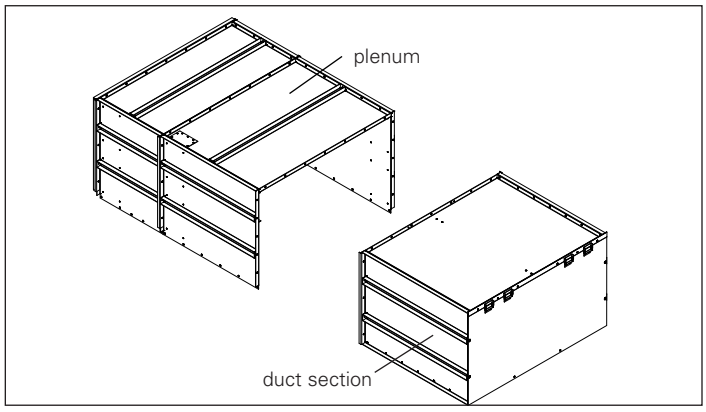


Figure 9. Identifying Plenum Style 30-50kA.

4.2.2.1 30/50kA style Plenum Installation

1. For any 24" wide sections with top-entry incoming-line cabling, a conduit must be installed to house the cables. This must be done before installing any plenum or duct parts.

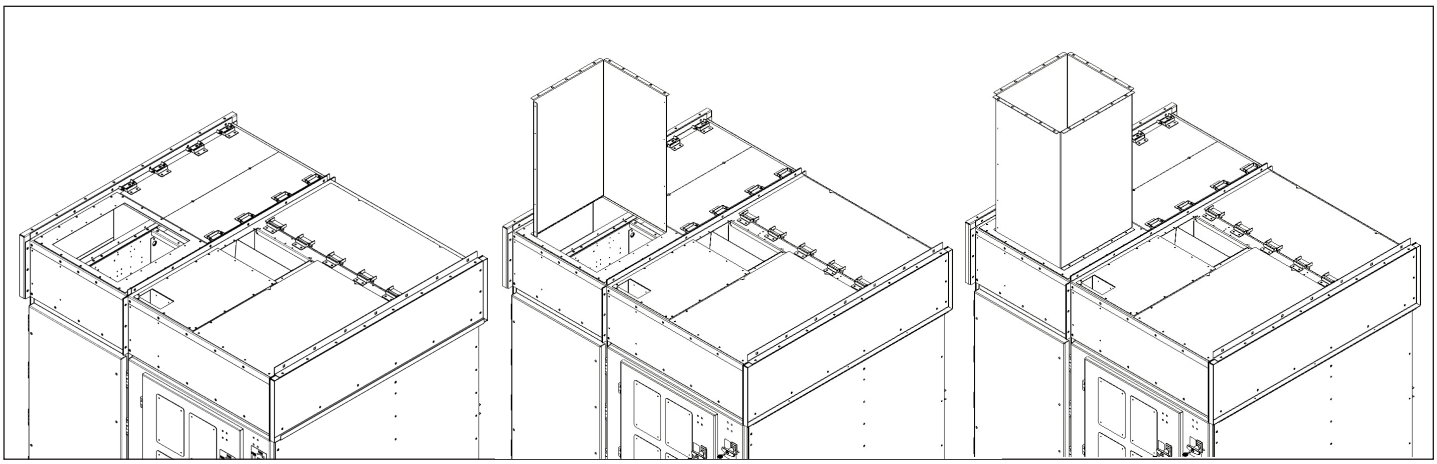


Figure 10. 30/50kA 24" wide sections.

a. Attach both of the conduit parts to the top of the main bus compartment with ¼" fasteners

b. Secure the conduit parts to each other with ¼" fasteners.

c. **REMEMBER** to install 1/4" cage nuts into the square holes on the top of the conduit. These will be needed at the end, to secure the conduit to the top panels, and are difficult to install at that step!

2. For any 36" wide sections with top-entry line or load cabling, a conduit must be installed to house the cables. This should be done before installing any plenum or duct parts.

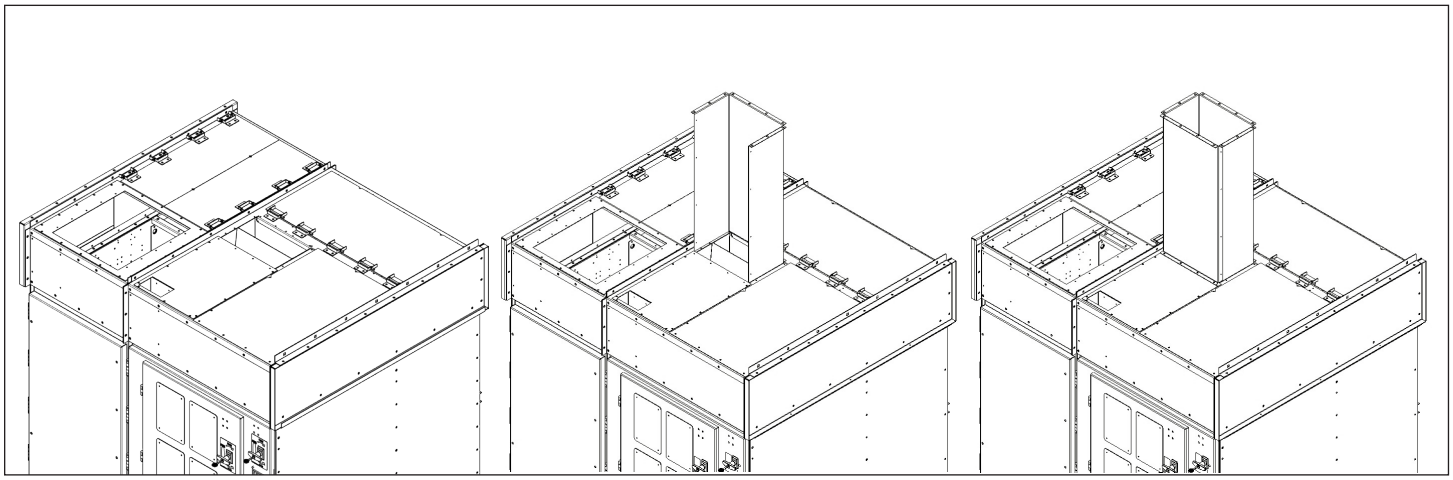


Figure 11. 30/50kA 36" wide sections.

a. Attach both of the conduit parts to the top of the main bus compartment with ¼" fasteners

b. Secure the conduit parts to each other with ¼" fasteners.

c. **REMEMBER** to install 1/4" cage nuts into the square holes on the top of the conduit. These will be needed at the end, to secure the conduit to the top panels, and are difficult to install at that point!

3. Start installing the plenums. Plenum sections are pre-assembled at the factory and shipped in assemblies to match the shipping splits of the equipment. Refer to the drawings for the location that each plenum assembly should be installed.
4. Using a crane or fork truck, lift the first plenum assembly into position on top of the MVC equipment.

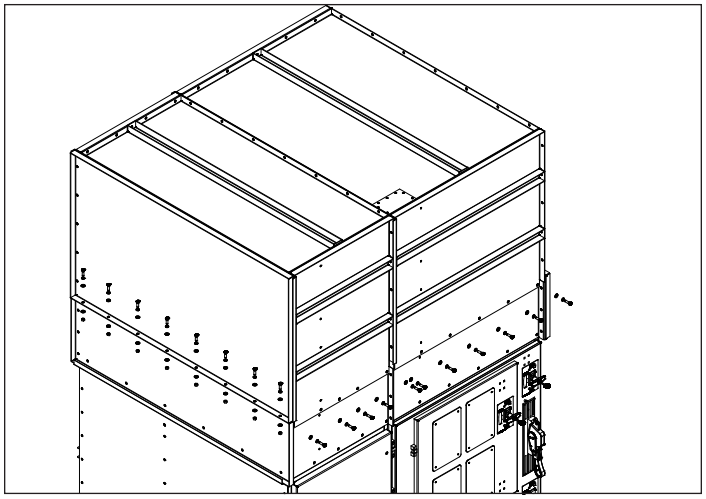


Figure 12. Installing Plenum Assembly.

5. Secure the plenum assembly around its entire perimeter with 5/16" fasteners as shown in Figure 12. Every bolt must have a lockwasher and a flat washer. Every nut must have a flat washer.
6. Install the conduit cover plates over all top-entry conduits using ¼" fasteners.
7. On the last plenum section installed, 2 bolts on each vertical flange will be protruding at the open end of the assembly. Remove these and set aside to prevent interference when installing the next plenum assembly.
8. Proceed to install the next plenum assembly as with the previous one.
9. Secure the new plenum assembly to the top of the equipment as above, next to the previous one.
10. Connect the vertical flanges of the adjacent plenum assemblies together, installing 30" long flat and angled seam covers as shown below. Use 5/16" fasteners with flat and lock washers.

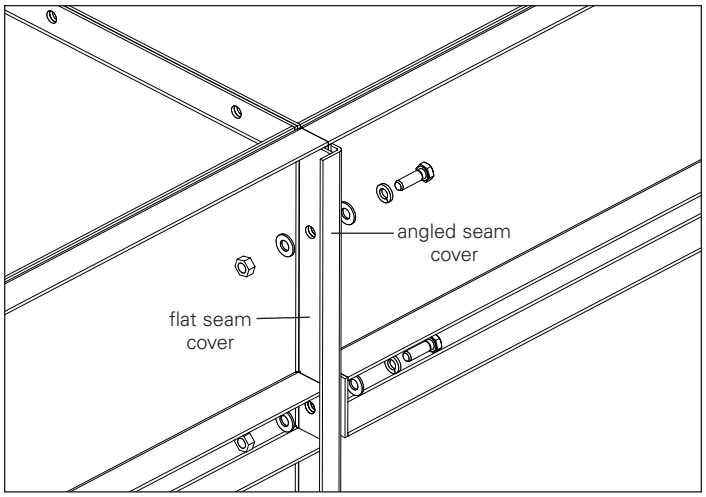


Figure 13. Installing Vertical Seam Covers.

11. Connect the top horizontal flanges of the adjacent plenum assemblies, installing two long angled seam covers as shown below. Use 5/16" fasteners with flat and lock washers.

    For 30kA equipment seam covers will be 40" long.
    For 50kA equipment seam covers will be 50" long.

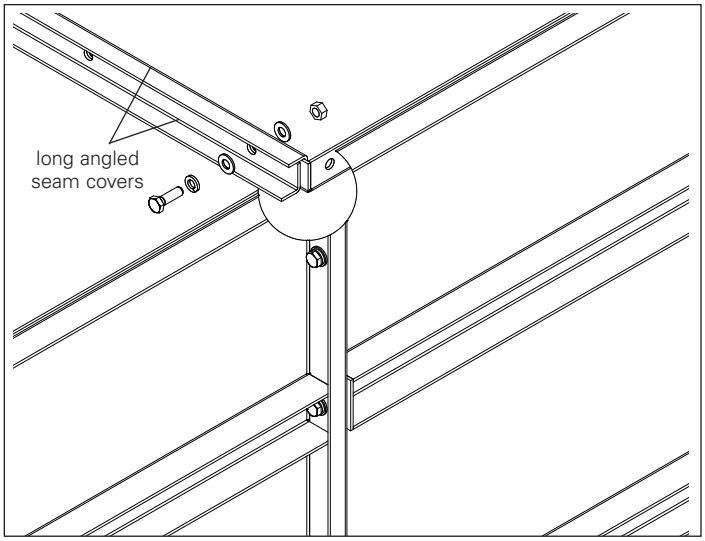


Figure 14. Installing Horizontal Seam Covers.

12. Install top entry conduit covers as required on the new section of plenum.
13. Continue adding plenum assembly sections in this fashion until the plenum for the entire lineup is complete.

4.2.2.2 Front- or Rear-exiting Exhaust Duct

1. A lineup which has the exhaust duct exiting from the front or the rear requires that two adjacent sections be selected for the duct to exit over. They can either both be 36" wide or one can be 24" and the other 36" wide. A duct adapter sheet is used instead of plenum front/rear covers over those two structures. The duct sections can then be bolted to the opening in this cover, as they are for a side-vented configuration. Flame baffles are not required at the connection between the duct and the adapter sheet.

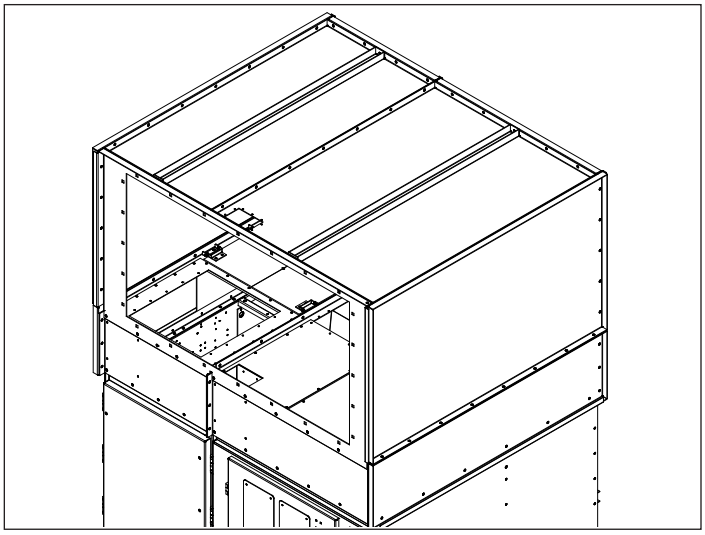


Figure 15. Front Exhaust Adapter.

The two sections over which the duct exhausts must have the correct orientation of hinges for the exhaust flaps. This only applies to the structures which have a duct installed above them; other structures in the lineup do not have this requirement. Refer to Figures 16 and 17 for correct hinge location.

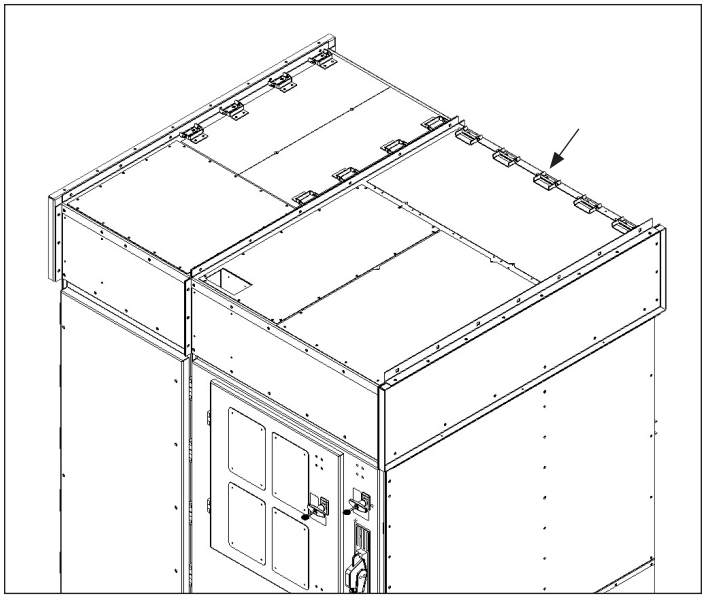


Figure 16. Front Exhaust Flap Hinge Location.

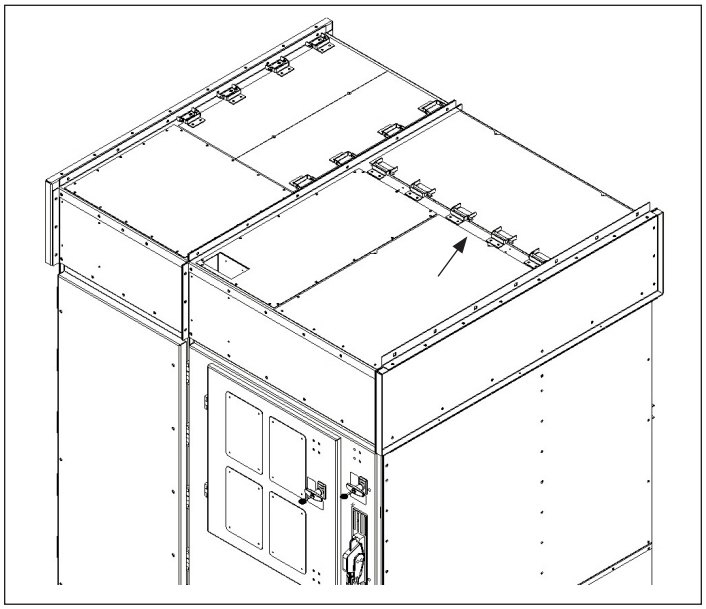


Figure 17. Rear Exhaust Flap Hinge Location.

4.2.2.3 30 / 50 kA style Duct Installation

1. In a side-vented configuration, ensure that a support angle is installed at the bottom edge of the plenum where the duct will attach. The angle should have 5/16" cage nuts installed in the square holes. If this part is missing, contact the factory for a replacement.

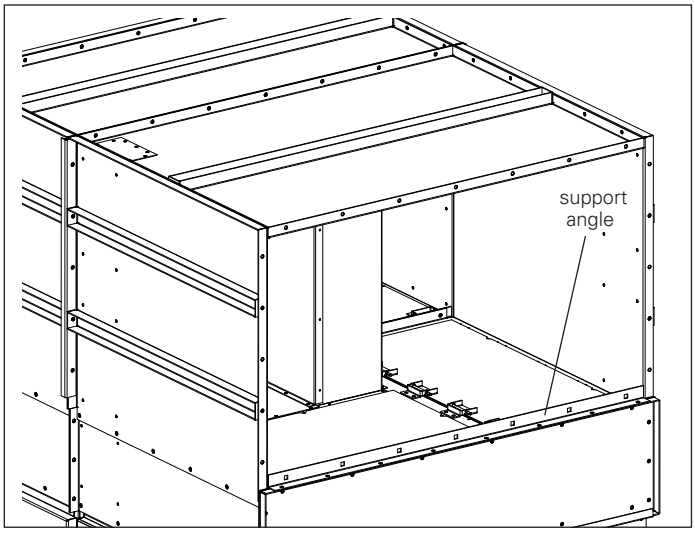


Figure 18. Side Vent Support Angle.

2. Lift and position the exhaust duct sections according to the job layout. Secure duct sections in place following the same procedure used for plenum sections, installing seam covers at all vertical and horizontal seams. Make sure the horizontal seams beneath the duct sections also have covers.
3. Support the duct sections as they are installed per layout drawings. The minimum unsupported distance is 78 in. (2000 mm).

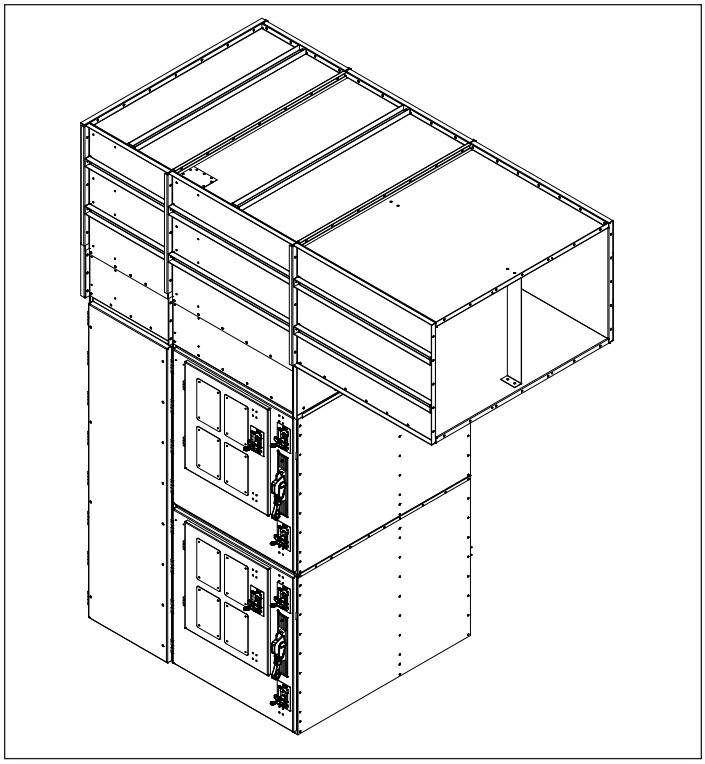


Figure 19. One Duct Section Installed.

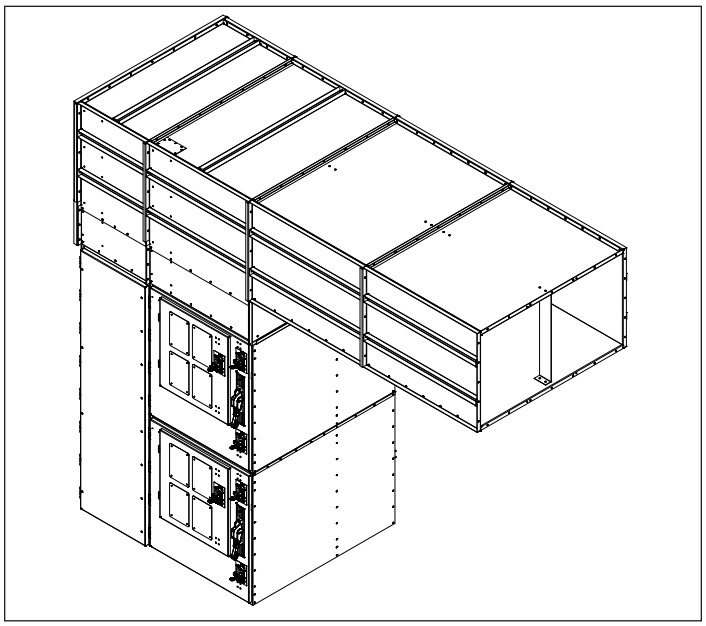


Figure 20. Two Duct Sections Installed.

4. The last section of duct has an exhaust flap installed. Ensure the flap can open freely, without obstruction. Check that the 4 bolts which protrude from the end of the duct section are installed with the bolt heads facing away from the duct. If the bolts are installed the opposite way, the shaft may catch on the exhaust flap clearance hole.

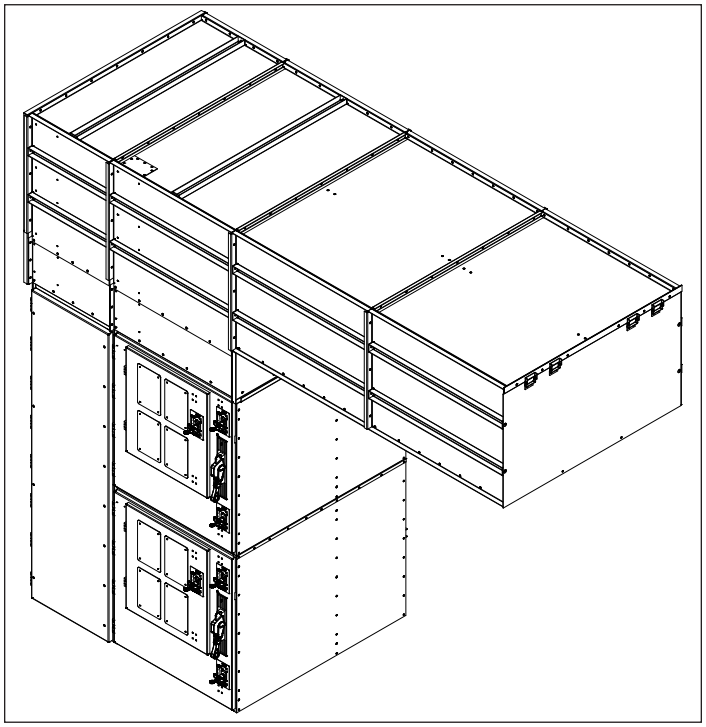


Figure 21. Exhaust Duct with End Flap.

5. Fasten the exhaust flap closed with the provided plastic push-in clips.

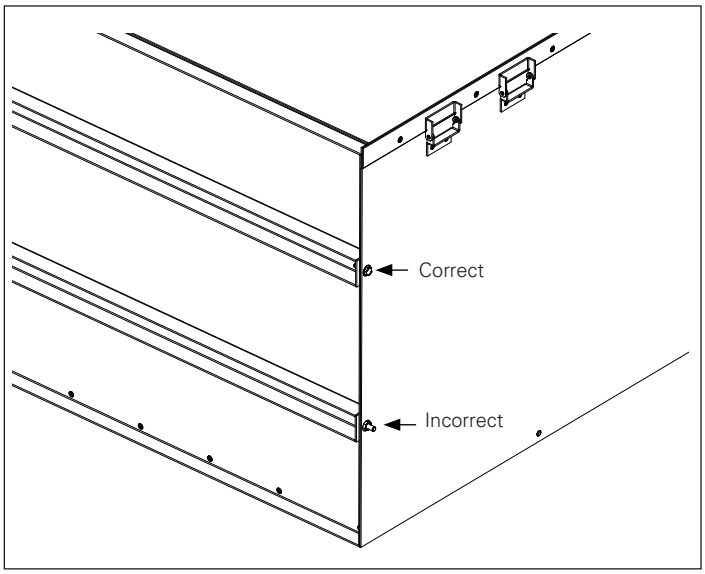


Figure 22. Duct end Bolts.

Section 5: Description of Arc Resistant AMPGARD MVC

Arc resistant Medium Voltage Control is tested for resistance to the effects of arcing due to an internal fault. The occurrence of arcing inside motor controllers produces a variety of physical phenomena. For example, the arc energy resulting from an arc developed in air at atmospheric pressure will cause a sudden pressure increase inside the enclosure and localized overheating. This results in both severe mechanical and thermal stresses on the equipment. Moreover, the materials involved in or exposed to the arc may produce hot decomposition products, either gaseous or particulate, which may be discharged to the outside of the enclosure.

IEEE guide C37.20.7 and EEMAC standard G14-1, 1987, provide procedures for testing the resistance of metal-clad and metal-enclosed medium voltage switchgear under conditions of arcing due to an internal fault. The arc resistant switchgear is classified by accessibility types in the two documents as follows.

IEEE C37.20.7, 2001 – Guide for Testing Medium-Voltage Metal-Enclosed Switchgear for Internal Arcing Faults

- Accessibility Type 1
  Switchgear with arc resistant designs or features at the freely accessible front of the equipment only.
- Accessibility Type 2
  Switchgear with arc resistant designs or features at the freely accessible exterior (front, back, and sides) of the equipment only.

  Type 2B
  Switchgear with arc resistant features inside control compartments in addition to the Type 2 requirements.

The IEEE standard defines internal arcing short-circuit current as the maximum value of the RMS symmetrical prospective current applied to the equipment under conditions of an arcing fault for the arcing duration specified by the manufacturer. The preferred value of the internal arcing short-circuit current is the rated short-time current of the equipment. The preferred arcing duration is indicated as 0.5 sec at the rated power frequency of the equipment.

A single test is done to verify resistance of switchgear against pressure as well as burn through. The actual values (which may be higher or lower than the preferred values) of the internal short-circuit current and arcing duration are specified by the manufacturer on the equipment ratings nameplate.

Arc resistant features are intended to provide an additional degree of protection to the personnel performing normal operating duties in close proximity to the equipment while the equipment is operating under normal conditions. Several conditions must be met for the equipment to perform as required. These conditions are considered normal operating conditions for proper application of arc resistant switchgear designs and are as follows:

1. All doors and covers providing access to high-voltage components are properly closed and latched.
2. A plenum and duct assembly is properly installed on top of the switchgear, when applicable.
3. Pressure relief devices are free to operate.
4. The fault energy available to the equipment does not exceed the rating of the equipment (short-circuit current and duration).
5. There are no obstructions around the equipment that could direct the arc fault products into an area intended to be protected.
6. The equipment is properly grounded.

The arc resistant rating of this equipment is only valid when all Medium-voltage compartment doors are closed and fully latched. The rating is valid with only the Low-voltage compartment door open. The equipment may be used without additional personal protective equipment where the fault level and the fault duration are within the equipment ratings. When coupled with other protective schemes, selected to operate within the rated duration of the equipment, the damaging effects of the arcing fault associated with fault duration can be minimized.

The instructions for installation, testing, maintenance, or repair herein are provided for the use of the product in general commercial applications and may not be appropriate for use in nuclear applications. Additional instructions may be available upon specific request to replace, amend, or supplement these instructions to qualify them for use with the product in safety-related applications in a nuclear facility.

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