

# Metal-Enclosed Switchgear— MVS Medium-Voltage Load Interrupter Fusible Switch

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MVS Medium-Voltage Load Interrupter Fusible Switch**

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## Specifications

See Eaton's *Product Specification Guide*, available on CD or on the Web.

CSI Format: .....	1995	2010
	<b>Sections 16361A, 16361B</b>	<b>Sections 26 13 16.11, 26 13 16.13</b>



*MVS Load Interrupter Switchgear*

## General Description

### MVS Load Interrupter Switchgear

#### General Description

Eaton's MVS Load Interrupter Switchgear is an integrated assembly of switches, bus and fuses that are coordinated electrically and mechanically for medium-voltage circuit protection. All major components are manufactured by Eaton, establishing one source of responsibility for the equipment's performance and ensuring high standards in quality, coordination, reliability and service.

A complete line of Eaton switches and fuses is available, as follows:

- 5, 15, 27 and 38 kV voltage classes
- 600 A continuous and load interrupting ratings, all voltage classes, 1200 A continuous and load interrupting for 5 and 15 kV classes
- 350 A continuous and load interrupting ratings for 5 kV and 15 kV classes for capacitive circuits
- Non-fused or fused with current limiting or boric acid-type fuses
- Manual or motor operated
- Indoor or outdoor non-walk-in enclosures
- Single switches and transformer primary switches
- Duplex loadbreak switch arrangements for selection of alternate feeds
- Two-position, manual no-load selector switches for selection of alternate feeds (5 and 15 kV only)
- Lineups with main bus
- Standard arrangements with automatic transfer control systems, two sources feeding one load or two sources feeding two loads on a split bus with tie switch

Standard design configurations for:

- NEMA® pads for cable lugs
- Surge arresters
- Instrument transformers
- Control power transformers
- IQ electronic metering
- Eaton's PowerNet™ accessing devices such as addressable relays and PONI cards
- Other auxiliary equipment



*Outdoor Duplex with Customer Metering*

#### Application Description

Eaton's Load Interrupter Type MVS metal-enclosed switchgear provides safe, reliable switching and fault protection for medium-voltage circuits rated from 2.4–38 kV. The MVS switch is ideal for applications where high duty cycle operation is not needed.

MVS switchgear has the advantage of low initial cost inherent in switch designs while offering the characteristics most vital to safety and coordination.

The MVS switch's quick-make, quick-break mechanism provides full-load current interrupting capability while fuses provide accurate, permanently calibrated short circuit detecting and interrupting capabilities. Visibility of actual blade position improves safety by giving positive assurance of circuit de-energization.

#### Standards and Certifications

Eaton's MVS load interrupter switchgear meets or exceeds the requirements of the following industry standards:

- IEEE® Standard C37.20.3
- ANSI C37.57
- NEMA SG5
- Canadian Standard CAN/CSA® C22.2 No. 31

Type MVS switches meet or exceed the requirements of the following industry standards:

- IEEE Standard C37.20.4
- ANSI C37.58
- ANSI C37.22
- NEMA SG6
- Canadian Standards CAN/CSA C22.2 No. 193 and CAN/CSA C22.2 No. 58

5 and 15 kV MVS switchgear assemblies are available as listed products with **Underwriters Laboratories** and **Canadian Standards Association** for most options.

Load interrupter switches should not be used to interrupt load currents above their interrupting rating of 600 or 1200 A, as they are not designed nor tested for interrupting fault currents on electrical systems. Optional fuses can be provided for phase overcurrent protection. For ground fault current tripping, see MSB and MEB switchgear **Tab 7**. Refer to **Page 8.0-13**, **Table 8.0-6** for applicable fuse ratings.

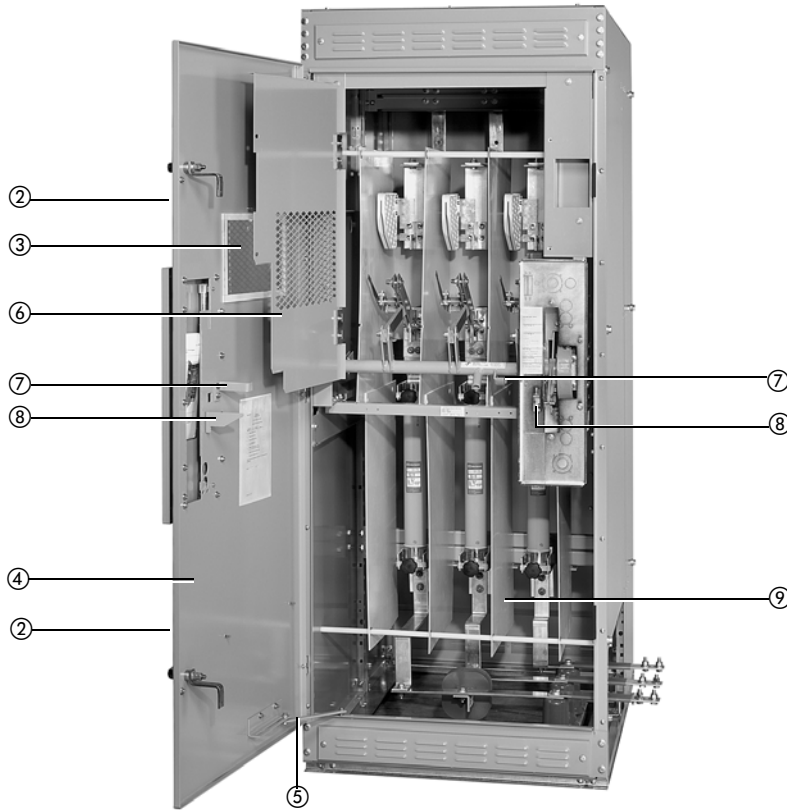
#### Seismic Qualification



Refer to **Tab 1** for information on seismic qualification for this and other Eaton products.

**General Description**

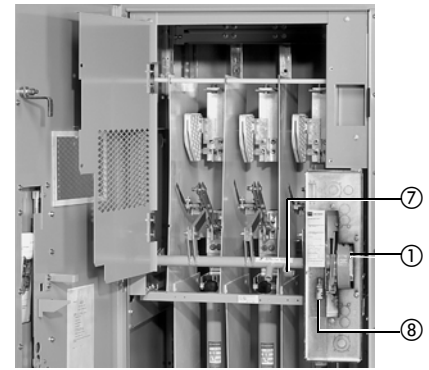
**Construction**



**Typical Switch with Front Door Open**

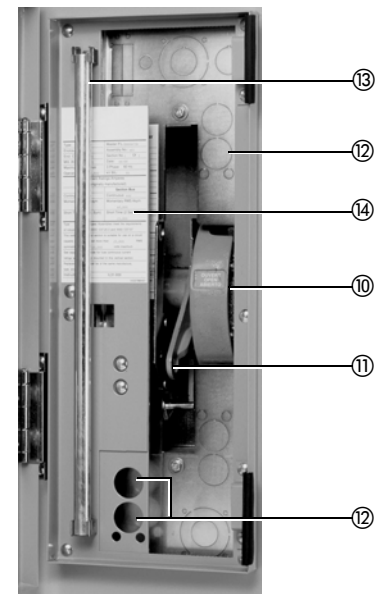
- ① **Switch Mechanism**  
Quick-make, quick-break stored energy operation.  
  
The opening and closing of the switch blades is done by the operating spring. An operator's actions only charge and release the operating spring.  
  
The switch blades cannot be teased to any intermediate positions. During the closing operation, full clearance between blades and stationary contacts is maintained until the switch mechanism goes over toggle.  
  
The switch mechanism has only metal-to-metal linkage—no chains or cables are used.  
  
Arc interruption takes place between copper-tungsten tipped auxiliary (flicker) blade and arcing contacts with a DE-ION® arc chute; no arcing takes place between the main blades and the stationary contacts to prolong the life of the main blades.  
  
Blow-out forces cannot be transmitted to the operating handle.

- ② **Provisions for Padlocking Door**  
Handle not visible in the photo.
- ③ **Inspection Window**  
A large 8.00-inch x 16.00-inch (203.2 x 406.4 mm) gasketed, rectangular, high impact viewing window permits full view of the position of all three switch blades through the closed door.
- ④ **Full Height Main Door**  
The door has a return flange and two rotary latch-type handles to provide latching members held in shear. It closes over a projecting frame.
- ⑤ **Foot-Operated Door Stop**
- ⑥ **Grounded Metal Safety Barrier**  
Prevents inadvertent contact with any live part, yet allows full-view inspection of the switch blade position.
- ⑦ **Door Interlock**  
Prevents the door of the enclosure from being opened when the switch is closed.
- ⑧ **Switch Interlock**  
Prevents inadvertent closure of the switch if the door of the enclosure is open.



**Switch with Hinged Screen Barrier Open**

- ⑨ **High Quality Insulation**  
Bus and switch insulators, switch drive rod barriers between phases, and barriers between outer phases and the housing, are of high strength, non-hygroscopic, track-resistant glass polyester as standard. Optional switch, fuse and main bus epoxy insulation system is available.
- ⑩ **Red-Green Switch Position Indicators**
- ⑪ **Provisions for Padlocking Switch Open or Closed**
- ⑫ **Provisions for Door and Switch Key Interlocks**
- ⑬ **The Operating Handle**  
It is conveniently located behind a small access door giving the structure a smooth homogeneous appearance and discourages casual contact by unauthorized personnel.
- ⑭ **Switchgear Assembly Rating Nameplate**



**Switch Operating Compartment Door Open**

## General Description

### Switch Mechanism

The quick-make, quick-break mechanism uses a heavy-duty coil spring that provides powerful opening and closing action. To close the switch, the handle is inserted into the spring charging cam, then rotated upward through an angle of 120 degrees. This action charges the operating spring, and as the mechanism is forced past toggle, the stored energy of the spring is released and transferred to the main shaft that snaps the switch closed.

As a result of the over-toggle action, the blades are moved independently of the operator. It is impossible to tease the switch into any intermediate position.

To open the switch, the handle is inserted into the spring charging cam and rotated downward through 120 degrees resulting in charging of the operating spring, then releasing its stored energy in similar sequence.

### Quick-Break DE-ION Arc Interruption

With the switch closed, both main and auxiliary (flicker) blades are closed, and all of the current flows through the main blades. The flicker blades are in the closed position in the arc chutes, but are past the arcing contacts and thus carry no current.

As the main blades open, current is transferred momentarily to the flicker blades, which are held in the arc chutes by high pressure contact fingers. There is no arcing at the main blades.

When the main blades reach a pre-determined angle of opening, a stop post on the main blades prevents further angular movement between the main and flicker blades. This starts the flicker blades out of the high pressure contacts in the arc chutes and as contacts are broken, the flicker blades are snapped into position by their torsion springs.

The heat of the arc, meanwhile, releases a blast of de-ionizing gas from the gas-generating material of the arc chute. This combination of quick-break and DE-ION action quickly extinguishes the arc and the circuit is safely de-energized.

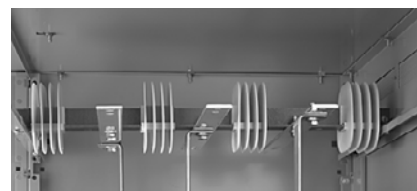
A non-fused switch has the ability to close and latch four times when rated 40 kA fault close, and one time when rated 61 kA fault close, and continue to carry rated current thus adding a large margin of integrity to the electrical system.

The 5/15 kV switch designs have also demonstrated the ability to surpass the number of ANSI C37.22 required loadbreak current operations by no less than 200%.

### Bus Insulation System

All bus runs are supported using a high strength and high creep, finned support providing in excess of 12.00 inches (304.8 mm) for 5/15 kV and 24.00 inches (609.6 mm) for 27/38 kV, of creep distance between phases and ground. The molded high track-resistant fins are constructed as standard of Aramid nylon or optional Cycloaliphatic epoxy.

- Significantly superior bus bracing than standoff type A20 insulators
- Significantly increased creep distance phase-to-phase and phase-to-ground
- Improved endurance from fault incidents
- Minimizes bus system failures due to tracking
- Eliminates additional ground planes in the switchgear for bus supporting systems



*Bus Support*

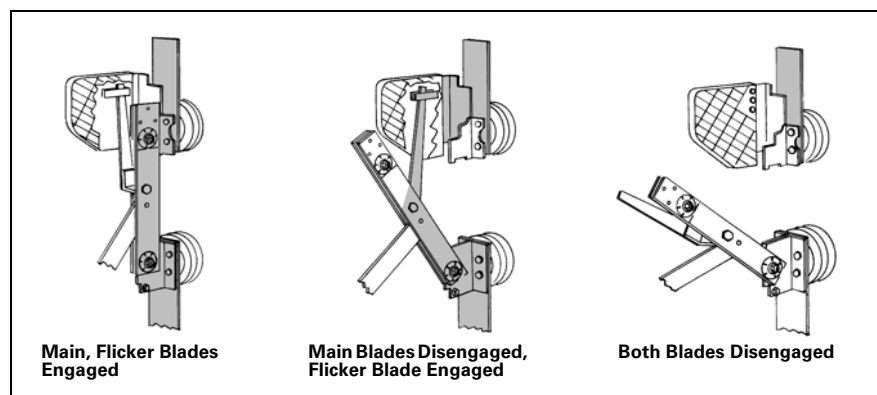
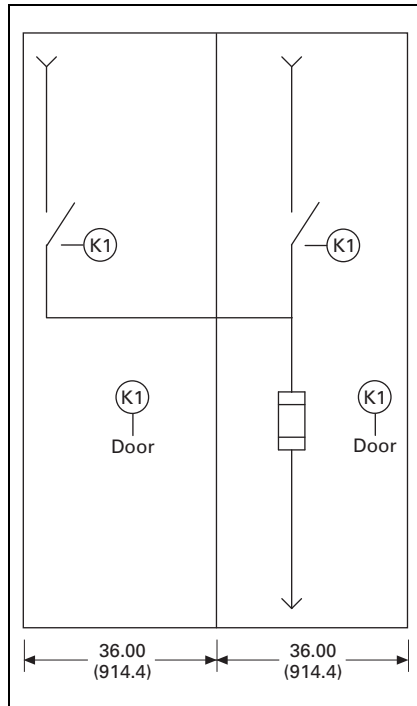


Figure 8.0-1. Switch Operation

**General Description**

**Duplex Switch Configuration**

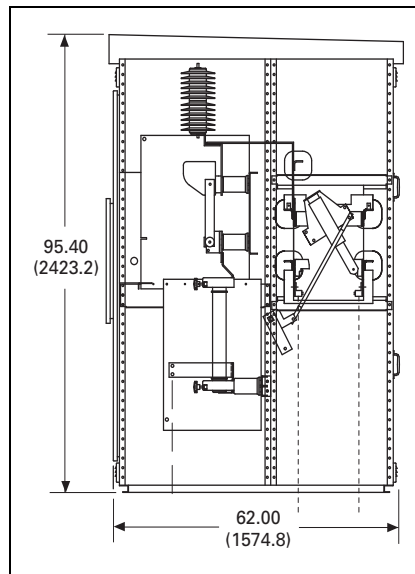
Two MVS load interrupter switch sections can be used to provide cost-effective source selectivity with a common load side bus feeding one load, fused or nonfused. Key interlocks are a standard feature provided to permit only one switch to be closed at one time and prevent opening any switch door unless both switches are open.



**Figure 8.0-2. Typical Duplex Switch Configuration with One K1 Key—Dimensions in Inches (mm)**

**Two-Position, No-Load Selector Switch**

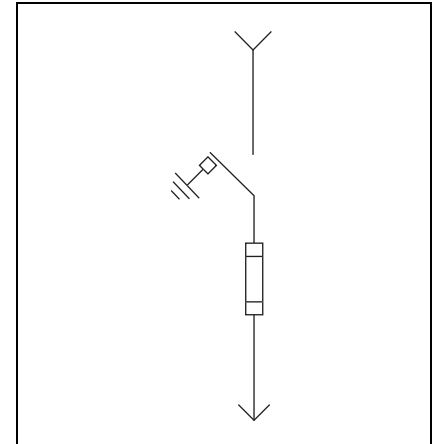
Eaton’s MVS load interrupter switch can be used to provide the most cost-effective source selectivity in a single compact structure with a two-position Type MVS non-loadbreak selector switch in series with the load break MVS switch. This selector switch is mechanically interlocked such that operation can be performed only when the load interrupter switch is in the open position. Also, neither the MVS switch nor the main door can be closed without the selector switch being positively locked in one of the two feeder positions.



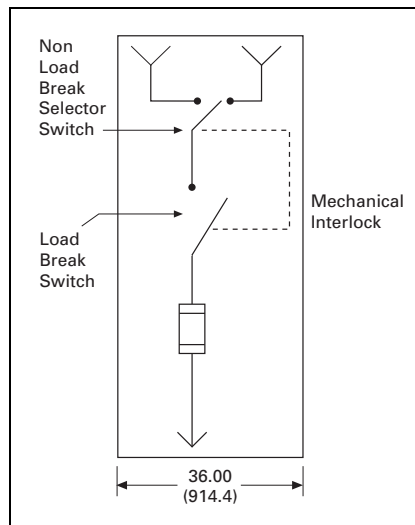
**Figure 8.0-3. Typical Two-Position Selector Switch for Bottom Cable Entrance—Dimensions in Inches (mm)**

**Loadbreak Switch with Grounding Jaw**

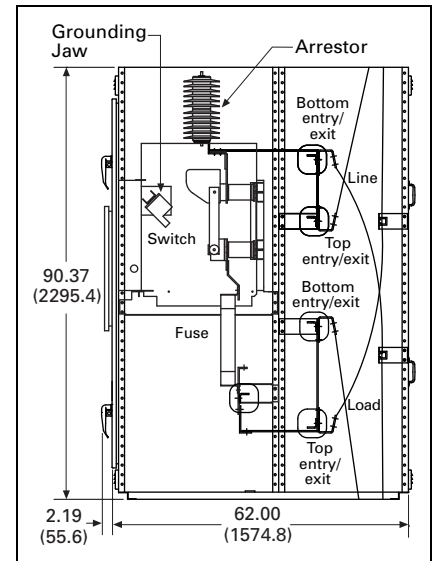
The loadbreak switch can be supplied with optional grounding jaws for automatic grounding of the load circuit. When the switch is opened, the switch main blades engage grounding jaws to ground the load circuit. This feature **cannot** be used in a duplex switch configuration. The ground jaw option is available at 5–38 kV. It is meant for applying a static ground, and is not rated for carrying fault currents.



**Figure 8.0-5. Typical Feeder Switch with Optional Grounding Jaw (5–38 kV)**



**Figure 8.0-4. Typical Selector Switch Configuration—Dimensions in Inches (mm)**



**Figure 8.0-6. Typical Section View of Feeder Switch with Optional Grounding Jaws**

## General Description

### Mini-MVS (26-Inch Wide)



**Mini-MVS Switchgear Assembly**  
*W = 26.00 inches (660.4 mm)*  
*H = 66.00 inches (1676.4 mm)*  
*D = 27.25 inches (692.2 mm)*

Eaton's Mini-MVS switchgear assembly is rated 200 A, 4.76 kV. The medium-voltage Mini-MVS switchgear assembly is for use in power distribution, transformer primary connections and isolation applications requiring a stand-alone assembly, cable in/cable out terminations and manual operation.

The Mini-MVS switchgear assembly is seismically qualified. The assembly is listed by UL® or CSA. The switch is available fused or non-fused. There is an option for an outdoor enclosure. Several built-in interlocks and safety features are provided.

### Mini-MVS Switchgear Assembly

#### Standard Features

- Seismically qualified
- Manually operated switch
- Door-to-switch safety interlocking
- Auxiliary switch, one Form C contact
- Viewing window for switch position
- Provisions for padlocking the switch in the OPEN position
- Provision for padlocking the two door handles closed
- Spare fuse rack
- Grounded metal screen barrier in front of the switch
- Cycloalaphatic epoxy insulators
- Line, load and ground cable lugs for #6 solid-4/0 stranded cable Aluminum or copper
- Key interlock provisions
- Listed—UL/CSA

#### Optional Features

- Enclosed type—indoor or outdoor
  - Outdoor enclosure includes space heater

**Note:** If the application requires a heater for condensation, an outdoor enclosure should be selected

- Fused or unfused switch
  - If fused, Eaton's Type CLE current limiting fuses from 10E amperes to 200E amperes are supplied
- Distribution type surge arresters, 3 or 6 kV
- Spare fuses

**General Description**

**Motor Operated  
MVS Switches**

**Application**

Eaton's MVS Pow-R-Drive™ motor operator makes possible the safety, convenience and coordination inherent in remote switch operation.



*Motor Operated MVS Switch*

**Description**

A MVS Pow-R-Drive motor operated switch is a standard, manually operated switch in combination with a heavy-duty electric motor-driven linear actuator that charges the spring. The linear actuator is located in a separate isolated low-voltage compartment. During electrical operation, it smoothly and quietly extends or retracts the proper distance to cause the switch mechanism to operate.

Standard motor operators are mounted in the switch enclosure. This eliminates the separate motor compartment conserving floor space.



*Manual Operation Override*

**Manual Operation**

To operate manually, loosen the holding screw that keeps the pin connecting the linear actuator to the mechanism in place. Remove this pin. Remove the clevis pin on the support of the bottom of the linear actuator. Unplug the cord from the disconnecting terminal block as the actuator is removed and set the actuator aside. The switch can now be operated manually with the removable handle.

**Key Interlock to Lock Switch Open**

A keyed lock is standard to lock the switch in the open position only.

This lock not only locks the switch in the open position, but also breaks the electrical motor contacts integral to the lock and permits the key to be removed. With the key, the operator can then open the lock on the switch door. This scheme gives positive assurance that the switch is open and cannot be closed with the door open.

## General Description

### Electronic Metering and Communications Apparatus

MVS switchgear assemblies can be equipped with Eaton's family of Power Xpert® and IQ digital meters to monitor a power circuit's electrical quantities within the capabilities of each device. Refer to **Tab 3** for further information on these devices.

Eaton's power management products provide hardware and software solutions that allow customers to interface with their switchgear at varying levels of sophistication.

Power Xpert and IQ Meters monitor common electrical parameters and communicate the data via standard Web interfaces. Power Xpert Gateways consolidate devices into a single Web browser interface and provide Ethernet connectivity. Eaton's Power Xpert Insight® and Foreseer Web-based software systems display, analyze and store data from multiple devices across the facility to enable management of the customer's power system. Refer to **Tab 2** for more information on communication systems.

### Outdoor Enclosures

Weatherproofing complying with the requirements of IEEE standard C37.20.3 is available for MVS switchgear assemblies. The weatherproofing consists of sloped roof panels that are joined together with caps. Doors and rear covers are fully gasketed. Externally accessible louvered filtered covers, top and bottom, front and rear, are provided for ventilation. At least one 250 watt heater is provided in each vertical section. Power for the heaters may be supplied from an external source, or an optional integral control power transformer may be specified to provide power for the heaters.

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**Outdoor Enclosure**



**Power Xpert Meter**  
PXM 4000/6000/8000

**IQ 130/140/150/250/260**  
PXM 2250/2260/2270/2280/2290

Refer to **Tab 3** for the complete offering and description of available electronic meters.

### Electronic Metering



**General Description**

**Partial Discharge Sensing and Monitoring for Switchgear**



**Coupling Capacitor Type PD Sensor**



**RFCT Sensor**



**InsulGard Relay (PD Monitoring)**

**Partial Discharge in Switchgear**

Partial discharge (PD) is a common name for various forms of electrical discharges such as corona, surface tracking, and discharges internal to the insulation. It partially bridges the insulation between the conductors. These high frequency discharges are essentially small arcs occurring in or on the surface of the insulation system when voltage stress exceeds a critical value. With time, airborne particles, contaminants and humidity lead to conditions that result in partial discharges. Partial discharges start at a low level and increase as more insulation becomes deteriorated. Examples of partial discharge in switchgear are surface tracking across bus insulation, or discharges in the air gap between the bus and a support, such as where a bus passes through an insulating window between the sections of the switchgear. If a partial discharge process is not detected and corrected, it can develop into a full-scale insulation failure followed by an electrical fault. Most switchgear flashover and bus failures are a result of insulation degradation caused by various forms of partial discharges.

**Sensing and Monitoring**

Eaton’s Type MVS metal-enclosed switchgear (2.4–27 kV) is corona-free by design. By making switchgear assemblies corona-free, Eaton has made its standard switchgear more reliable. However, as indicated above, with time, airborne particles, contaminants and humidity lead to conditions that cause partial discharges to develop in switchgear operating at voltages 4000 V and above. Type MVS switchgear can be equipped with factory-installed partial discharge sensors and partial discharge sensing relay for continuous monitoring of the partial discharges under normal operation. Timely detection of insulation degradation through increasing partial discharges can identify potential problems so that corrective actions can be planned and implemented long before permanent deterioration develops. Partial discharge detection can be the foundation of an effective predictive maintenance program. Trending of partial discharge data over time allows prediction of failures, which can be corrected before catastrophic failure occurs.

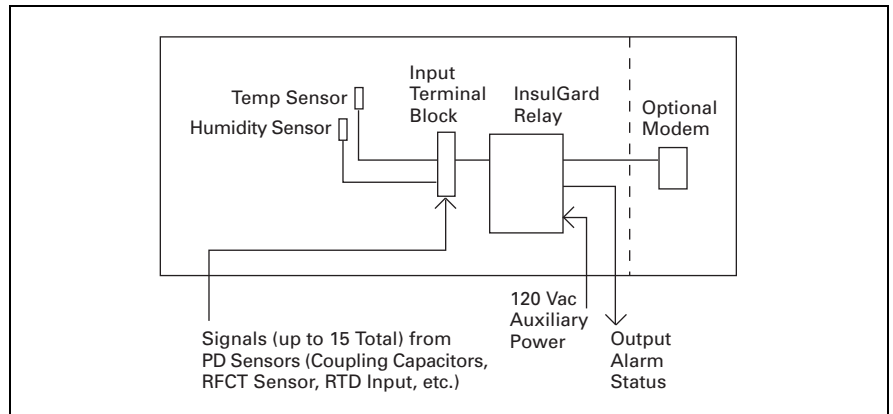
The PD sensing and monitoring system consists of Eaton’s InsulGard™ relay and PD sensors specifically developed for application in the switchgear to work with the relay. There are two types of PD sensors used in the switchgear: the first sensor is a coupling capacitor type sensor developed for use with 5, 15 and 27 kV switchgear.

The coupling capacitor sensor detects partial discharges within the switchgear cubicle and/or adjacent cubicles, and is typically installed on the load side of the feeder switches or on the main bus. The second sensor is a small donut type radio frequency current transformer (RFCT). It is designed for installation around ground shields of customer’s incoming or outgoing power cables. It detects partial discharges in customer’s power cables and external electrical noise.

Typically one set of coupling capacitor sensors is used at every two cubicles. One RFCT sensor is used for each incoming and outgoing power cable circuit.

Output signals from sensors (coupling capacitor and RFCT) are wired out to terminal blocks for future or field use, or connected to the InsulGard relay. One InsulGard relay can monitor up to 15 output signals, and temperature and humidity. The temperature and humidity sensors are included with each InsulGard relay system. The relay continuously monitors the switchgear primary system for partial discharges and provides an alarm signal (contact closure) when high PD level is detected. Data analysis and diagnostics by Eaton engineers can also be provided by remote communication with the InsulGard relay.

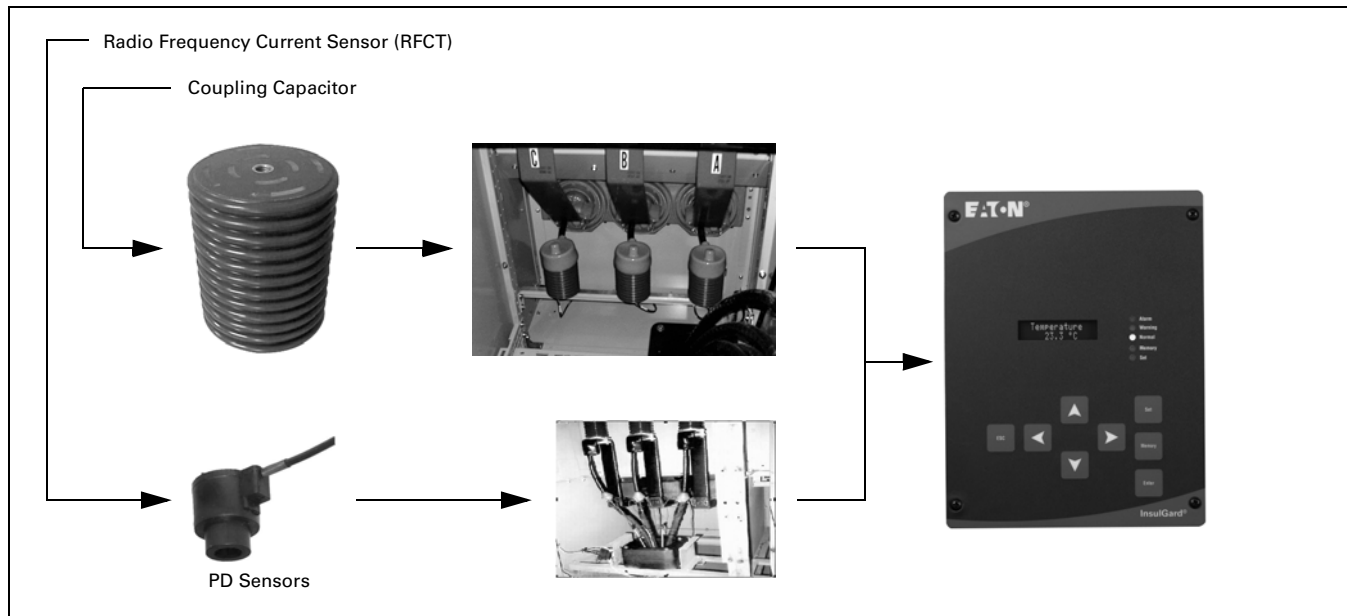
The sensors and InsulGard relay are optional in MVS switchgear.



**Figure 8.0-7. InsulGard Relay System**

## General Description—Partial Discharge Sensing and Monitoring

### Partial Discharge Sensors and Monitoring for Switchgear



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Figure 8.0-8. How the Process Works—Sensing and Data Collection

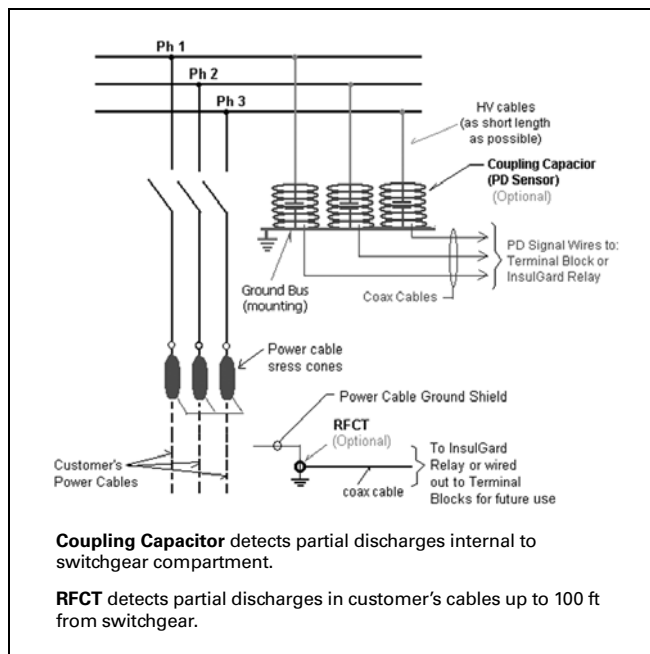


Figure 8.0-9. Typical Partial Discharge Sensor Connections in MVS Switchgear (5–27 kV)

**Note:** Use one set of PD sensing capacitors at every two vertical sections, or portion thereof. Use one RFCT at each incoming/outgoing cable circuit.

## Application

## MVS Switchgear with Automatic Transfer Control



Two-Switch Automatic Transfer



ATC Controller

## Application

Eaton's MVS switchgear with an automatic transfer control system is an integrated assembly of motor operated MVS switches, sensing devices and control components. Available in 5–38 kV classes.

It is typically applied where the continuity of service for critical loads from two power sources in either a two-switch (one load) or three-switch (two loads) configuration is desired.

MVS switchgear with an automatic transfer control system can meet most automatic throwover requirements as it has a wide variety of operational sequences embodied in one standard automatic transfer control system.

**Please note that the duty cycle of load interrupter switches is limited by ANSI Standard C37.22. Refer to Table 8.0-4 for maximum number of switching operations allowed. If the number of switching operations is expected to exceed the maximum allowed, then load interrupter switches should not be used. Use circuit breakers (refer to Type MSB, MEB, MEF or VCP-W switchgear designs). Also note that the operating times of Eaton's motor operated load interrupter switches are much longer compared to circuit breakers, therefore, the switches are not suitable for closed-transition transfer applications. Use circuit breakers if closed-transition transfer is required.**

## Typical Two-Switch Automatic Transfer Using ATC Controller

Eaton's ATC-900 controller continuously monitors all three phases on both sources for correct voltages. Should the voltage of the normal source be lost while the voltage of the alternate source remains normal, the voltage sensing function in the ATC controller will change state starting the time delay function. If the voltage of the normal source is not restored by the end of the time delay interval, the normal switch will open and the alternate source switch will close, restoring power to the load.

## ATC Controller

Eaton's ATC controller is equipped to display history information either via the front panel or over the PowerNet power monitoring system. ATC-900 controller stores 320 time stamped events. Oscillographic data for last 10 events can be downloaded via USB port or displayed in the controller's display window. Controller allows communications via RS-232 or Modbus through RS-485 port, Ethernet or via USB interface.

## Standard Features

- Voltage sensing on both sources is provided by the ATC controller
- Lights to indicate status of switches, sources, etc.
- Interlocking to prevent paralleling of sources via software
- Control power for the automatic transfer control system is derived from the sensing voltage transformers
- Manual override operation
- Open transition on return to normal
- Programmable time delays on both sources, "OFF DELAY" and "ON DELAY"
- Four programmable digital inputs and outputs
- Single-source responsibility; all basic components are manufactured by Eaton
- Key interlocking of operating system and doors where required to provide operator safety

## Optional Features

- Lockout on phase and/or ground overcurrents and/or internal bus faults
- Blown fuse overcurrent lockout
- Load current, power and PF metering with optional dcT module
- 24 Vdc control power input
- Up to four additional I/O modules, each with four programmable digital inputs and digital outputs

## Technical Data

### Technical Data

#### Test Data

All Eaton's MVS switch ratings have been thoroughly tested in recognized high power laboratories with certified inspectors from both UL and CSA organizations. Tests were performed to substantiate all published ratings in accordance with ANSI, IEEE, CSA and NEMA standards.

The testing program included tests of:

- Basic impulse levels
- Momentary withstand
- Short-time withstand
- Fault closing
- Load interrupting at various loads, various power factors
- Mechanical life tests
- Temperature rise test

These tests verified not only the performance of the switch and integrated switch-fuse assembly, but also the suitability of the enclosure venting, rigidity and bus spacing.

The mechanical life test subjected the MVS switch to a number of no load cycles greater than the requirements tabulated in ANSI C37.22 standards. There were no moving or current carrying part failures as a result.

The Fault Close and Load Interrupting test demonstrated significant improved performance above ANSI/IEEE standards. See **Tables 8.0-3** and **8.0-4** for results.

**Table 8.0-1. Switch Ratings (Non-Fused)**

Rated Maximum Voltage kV	Impulse Withstand kV	Continuous and Load-Break Amperes	Fault-Close & Momentary Short-Circuit Current		Rated Short-Time Short-Circuit Current (2 sec.) kA rms Sym.
			kA Asym	kA Peak	
4.76	60	600	40	65	25
4.76	60	600	61	99	38
4.76	60	1200	40	65	25
4.76	60	1200	61	99	38
15	95	600	40	65	25
15	95	600	61	99	38
15	95	1200	40	65	25
15	95	1200	61	99	38
27	125	600	40	65	25
27	125	600	64	104	40
38	150	600	40	65	25
38	150	600	50.4	81.9	31.5

**Table 8.0-2. Switchgear Assembly Main Cross Bus Ratings**

Rated Maximum Voltage kV	Rated BIL kV	Rated Main Bus Current Amperes	Rated Momentary Short-Circuit Current		Rated Short-Time Short-Circuit Current (2 sec.) kA rms Sym.
			kA Asym	kA Peak	
4.76	60	600-1200	40	65	25
4.76	60	600-1200	61	99	38
4.76	60	600-1200	80	130	50
4.76	60	1200	101	164	63
4.76	60	2000	61	99	38
4.76	60	2000	80	130	50
4.76	60	2000	101	164	63
15	95	600-1200	40	65	25
15	95	600-1200	61	99	38
15	95	600-1200	80	130	50
15	95	1200	101	164	63
27	125	600-1200	40	65	25
27	125	600-1200	64	104	40
38	150	600-1200	40	65	25
38	150	600-1200	50.4	81.9	31.5

**Table 8.0-3. MVS Switch Duty Cycle for Full Load Operations**

Rated Maximum kV	Switch Load Interrupting Ampere Rating	ANSI Required Number of Load Interrupting Operations	Eaton MVS Switch Number of UL Tested Load Break Operations
4.76	600	50	60
4.76	1200	20	50
15	600	30	60
15	1200	10	50
27	600	10	10
38	600	5	5

**Table 8.0-4. MVS Switch Duty Cycle for Fault Close Operations—Non-Fused**

Rated Maximum kV	Switch Fault Close Rating		ANSI Required Number of Fault Close Operations	Eaton MVS Switch Number of UL Tested Fault Close Operations
	kA Asym	kA Peak		
5 and 15	40	65	1	4
5 and 15	61	99	1	1
27	40	65	1	1
27	61	99	1	1
38	40	65	1	1
38	50.4	81.9	1	1

**Table 8.0-5. Mini-MVS Ratings, rms Values**

Description	Unfused	Fused
Rated maximum voltage	4.76 kV	4.76 kV
Impulse withstand voltage (BIL)	60 kV	60 kV
Low frequency withstand voltage	19 kV	19 kV
Frequency	60 Hz	60 Hz
Continuous current, maximum	200 A	200 A
Load current interrupting rating <sup>①</sup>	200 A	200 A
Magnetizing interrupting current	4 A	4 A
Short-time short-circuit current, 2 seconds, rms sym	12.5 kA	<sup>②</sup>
Momentary current, asymmetrical/peak	20 kA/32.5 kA	101 kA/164 kA <sup>③</sup>
Fault close current, asymmetrical/peak	20 kA/32.5 kA	101 kA/164 kA <sup>③</sup>

<sup>①</sup> 100% to 80% power factor lagging.

<sup>③</sup> Rating with Eaton BHLE fuse.

<sup>②</sup> Not applicable for fused units.

**Technical Data**

**Table 8.0-6. Primary Fuses, Standard Ratings and Fused Switch Fault Close Rating**

Type Fuse	Switchgear Rated Maximum Voltage, kV	Fuse Rated Continuous Current Range, Amperes	Rated Interrupting Capacity kA Symmetrical ①	Fused Switch Momentary and Fault-Close Rating ①	
				kA Asym	kA Peak
RBA-200	4.76	10–200	19	30.4	49
RBA-400	4.76	10–200	25	40	65
RBA-400	4.76	0.5–400	37.5	60	97.5
RBA-800	4.76	0.5–400	25	40	65
RBA-800	4.76	0.5–720	37.5	60	97.5
BHLE	4.76	10–450	63	101 ②	164
CLE600/750	4.76	600–750	40	64	104
RBA-200	15	10–200	14.4	23	37
RBA-400	15	0.5–400	25	40	65
RBA-400	15	0.5–400	29.4	47	76
RBA-800	15	0.5–720	25	40	65
RBA-800	15	0.5–720	29.4	47	65
HRBA-400	14.4	0.5–400	34.8	55.7	90
HRBA-800	14.4	0.5–720	34.8	55.7	90
BHLE	15	10–250	63	101 ②	164
BHCL	15	300	63	101 ②	164
RBA-200	25.8	10–200	10.5	16.8	27
RBA-400	25.8	0.5–300	21	33.6	54.6
RBA-800	25.8	0.5–540	21	33.6	54.6
Cooper NX	27	0.5–100	35	56	91
RBA-200	38	10–200	6.9	11	18
RBA-400	38	0.5–300	16.8	26.8	47
RBA-800	38	0.5–540	16.8	26.8	47
GE EJO-1	38	20–80	12.5	20	32.5
Cooper NX	38	20–100	35	56	91

① When RBA expulsion fuses are used, and two ratings appear, the lower rating applies when the lower-rated switch (15 kV, 40 kA fault close, 25 kA short-time current) versus the higher rating that applies when the higher-rated switch (15 kV, 61 kA fault close, 38 kA short-time) is used.

② UL and CSA listed integrated rating with an Eaton BHLE or BHCL fuse.

**Note:** For additional fuse data, refer to fuse documents in **Tab 9**.

**Table 8.0-7. Eaton Metal-Enclosed Switchgear Fuse Correction Factors**

Eaton Fuse Type	kV Class	Fuse Rated Continuous Current	Enclosure Correction Factor (F1)
RBA 200/400/800	All	All	1.0
CLE, HLE, BHLE, HCL	5.5	10–150	1.00
CLE, HLE, BHLE, HCL	5.5	175	0.94
CLE, HLE, BHLE, HCL	5.5	200	0.90
CLE, HLE, BHLE, HCL	5.5	250	0.81
CLE, HLE, BHLE, HCL	5.5	300	0.94
CLE, HLE, BHLE, HCL	5.5	350	0.84
CLE, HLE, BHLE, HCL	5.5	400	0.80
CLE, HLE, BHLE, HCL	5.5	450	0.84
CLE	5.5	600, 750, 1100	0.83
CLE, HLE, BHLE, HCL, BHCL	15.5	10–150	1.00
CLE, HLE, BHLE, HCL, BHCL	15.5	175	0.89
CLE, HLE, BHLE, HCL, BHCL	15.5	200	0.86
CLE, HLE, BHLE, HCL, BHCL	15.5	250	0.82
CLE, HLE, BHLE, HCL, BHCL	15.5	300	0.75

**Method to Determine the Minimum Recommended Fuse Size for Fuse Applied on Primary Side of a Power Transformer**

If the power transformer has one or more supplementary cooled ratings (FA, FOA, FOW, low temperature rise designs permitted to be operated at a higher permissible temperature rises, etc.), perform two calculations, (A) and (B), as outlined below and select the fuse with the higher continuous

current rating as determined from calculation (A) or (B). It is possible that the fuse selection process yields the same fuse continuous current rating for the transformer base kVA rating as well as the maximum supplementary cooled kVA rating.

If the power transformer has no supplementary cooled ratings, perform only calculations (A) to determine the minimum recommended fuse size.

**Calculations (A):**

- A.1 Calculate the full load current based on base kVA rating of the transformer.  
Three-phase transformer:  
 $I_{FL} = \text{base kVA rating} \div (\sqrt{3} * \text{Rated Primary Voltage})$   
Single-phase transformer:  
 $I_{FL} = \text{base kVA rating} \div (\text{Rated Primary Voltage})$ .

## Technical Data

A.2 Multiply the result of Step A.1 by appropriate factor for a given Eaton fuse type being considered for the application:

8.3/15.5/25.8/38 kV RBA:	1.4
5.5 kV CLE/HLE/HCL/BHLE:	1.4
8.3 kV CLE/HLE/HCL/BHLE:	1.4
15.5 kV CLE/HLE/HCL/BHLE:	1.5

A.3 Select the closest available published fuse with the continuous current rating that is equal to or greater than the calculated value in Step A.2. This is the suggested minimum recommended fuse size when the fuse is applied in an open air with ambient temperature within 40 °C and –30 °C, installed at an altitude of 3300 ft (1000 m) or less, and operated at 60 Hz.

A.4 If the fuse is applied in an enclosing package such as metal-enclosed switchgear, contact the enclosing package manufacturer for appropriate correction factor for the fuse selected in Step A.3. When installed within Eaton's switchgear, refer to the **Table 8.0-7** for applicable enclosure correction factor (F1).

A.5 If the actual ambient air temperature ( $T_{amb}$ ) surrounding the fuse (or surrounding the enclosure if the fuse is installed in an enclosure) is greater than 40 °C; determine the appropriate temperature correction factor, 0.3% per °C. This factor is given by:

$$F2 = 1 - ([T_{amb} - 40] * 0.3 \div 100),$$

where  $T_{amb}$  = actual ambient temperature in °C. To provide conservative result, for actual ambient less than or equal to 40 °C, consider  $F2 = 1.0$ .

A.6 If the fuse is applied at an altitude (H) greater than 3300 ft (1000 m) above sea level, determine the appropriate altitude correction factor, 0.5% per 1000 ft. This factor is given by:

$$F3 = 1 - ([H - 3300] * 0.5 \div 100000),$$

where H = actual altitude in feet. For H less than or equal to 3300 feet, consider  $F3 = 1.0$ .

A.7 Multiply the continuous current rating of the fuse selected in Step A.3 by the correction factors from Steps A.4, A.5 and A.6. This provides a modified continuous current value for the selected fuse.

A.8 If the modified continuous current value as determined in Step A.7 is equal to or greater than the value determined in Step A.2, then the selected fuse is the minimum recommended size for the application. If the modified continuous current value is less than the value determined in Step A.2, select the next higher available continuous fuse rating and repeat Steps A.4 through A.8.

### Calculations (B):

B.1 Calculate the full load current based on maximum supplementary kVA rating of the transformer.

Three-phase transformer:  
 $I_{FL} = \text{Maximum kVA rating} \div (\sqrt{3} * \text{Rated Primary Voltage})$

Single-phase transformer:  
 $I_{FL} = \text{Maximum kVA rating} \div (\text{Rated Primary Voltage}).$

B.2 Multiply the result of Step B.1 by appropriate factor for a given Eaton fuse type being considered for the application:

8.3/15.5/25.8/38 kV RBA:	1.2
5.5 kV CLE/HLE/HCL/BHLE:	1.2
8.3 kV CLE/HLE/HCL/BHLE:	1.2
15.5 kV CLE/HLE/HCL/BHLE:	1.3

B.3 Select the closest available published fuse with the continuous current rating that is equal to or greater than the calculated value in Step B.2. This is the suggested minimum recommended fuse size when the fuse is applied in an open air with ambient temperature within 40 °C and –30 °C, installed at an altitude of 3300 ft (1000 m) or less, and operated at 60 Hz.

B.4 If the fuse is applied in an enclosing package such as metal-enclosed switchgear, contact the enclosing package manufacturer for appropriate correction factor for the fuse selected in Step B.3. When installed within Eaton's switchgear, refer to the **Table 8.0-7** for applicable enclosure correction factor (F1).

B.5 If the actual ambient air temperature ( $T_{amb}$ ) surrounding the fuse (or surrounding the enclosure if the fuse is installed in an enclosure) is greater than 40 °C; determine the appropriate temperature correction factor, 0.3% per °C. This factor is given by:

$$F2 = 1 - ([T_{amb} - 40] * 0.3 \div 100),$$

where  $T_{amb}$  = actual ambient temperature in °C. To provide conservative result, for actual ambient less than or equal to 40 °C, consider  $F2 = 1.0$ .

B.6 If the fuse is applied at an altitude (H) greater than 3300 ft (1000 m) above sea level, determine the appropriate altitude correction factor, 0.5% per 1000 ft. This factor is given by:

$$F3 = 1 - ([H - 3300] * 0.5 \div 100000),$$

where H = actual altitude in feet. For H less than or equal to 3300 feet, consider  $F3 = 1.0$ .

B.7 Multiply the continuous current rating of the fuse selected in Step B.3 by the correction factors from Steps B.4, B.5 and B.6. This provides a modified continuous current value for the selected fuse.

B.8 If the modified continuous current value as determined in Step B.7 is equal to or greater than the value determined in Step B.2, then the selected fuse is the minimum recommended size for the application. If the modified continuous current value is less than the value determined in Step B.2, select the next higher available continuous fuse rating and repeat Steps B.4 through B.8.

## Technical Data

**Example #1:**

1500 kVA, three-phase, 4.16 kV/480 V transformer, no supplemental rating, Eaton Type CLE Primary Fuses are applied in Eaton's metal-enclosed switchgear, ambient surrounding the switchgear is 45 °C, switchgear is installed at an altitude of 3000 feet above sea level.

Because the transformer does not have any supplemental ratings, only calculations (A) are required.

$$\text{Step A.1: } I_{FL} = 1500 \div (\sqrt{3} * 4.16) = 208.18 \text{ A.}$$

$$\text{Step A.2: } I_{FL} * 1.4 = 208.18 * 1.4 = 291.45 \text{ A.}$$

Step A.3: Closest available CLE fuse rating equal to or higher than 291.45 is 300 A.

Step A.4: From **Table 8.0-7**, enclosure derating factor (F1) for 5.5 kV CLE 300 A fuse is 0.94.

Step A.5: Ambient temperature correction factor  $F2 = 1 - [(45 - 40) * 0.3 \div 100] = 0.985$ .

Step A.6: Altitude correction factor  $F3 = 1.0$

Step A.7: Modified continuous current value =  $300 * 0.94 * 0.985 * 1.0 = 277.77 \text{ A.}$

Step A.8: Because the modified continuous current value of 277.77 is less than 291.45 A calculated in Step A.2, select the next higher available CLE fuse rating, which is 350 A, and repeat calculations Steps A.4 to A.8.

Step A.4: From **Table 8.0-7**, enclosure derating factor (F1) for 5.5 kV CLE 350 A fuse is 0.84.

Step A.5:  $F2 = 0.985$

Step A.6:  $F3 = 1.0$

Step A.7: Modified continuous current value =  $350 * 0.84 * 0.985 * 1.0 = 289.59 \text{ A.}$

Step A.8: Because the modified continuous current value of 289.59 A is less than 291.45 A calculated in the initial Step A.2, select the next higher available CLE fuse rating, which is 400 A, and repeat calculations Steps A.4 to A.8.

Step A.4: From **Table 8.0-7**, Enclosure derating factor (F1) for 5.5 kV CLE 400 A fuse is 0.8.

Step A.5:  $F2 = 0.985$

Step A.6:  $F3 = 1.0$

Step A.7: Modified continuous current value =  $400 * 0.8 * 0.985 * 1.0 = 315.2 \text{ A.}$

Step A.8: Because the modified continuous current value of 315.2 A is greater than 291.45 A calculated in the initial Step A.2, 400 A is the minimum recommended fuse size for this transformer application. **Select 5.5 kV CLE 400 A fuse.**

**Example #2:**

2500 kVA, three-phase, 13.2 kV/480 V transformer, no supplemental rating, Eaton Type CLE Primary Fuses are applied in Eaton's metal-enclosed switchgear, ambient surrounding the switchgear is 30 °C, switchgear is installed at an altitude of 4500 feet above sea level.

Because the transformer does not have any supplemental ratings, only calculations (A) are required.

$$\text{Step A.1: } I_{FL} = 2500 \div (\sqrt{3} * 13.2) = 109.34 \text{ A.}$$

$$\text{Step A.2: } I_{FL} * 1.5 = 109.34 * 1.5 = 164.02 \text{ A.}$$

Step A.3: Closest available CLE fuse rating equal to or higher than 164.02 is 175 A.

Step A.4: From **Table 8.0-7**, Enclosure derating factor (F1) for 15.5 kV CLE 175 A fuse is 0.89.

Step A.5: Because actual ambient is less than 40 °C,  $F2 = 1.0$ .

Step A.6: Altitude correction factor  $F3 = 1 - [(4500 - 3300) * 0.5 \div 100000] = 0.994$ .

Step A.7: Modified continuous current value =  $175 * 0.89 * 1.0 * 0.994 = 154.82 \text{ A.}$

Step A.8: Because the modified continuous current value of 154.82 is less than 164.02 A calculated in Step A.2, select the next higher available CLE fuse rating, which is 200 A, and repeat calculations Steps A.4 to A.8.

Step A.4: From **Table 8.0-7**, Enclosure derating factor (F1) for 15.5 kV CLE 200 A fuse is 0.86.

Step A.5:  $F2 = 1.0$

Step A.6:  $F3 = 0.994$

Step A.7: Modified continuous current value =  $200 * 0.86 * 1.0 * 0.994 = 171 \text{ A.}$

Step A.8: Because the modified continuous current value of 171 A is greater than 164.02 A calculated in the initial Step A.2, 200 A is the minimum recommended fuse size for this transformer application. **Select 15.5 kV CLE 200 A fuse.**

**Example #3:**

2500/3333 kVA AA/FA, three-phase, 13.2 kV/480 V transformer, Eaton Type CLE Primary Fuses are applied in Eaton's metal-enclosed switchgear, ambient surrounding the switchgear is 40 °C, switchgear is installed at an altitude of less than 3300 feet above sea level.

Because the transformer has supplemental rating, both calculations (A) and (B) are required.

**Calculations (A):**

$$\text{Step A.1: } I_{FL} = 2500 \div (\sqrt{3} * 13.2) = 109.34 \text{ A.}$$

$$\text{Step A.2: } I_{FL} * 1.5 = 109.34 * 1.5 = 164.02 \text{ A.}$$

Step A.3: Closest available CLE fuse rating equal to or higher than 164.02 is 175 A.

Step A.4: From **Table 8.0-7**, Enclosure derating factor (F1) for 15.5 kV CLE 175 A fuse is 0.89.

Step A.5: Because actual ambient is less than or equal to 40 °C,  $F2 = 1.0$ .

Step A.6: Altitude correction factor  $F3 = 1.0$ .

Step A.7: Modified continuous current value =  $175 * 0.89 * 1.0 * 1.0 = 155.75 \text{ A.}$

Step A.8: Because the modified continuous current value of 155.75 is less than 164.02 A calculated in Step A.2, select the next higher available CLE fuse rating, which is 200 A, and repeat calculations Steps A.4 to A.8.

## Technical Data

Step A.4: From **Table 8.0-7**, enclosure derating factor (F1) for 15.5 kV CLE 200 A fuse is 0.86.

Step A.5:  $F2 = 1.0$

Step A.6:  $F3 = 1.0$

Step A.7: Modified continuous current value =  $200 * 0.86 * 1.0 * 1.0 = 172 \text{ A}$ .

Step A.8: Because the modified continuous current value of 172 A is greater than 164.02 A calculated in the initial Step A.2, 200 A is the minimum recommended fuse size for this transformer application on the basis of base kVA of 2500.

### Calculations (B):

Step B.1:  $I_{FL} = 3333 \div (\sqrt{3} * 13.2) = 145.78 \text{ A}$

Step B.2:  $I_{FL} * 1.3 = 145.78 * 1.3 = 189.51 \text{ A}$

Step B.3: Closest available CLE fuse rating equal to or higher than 189.51 is 200 A.

Step B.4: From **Table 8.0-7**, enclosure derating factor (F1) for 15.5 kV CLE 200 A fuse is 0.86.

Step B.5: Because actual ambient is less than or equal to 40 °C,  $F2 = 1.0$ .

Step B.6:  $F3 = 1.0$ .

Step B.7: Modified continuous current value =  $200 * 0.86 * 1.0 * 1.0 = 172 \text{ A}$ .

Step B.8: Because the modified continuous current value of 172 A is less than 189.51 A calculated in Step B.2, select the next higher available CLE fuse rating, which is 250 A, and repeat calculations Steps B.4 to B.8.

Step B.4: From **Table 8.0-7**, Enclosure derating factor (F1) for 15.5 kV CLE 250 A fuse is 0.82.

Step B.5:  $F2 = 1.0$

Step B.6:  $F3 = 1.0$

Step B.7: Modified continuous current value =  $250 * 0.82 * 1.0 * 1.0 = 205 \text{ A}$

Step B.8: Because the modified continuous current value of 205 A is greater than 189.51 A calculated in the initial Step B.2, 250 A is the minimum recommended fuse size for this transformer application on the basis of its maximum kVA of 3333.

From final Step A.8, minimum recommended fuse rating = 200 A.

From final Step B.8, minimum recommended fuse rating = 250 A.

Select the fuse with the higher continuous current rating as determined from calculation (A) or (B). Therefore, **select 15.5 kV, CLE 250 A fuse for this transformer application.**



**Technical Data**

**Surge Protection**

IEEE standard C62.11 for **Metal Oxide Surge Arresters** lists the maximum rated ambient temperature as 40 °C. The ambient temperature inside an Eaton MVS switchgear vertical section may exceed this temperature, especially in outdoor applications where solar radiation may produce

a significant contribution to the temperature. **Table 8.0-8** lists the recommended minimum duty cycle voltage rating for various system grounding methods. Surge arrester rating is based upon the ambient air temperature in the switchgear vertical section not exceeding 55 °C.

**Table 8.0-8. Suggested Minimum Ratings (kV) for Metal Oxide Surge Arresters Located in Metal-Enclosed Switchgear**

Service Voltage Line-to-Line kV	Distribution Class Arresters						Station Class Arresters					
	Solidly Grounded System		Low Resistance Grounded System		High Resistance or Ungrounded System		Solidly Grounded System		Low Resistance Grounded System		High Resistance or Ungrounded System	
	Arrester Ratings kV						Arrester Ratings kV					
	Nominal	MCOV	Nominal	MCOV	Nominal	MCOV	Nominal	MCOV	Nominal	MCOV	Nominal	MCOV
2.30	3	2.55	3	2.55	3	2.55	3	2.55	3	2.55	3	2.55
2.40	3	2.55	3	2.55	6	5.10	3	2.55	3	2.55	6	5.10
3.30	3	2.55	3	2.55	6	5.10	3	2.55	3	2.55	6	5.10
4.00	3	2.55	6	5.10	6	5.10	3	2.55	6	5.10	6	5.10
4.16	6	5.10	6	5.10	6	5.10	6	5.10	6	5.10	6	5.10
4.76	6	5.10	6	5.10	9	7.65	6	5.10	6	5.10	9	7.65
4.80	6	5.10	6	5.10	9	7.65	6	5.10	6	5.10	9	7.65
6.60	6	5.10	6	5.10	9	7.65	6	5.10	6	5.10	9	7.65
6.90	6	5.10	6	5.10	9	7.65	6	5.10	9	7.65	9	7.65
7.20	6	5.10	6	5.10	10	8.40	6	5.10	9	7.65	10	8.40
8.32	9	7.65	9	7.65	12	10.20	9	7.65	9	7.65	12	10.20
8.40	9	7.65	9	7.65	12	10.20	9	7.65	9	7.65	12	10.20
11.00	9	7.65	9	7.65	15	12.70	9	7.65	10	8.40	15	12.70
11.50	9	7.65	10	8.40	18	15.30	9	7.65	12	10.20	18	15.30
12.00	10	8.40	10	8.40	18	15.30	10	8.40	12	10.20	18	15.30
12.47	10	8.40	12	10.20	18	15.30	10	8.40	12	10.20	18	15.30
13.20	12	10.20	12	10.20	18	15.30	12	10.20	12	10.20	18	15.30
13.80	12	10.20	12	10.20	18	15.30	12	10.20	15	12.70	18	15.30
14.40	12	10.20	12	10.20	21	17.00	12	10.20	15	12.70	21	17.00
18.00	15	12.70	15	12.70	27	22.00	15	12.70	18	15.30	27	22.00
20.78	18	15.30	18	15.30	30	24.40	18	15.30	21	17.00	30	24.40
22.00	18	15.30	18	15.30	30	24.40	18	15.30	21	17.00	30	24.40
22.86	18	15.30	21	17.00	—	—	18	15.30	24	19.50	36	29.00
23.00	18	15.30	21	17.00	—	—	18	15.30	24	19.50	36	29.00
24.94	21	17.00	24	19.50	—	—	21	17.00	24	19.50	36	29.00
25.80	21	17.00	24	19.50	—	—	21	17.00	24	19.50	36	29.00
26.40	21	17.00	24	19.50	—	—	21	17.00	27	22.00	39	31.50
33.00	27	22.00	30	24.40	—	—	27	22.00	36	29.00	45	36.50
34.50	30	24.40	30	24.40	—	—	30	24.40	36	29.00	48	39.00
38.00	30	24.40	—	—	—	—	30	24.40	36	29.00	—	—

**Note:** MCOV = Maximum Continuous Operating Voltage.

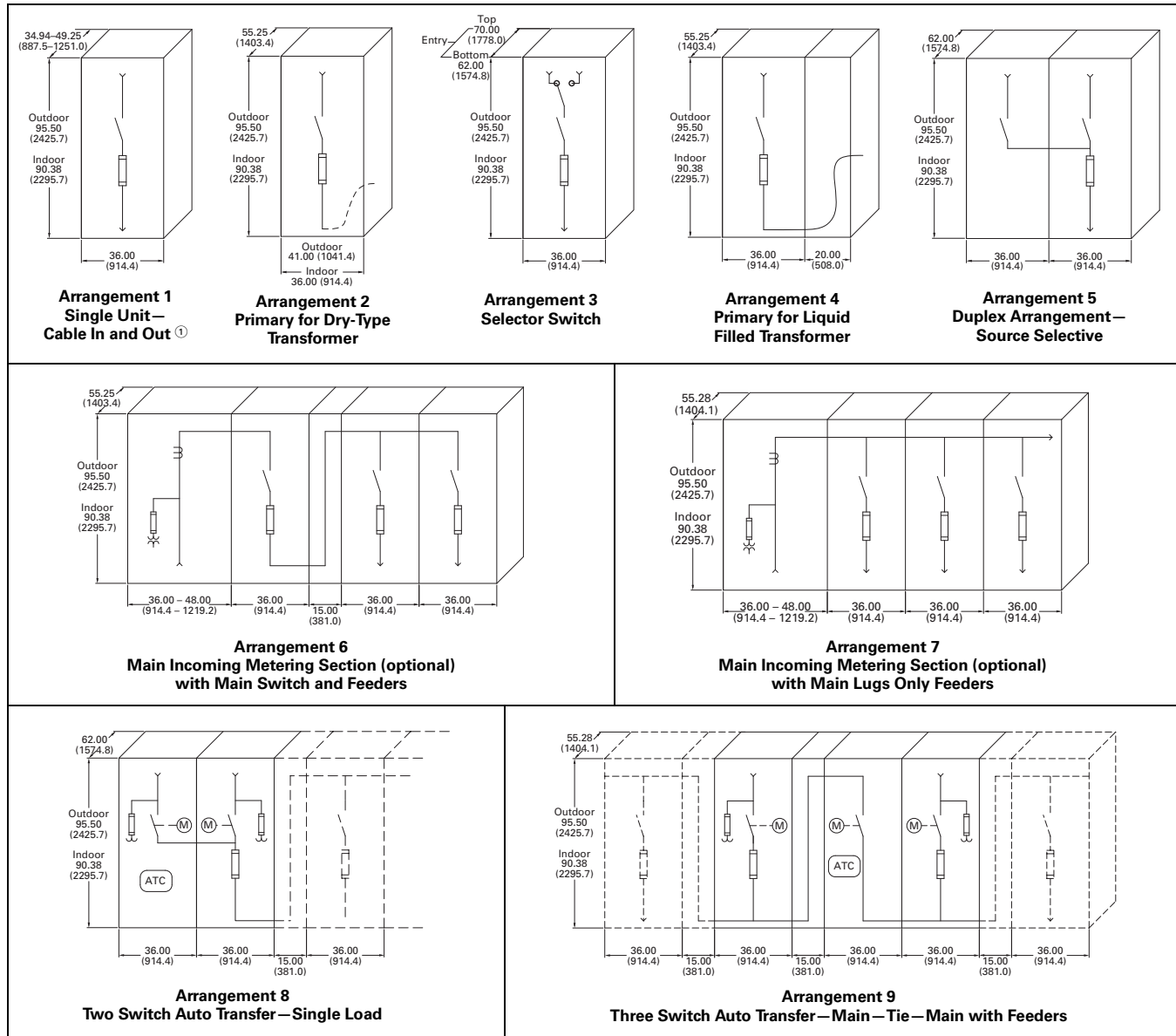
**Layouts—Dimensions**

**Typical Arrangements—5 and 15 kV**

The drawings in this section represent the most common arrangements. **Layouts shown are for rear-accessible equipment.** Front-accessible designs are available—refer to Eaton. Many other configurations and combinations are available. Two voltage transformers for customer metering and one control transformer for auxiliary power can be mounted in the structures shown.

For control power transformer larger than 1 kVA, additional space is required. **Depth of units will vary** due to cable entrance and exit requirements, the addition of lightning arresters, instrument transformers, special cable terminators, etc. **Disconnect fuses may require wider sections.** Cables are shown out top and bottom for layout only. Top or bottom must be

selected for incoming and for outgoing cables. Structure depth is based on two 500 kcm XLP or EPR insulated cables per phase using preformed slip-on cable termination devices. **Refer to note** below for minimum required depth when more than two cables per phase are used. For unit substation alignment details, see **Tabs 13 and 14.**



**Figure 8.0-10. 5 and 15 kV Typical Arrangements—Dimensions in Inches (mm)**

① Mini-MVS switch unit in 26.00-inch (660.4 mm) wide, 27.25-inch (692.2 mm) deep and 66.00-inch (1676.4 mm) tall enclosure can be provided for 5 kV, 200 A.

**Note:** Width for Utility Metering Structures may vary.

**Note:** ATC = Automatic Transfer Controller (see Page 8.0-11). M = Motor Operator.

**Note:** Minimum depth of MVS unit: Up to two 500 kcm per phase: 55.00 inches (1397.0 mm) or 62.00 inches (1574.8 mm) deep; three or four 500 kcm per phase: 70.00 inches (1778.0 mm) deep, five or six 500 kcm per phase: 80.00 inches (2032.0 mm) deep.

**Not to be used for construction purposes unless approved.**

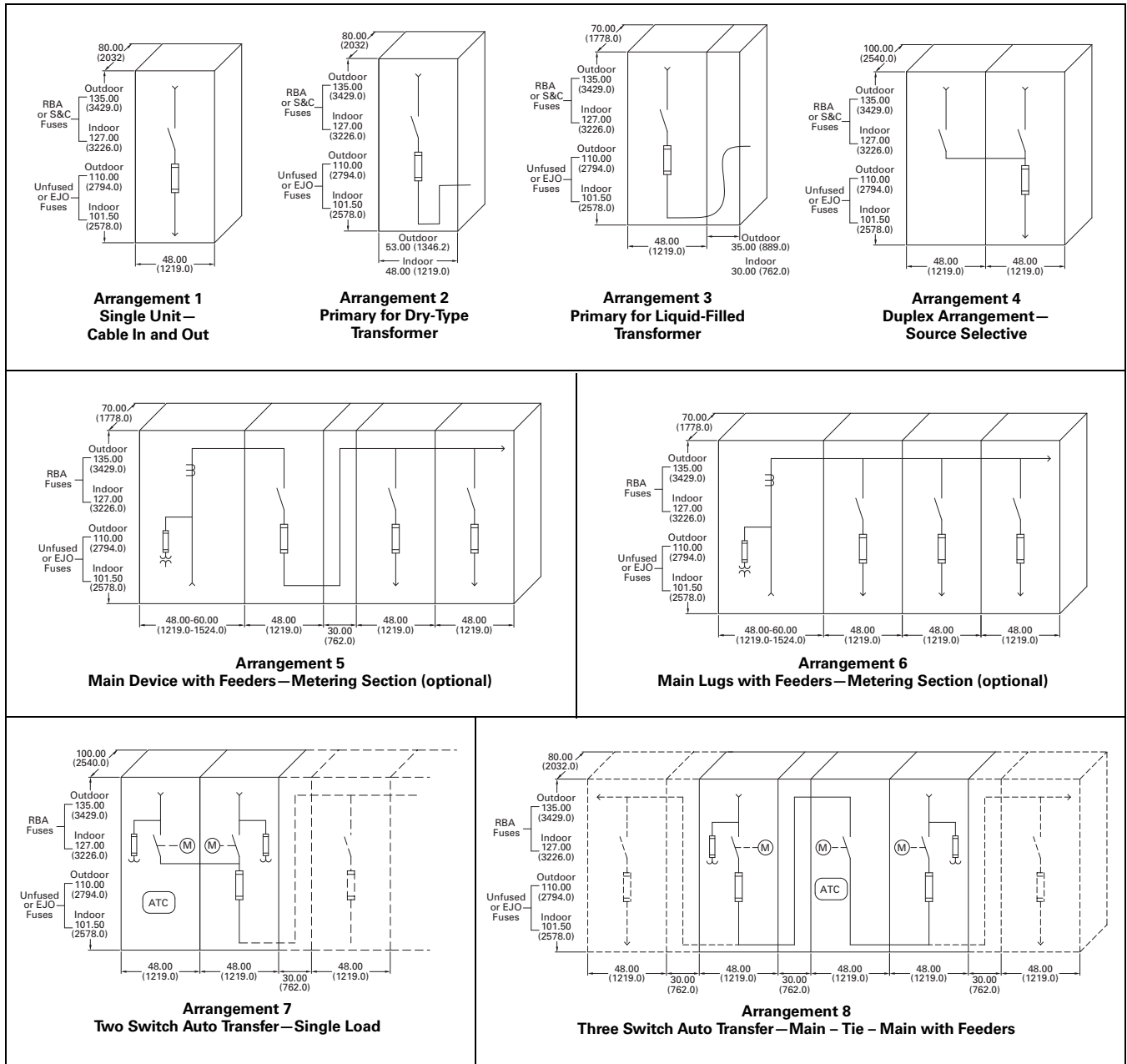
**Layouts—Dimensions**

**Typical Arrangements—27 and 38 kV**

The drawings in this section represent the most common arrangements. **Layouts shown are for rear-accessible equipment.** Front-accessible designs are available—refer to Eaton. Many other configurations and combinations are available. Two voltage transformers for metering and one control transformer

for auxiliary power can be mounted in the structures shown. For control power above 1 kVA, additional space is required. **Depth of units will vary** due to cable entrance and exit requirements, the addition of lightning arresters, instrument transformers, special cable terminators, etc. Cables are shown out

top and bottom for layout only. Top or bottom must be selected for incoming and for outgoing cables. Cable sizing is based on two 500 kcmil XLP or EPR insulated cables per phase using preformed slip-on cable termination devices. For unit substation alignment details, see **Tab 13** and **14**.



**Figure 8.0-11. 27 and 38 kV Typical Arrangements—Dimensions in Inches (mm)**

**Note:** Width for Utility Metering Structures may vary.

**Note:** ATC = Automatic Transfer Controller (see **Page 8.0-11**). M = Motor Operator.

**Not to be used for construction purposes unless approved.**

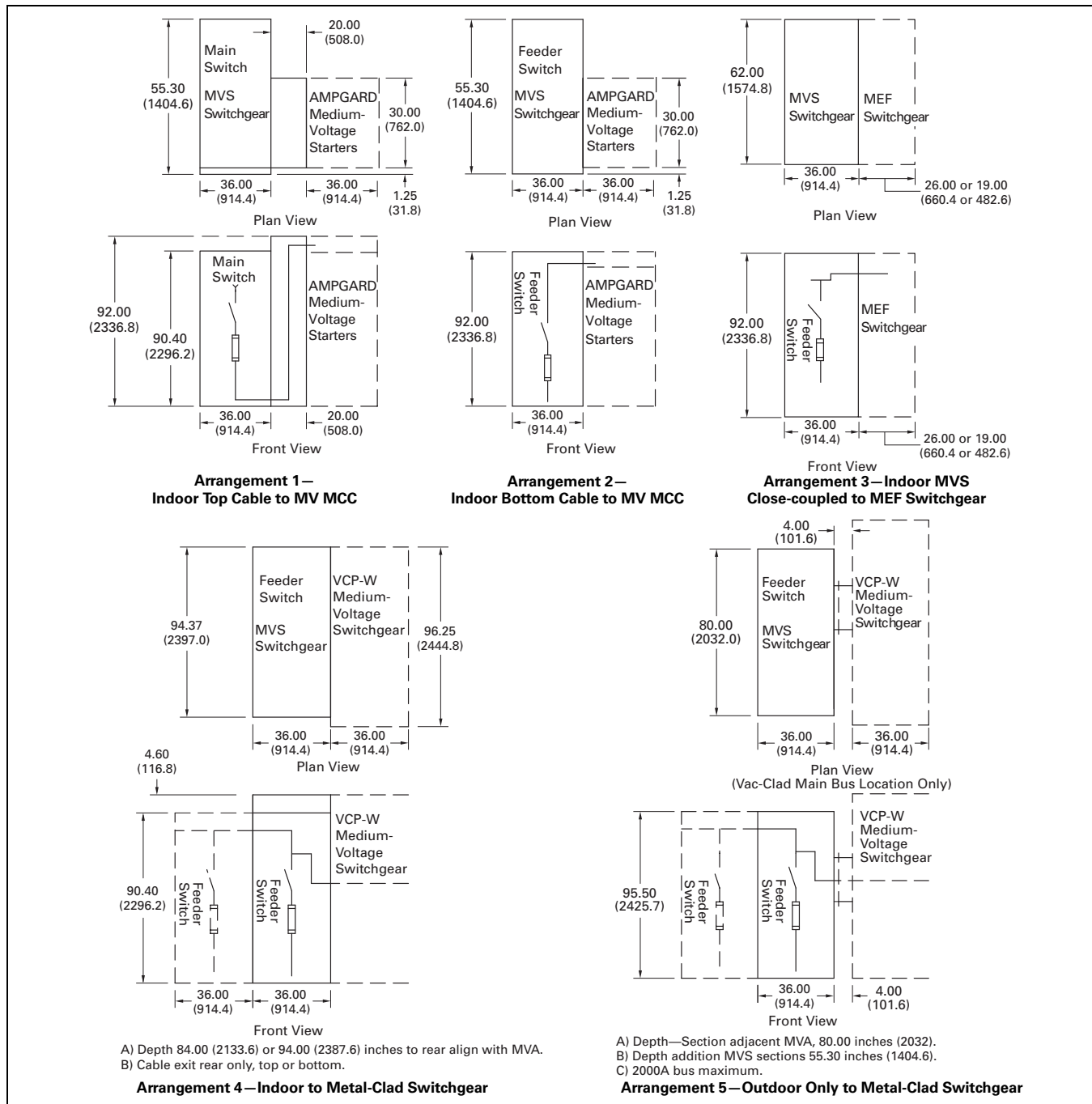
**Layouts—Dimensions**

**Typical Arrangements—MVS Connecting to Other Switchgear**

The drawings in this section represent the most common arrangements. Layouts shown are for rear-accessible equipment. Front-accessible designs are available—see **Page 8.0-25**. Many other configurations and combinations are available. Two voltage transformers for metering and one control transformer for auxiliary power can be mounted in

the structures shown. For control power transformer larger than 1 kVA, additional space is required. **Depth of units will vary** due to cable entrance and exit requirements, the addition of lightning arresters, instrument transformers, special cable terminators, etc. **Disconnect fuses may require wider sections.** Cables are shown out top and bottom

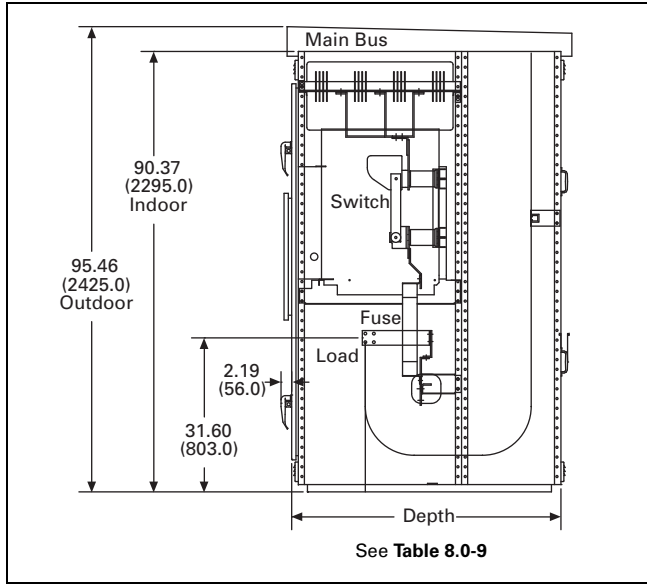
for layout only. Top or bottom must be selected for incoming and for outgoing cables. Cable sizing is based on two 500 kcmil XLP or EPR insulated cables per phase using preformed slip-on cable termination devices. For unit substation alignment details, see **Tab 13** and **14**.



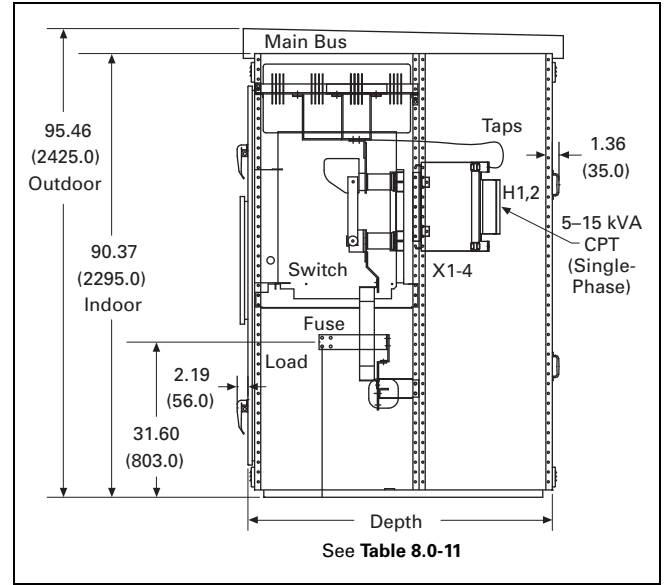
**Figure 8.0-12. Connections to AMPGARD® MCC (7.2 kV Maximum) and to VCPW Switchgear (15 kV Maximum)—Dimensions in Inches (mm)**

*Not to be used for construction purposes unless approved.*

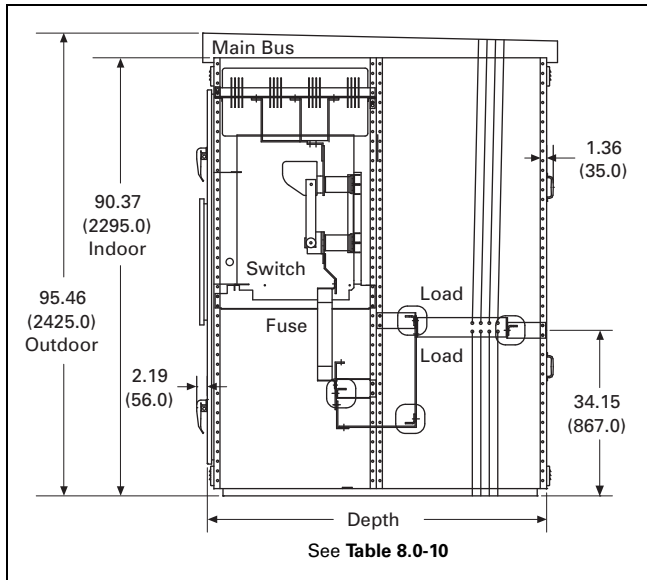
**Layouts—Dimensions, 5 and 15 kV Switch**



**Figure 8.0-13. Front Access Feeder Circuit—Fused or Unfused**



**Figure 8.0-15. Rear Access Feeder Circuit With Bus Connected CPT**



**Figure 8.0-14. Rear Access Feeder Circuit—Fused or Unfused**

**Table 8.0-9. Front Access**

No. of Cables per Phase (Based on 500 kcmil)	Minimum Structure Depth—Inches (mm)	
	5 kV	15 kV
1 or 2 out bottom	34.94 (887.5)	34.94 (887.5)
1 or 2 out top	49.25 (1250.0)	49.25 (1250.0)

**Table 8.0-10. Rear Access**

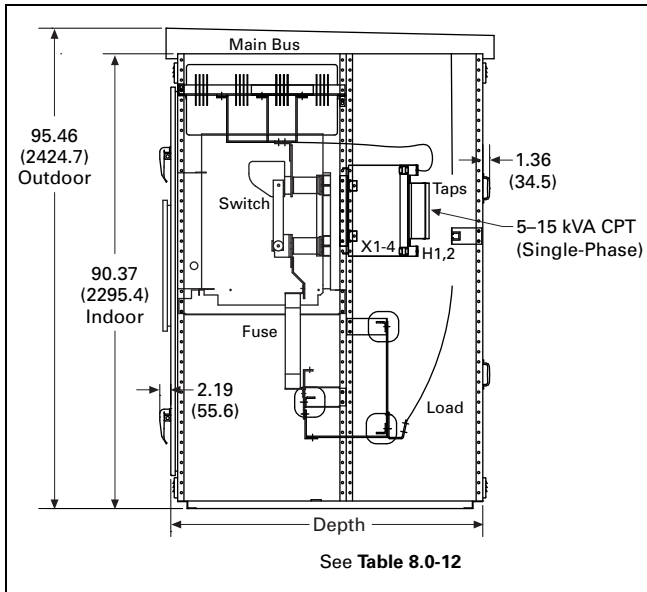
No. of Cables per Phase (Based on 500 kcmil)	Minimum Structure Depth—Inches (mm)	
	5 kV	15 kV
3 or 4 top or bottom	62.00 (1574.8)	70.00 (1778.0)
5 or 6 top or bottom	70.00 (1778.0)	80.00 (2032.0)

**Table 8.0-11. Rear Access**

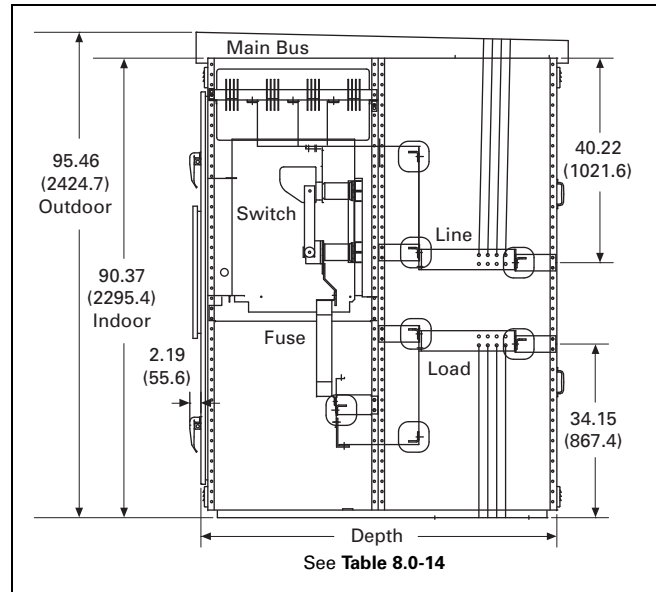
No. of Cables per Phase (Based on 500 kcmil)	Minimum Structure Depth—Inches (mm)	
	5 kV	15 kV
1 or 2 out bottom	62.00 (1574.8)	62.00 (1574.8)

*Dimensions in inches (mm).  
Not to be used for construction purposes unless approved.*

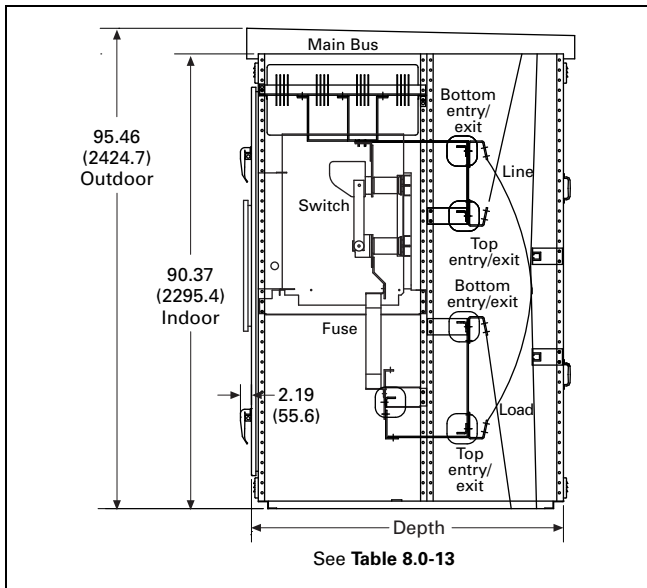
**Layouts—Dimensions, 5 and 15 kV Switch**



**Figure 8.0-16. Rear Access Feeder Circuit With Bus Connected CPT**



**Figure 8.0-18. Rear Access Cable In/Cable Out With Main Bus**



**Figure 8.0-17. Rear Access Cable In/Cable Out With Main Bus**

8

**Table 8.0-12. Rear Access**

No. of Cables per Phase (Based on 500 kcmil)	Minimum Structure Depth—Inches (mm)	
	5 kV	15 kV
1 or 2 out top	70.00 (1778.0)	70.00 (1778.0)

**Table 8.0-13. Rear Access**

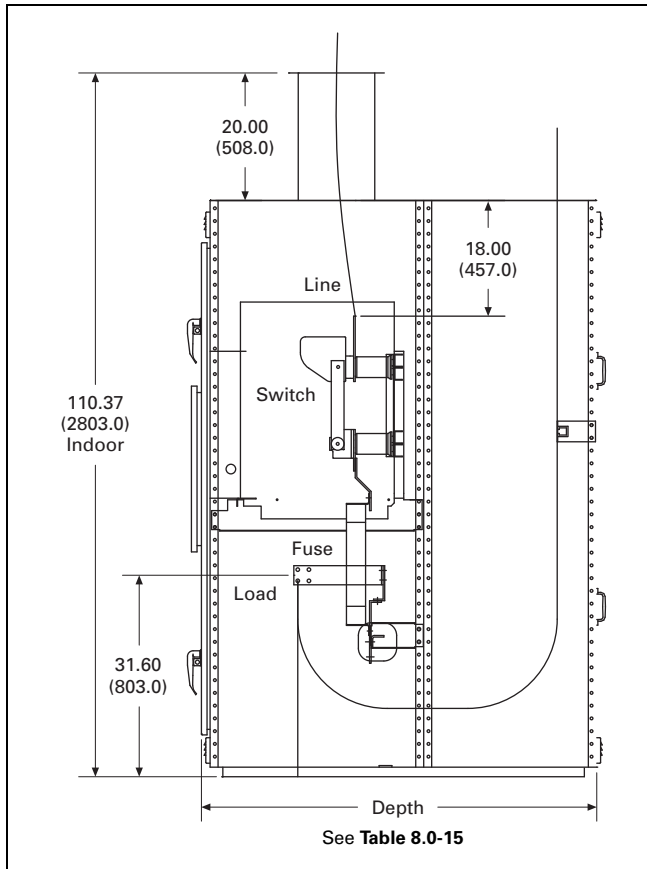
No. of Cables per Phase (Based on 500 kcmil)	Minimum Structure Depth—Inches (mm)	
	5 kV	15 kV
1 or 2 top or bottom	55.25 (1403.3)	62.00 (1574.8)

**Table 8.0-14. Rear Access**

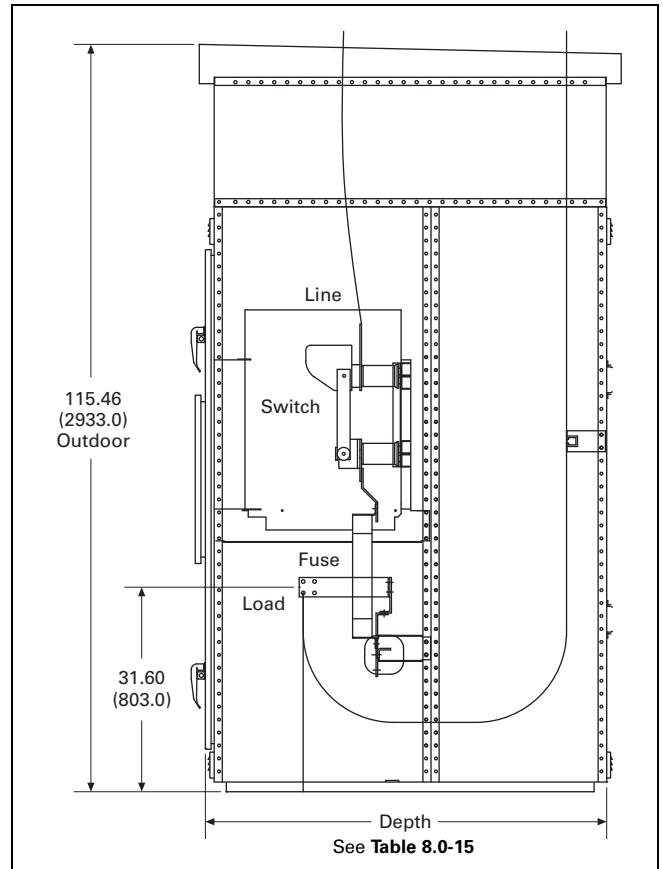
No. of Cables per Phase (Based on 500 kcmil)	Minimum Structure Depth—Inches (mm)	
	5 kV	15 kV
3 or 4 top in/bottom out	62.00 (1574.8)	70.00 (1778.0)
5 or 6 top in/bottom out	70.00 (1778.0)	80.00 (2032.0)

*Dimensions in inches (mm).  
Not to be used for construction purposes unless approved.*

**Layouts—Dimensions, 5 and 15 kV Switch**



**Figure 8.0-19. Front Access Indoor, Cable In/Cable Out**



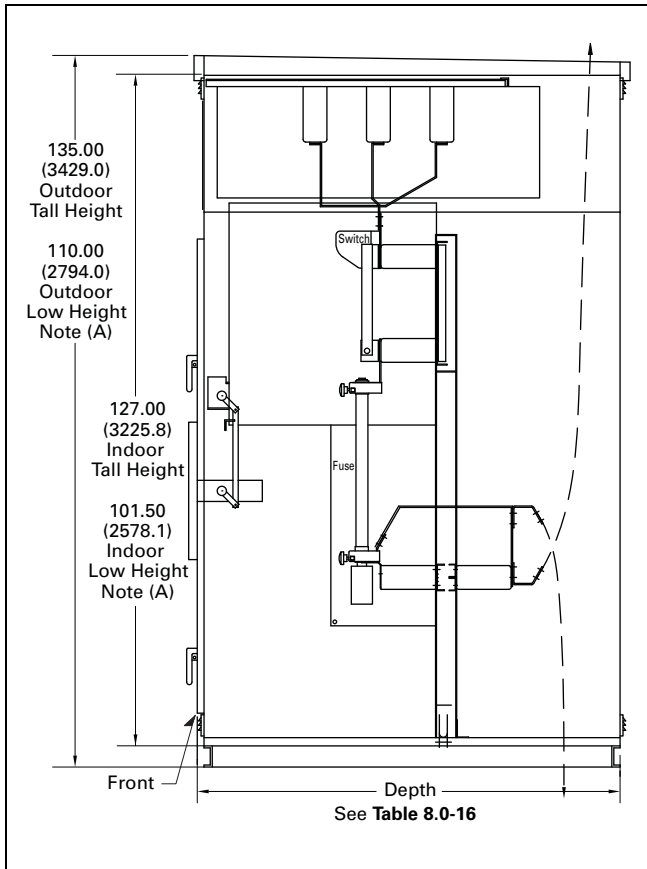
**Figure 8.0-20. Front Access Outdoor, Cable In/Cable Out**

**Table 8.0-15. Front Access, Cable Exit—Top or Bottom**

No. of Cables per Phase (Based on 500 kcmil)	Minimum Structure Depth—Inches (mm)	
	5 kV	15 kV
1 or 2 top in bottom out	34.94 (887.5)	34.94 (887.5)
1 or 2 top in top out	49.25 (1250.0)	49.25 (1250.0)

*Dimensions in inches (mm).  
Not to be used for construction purposes unless approved.*

**Layouts—Dimensions, 27 and 38 kV Switch**

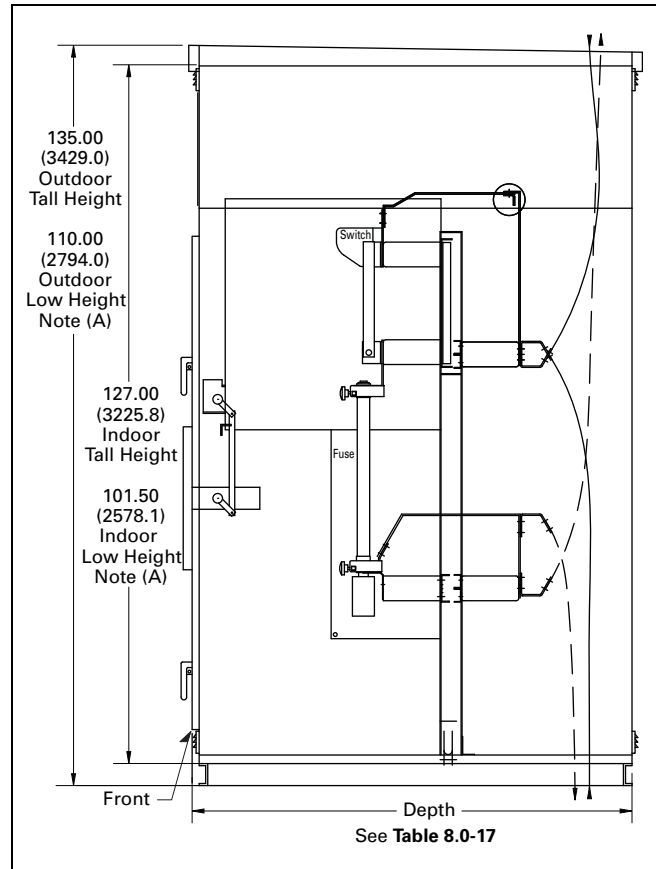


**Figure 8.0-21. Rear Access, Cable Exit—Top or Bottom**

**Note A:** Low height dimensions are for non-fused, manually operated switch only. For all motor operated switches and all fused switches, tall height dimensions apply.

**Table 8.0-16. Rear Access, Cable Exit—Top or Bottom**

No. of Cables per Phase (Based on 500 kcmil)	Minimum Structure Depth—Inches (mm)	
	27 kV	38 kV
1 or 2	80.00 (2032.0)	80.00 (2032.0)



**Figure 8.0-22. Rear Access, Cable Entry and Exit—Top or Bottom**

**Note A:** Low height dimensions are for non-fused, manually operated switch only. For all motor operated switches and all fused switches, tall height dimensions apply.

**Table 8.0-17. Rear Access, Cable Entry and Exit—Top or Bottom**

No. of Cables per Phase (Based on 500 kcmil)	Minimum Structure Depth—Inches (mm)	
	27 kV	38 kV
1 or 2	80.00 (2032.0)	80.00 (2032.0)

*Dimensions in inches (mm).*

*Not to be used for construction purposes unless approved.*



Layouts—Dimensions

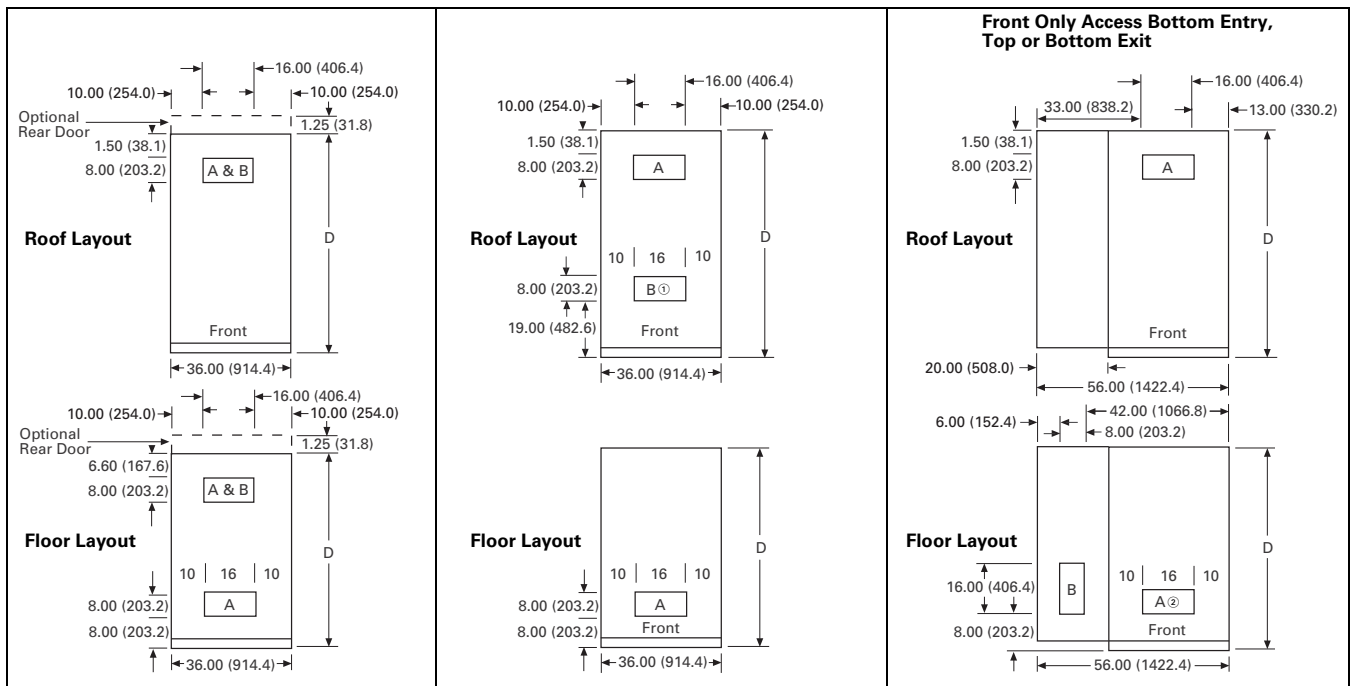


Figure 8.0-23. 5 and 15 kV Roof Layouts and Floor Layouts

① Cable location not available with top main bus.

② When high continuous current fusing or instrumentation is required, consult the Eaton factory for guidance.

Note: A = Power Cable to Load. B = Power Cable from Source. See Figures 8.0-10 and 8.0-13 through 8.0-20 as applicable for dimension D on Pages 8.0-18 and 8.0-21 through 8.0-23.

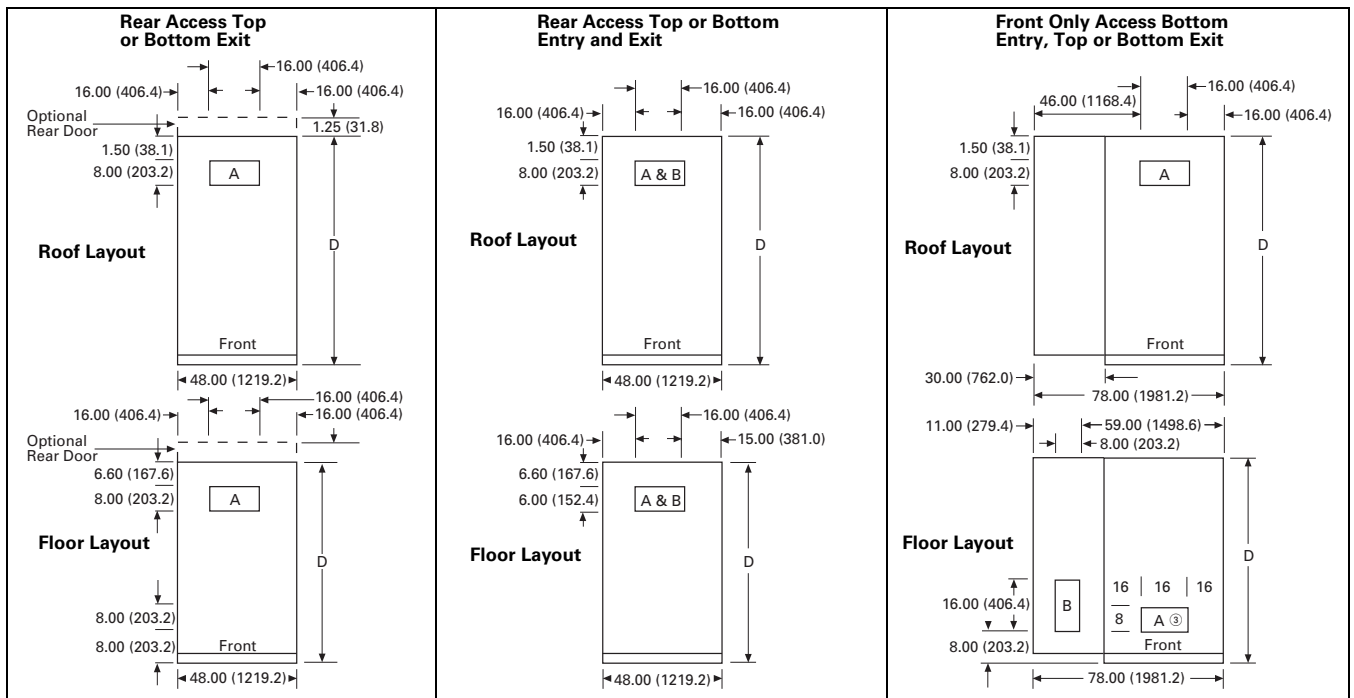


Figure 8.0-24. 27 and 38 kV Roof Layouts and Floor Layouts

③ When high continuous current fusing or instrumentation is required, consult the Eaton factory for guidance.

Note: A = Power Cable to Load. B = Power Cable from Source. See Figures 8.0-11 and 8.0-21 through 8.0-22 as applicable for dimension D on Pages 8.0-19 and 8.0-24.

Dimensions in inches (mm).

Not to be used for construction purposes unless approved.

Layouts—Dimensions

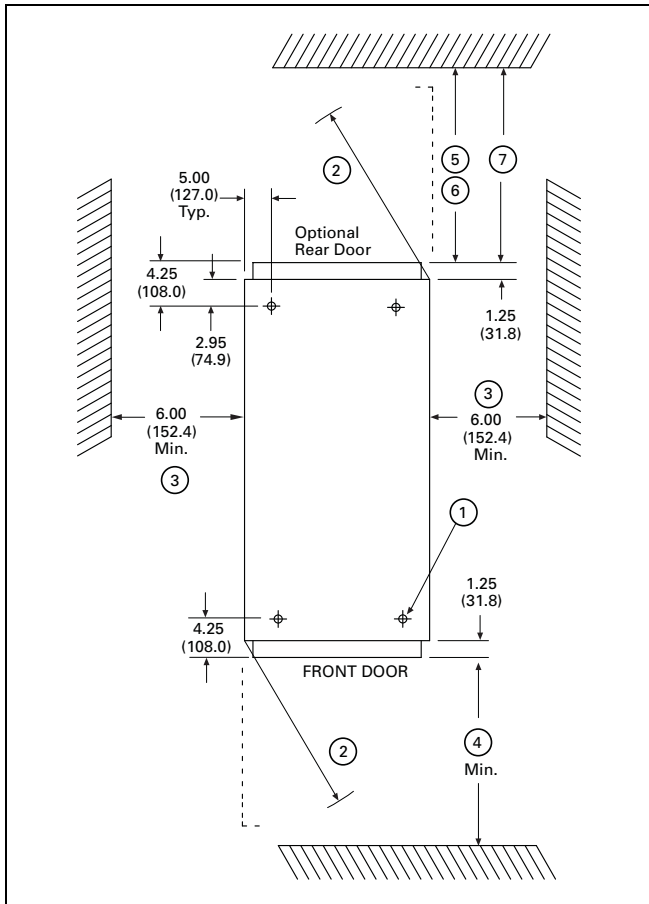


Figure 8.0-25. Typical Anchor Plan—5-15 kV Indoor or Outdoor

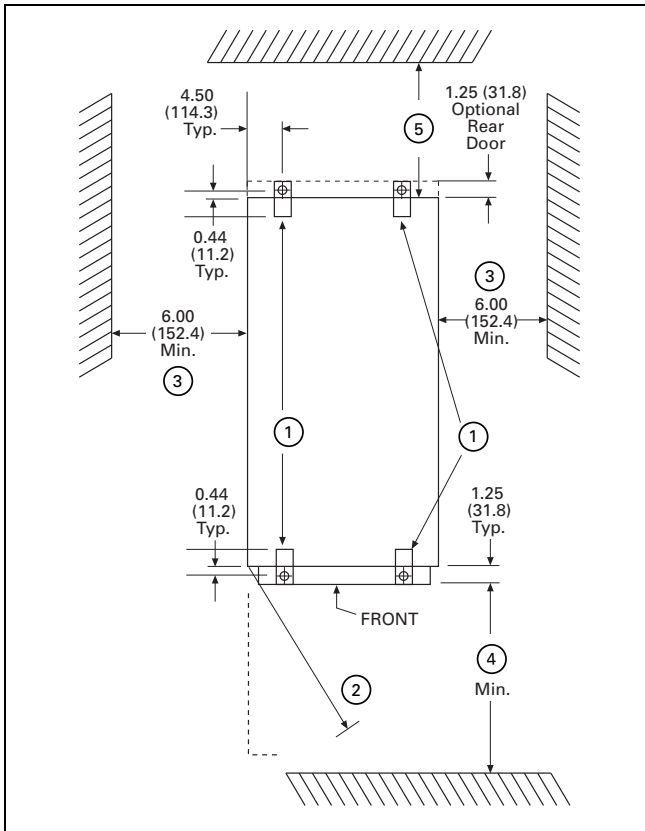
- ① Locations for tie-down 0.65 (16.5) diameter holes in four places. Customer provided bolts for anchoring should be 0.50–13 min. SAE Grade 5 (M12 x 1.75 CL 10.9) and tightened to 75 ft-lb (101.7 Nm).
- ② Door swing equals unit width at 90°.
- ③ The standard minimum clearances on side. The authority having jurisdiction may require a larger distance.
- ④ Minimum clearances in front is the width of the widest vertical section plus 1.00 inch (25.4 mm). The authority having jurisdiction may require a larger distance.
- ⑤ The standard minimum recommended distance is 30.00 inches (762.0 mm) for assemblies requiring rear access for installation and maintenance. The authority having jurisdiction may require a larger distance.
- ⑥ For MVS only. If the application is specifically provided by contract as not requiring rear access as stated in 5, then the minimum recommended distance is 6.00 inches (152.4 mm).
- ⑦ If optional rear door is supplied, the minimum is the width of the widest vertical section plus 1.00 inch (25.4 mm). The authority having jurisdiction may require a larger distance.
- ⑧ Finished foundation’s surface shall be level within 0.06 inch (1.5 mm) in 36.00 inches (914.4 mm) left-to-right, front-to-back and diagonally, as measured by a laser level.

Table 8.0-18. Approximate Weights in Lb (kg)

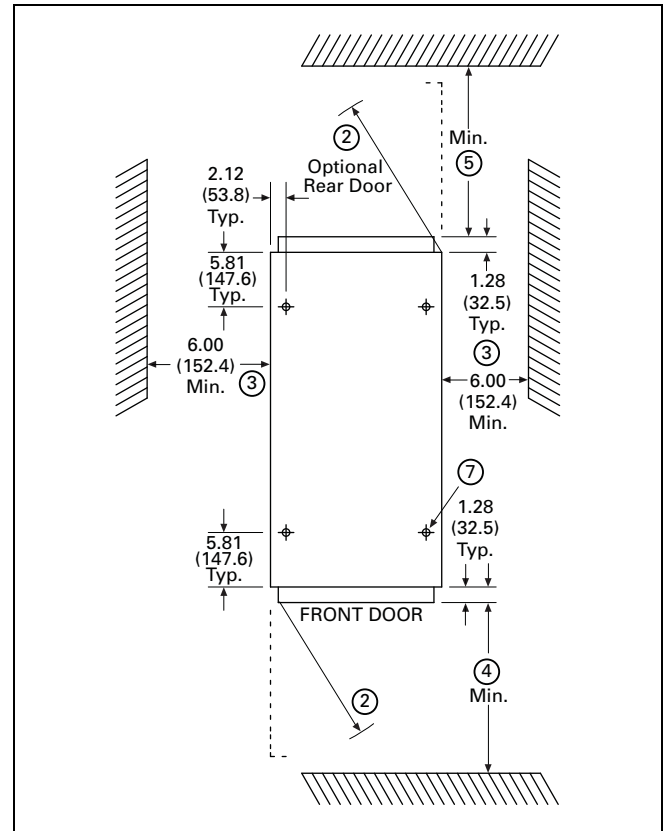
Switch Description	Indoor	Outdoor
<b>5 or 15 kV Class</b>		
Non-fused switch	1500 (681)	1800 (817)
Fuses (3), add	200 (91)	200 (91)
Indoor transition	300 (136)	—
Outdoor throat	—	500 (227)

*Dimensions in Inches (mm).  
Not to be used for construction purposes unless approved.*

**Layouts—Dimensions**



**Figure 8.0-26. Typical Anchor Plan—27–38 kV Outdoor**



**Figure 8.0-27. Typical Anchor Plan—27–38 kV Indoor**

- ① Typical location for four (two front, two back) Eaton supplied tie down clips for all 27–38 kV. Customer provided bolts for anchoring should be 0.50–13 min. SAE Grade 5 M12 x 1.75 min. CL 10.9 or stronger, and tightened to 75 ft-lb.
- ② Door swing equals vertical section width at 90°.
- ③ Minimum clearance on side. Local jurisdictions may require a larger clearance.
- ④ Minimum clearance in front is the width of the widest vertical section plus 1.00 inch (25.4 mm), but not less than that required by the NEC®. Local jurisdictions may require a larger distance.
- ⑤ Minimum clearance in rear is 30.00 inches (762.0 mm). If rear doors are supplied, the minimum clearance is the width of the widest vertical section equipped with a rear door plus 1.00 inch (25.4 mm). Local jurisdictions may require a larger clearance.
- ⑥ Finished foundation’s surface shall be level within 0.06-inch (1.5 mm) in 36.00 inches (914.4 mm) left-to-right, front-to-back and diagonally, as measured by a laser level.
- ⑦ Locations for 0.50-inch (12.7 mm) anchor bolts.

**Table 8.0-19. Approximate Weights in Lb (kg)**

Switch Description	Indoor	Outdoor
<b>27 or 38 kV Class</b>		
Non-fused switch	2000 (908)	2400 (1090)
Fuses (3), add	300 (136)	300 (136)
Indoor transition	1100 (499)	—
Outdoor throat	—	1200 (545)
Motor operator adder	400 (182)	400 (182)

*Dimensions in Inches (mm).*

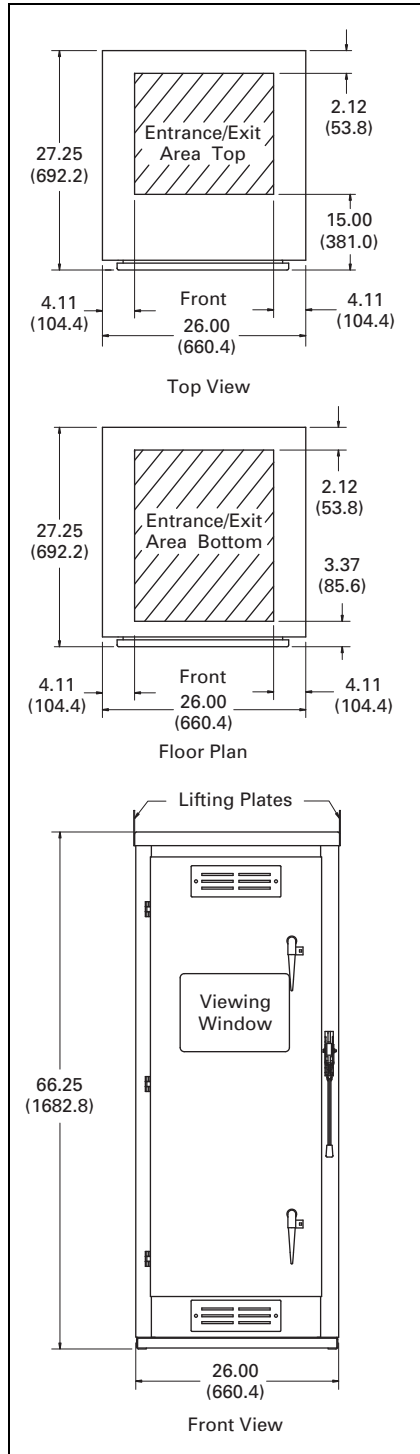
*Not to be used for construction purposes unless approved.*

Layouts—Dimensions

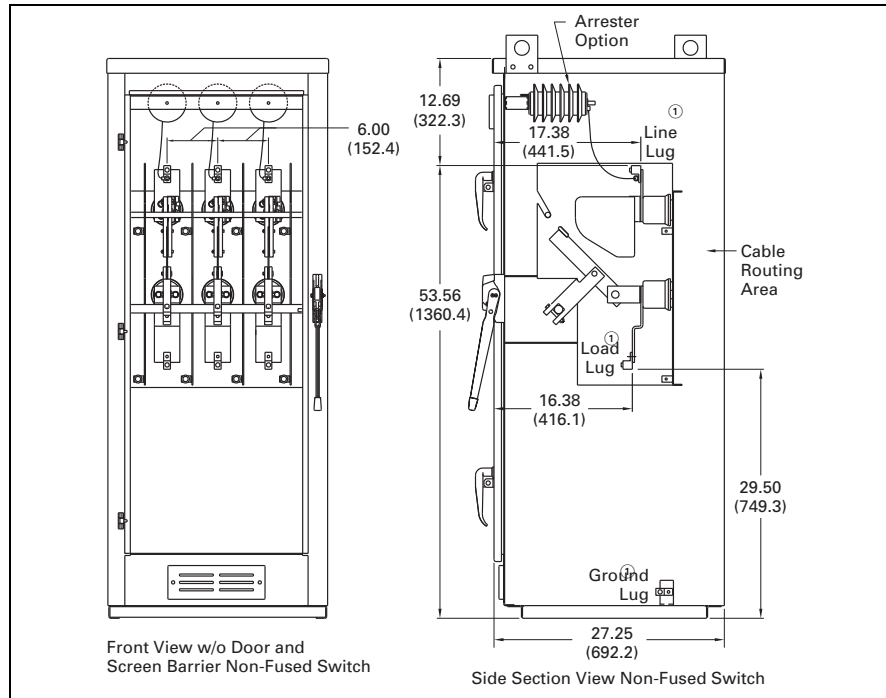
**Mini-MVS Switch  
(5 kV, 200 A Only)**

**Dimensions and Weights**

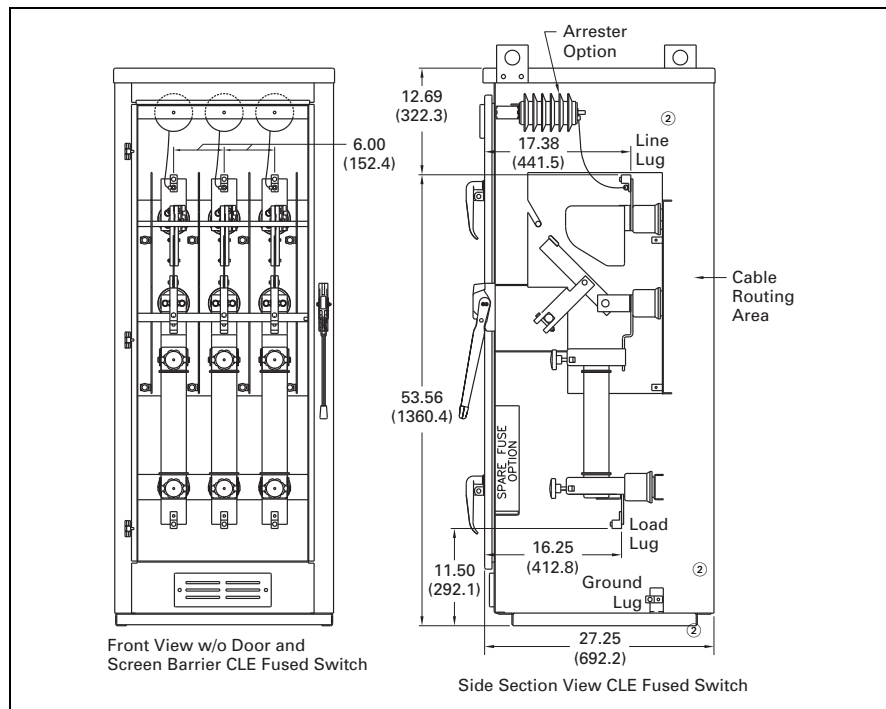
Maximum weight of switch assembly is 550 lb (250 kg).



**Figure 8.0-28. Front View and Conduit Entrance**



**Figure 8.0-29. Front and Side View of Non-Fused Mini-MVS Switchgear Assembly**  
① Cable Size #6-2/0, 1/Phase.



**Figure 8.0-30. Front and Side View of Fused CLE Mini-MVS Switchgear Assembly**  
② Cable Size #6-2/0, 1/Phase.

**Note:** The Mini-MVS unit is designed for front access only or as front and rear access. Cable terminations are accessible from the front. Line and load cables can both enter from top, or both can enter from bottom, or line can enter from top and load can exit from bottom. However, for California applications, line cables must enter from top, and load cables must exit from bottom. The unit can be placed against the wall, with a minimum 6.00-inch (152.4 mm) clearance. For rear access applications, a minimum 30.00-inch (762.0 mm) clearance is recommended. Check for additional NEC code clearance requirements.

## General Description

MVS-ND Medium-Voltage—Load Interrupter Switchgear—  
5 and 15 kV (18.00-Inch Wide)

Indoor Unit



Indoor with Top Hat



Outdoor with Top Hat

## General Description

Type MVS-ND load interrupter switchgear offers the same great functionality of traditional MVS switchgear in a reduced footprint. It uses a Type MVS-ND load interrupter switch with its poles arranged front-to-back and provides the narrowest footprint available without the use of environmentally harmful SF<sub>6</sub> gas. Type MVS-ND switchgear, like all other Eaton metal-enclosed and metal-clad switchgear, depends on air for its primary phase-to-phase and phase-to-ground insulation. It is designed for general power distribution or transformer primary switching, where infrequent switching means is required.

Type MVS-ND load interrupter switchgear is available as follows:

- Rated maximum voltage of 4.76 or 15 kV
- Rated continuous and load-break current rating of 600 or 1200 A
- Indoor or outdoor non-walk-in enclosures
- Can be supplied as single unit or lineup of multiple units with main bus
- Duplex arrangement for Source 1 or Source 2 selection
- Main-tie-main lineup
- Close-coupled primary for dry or liquid-filled transformer
- Close-coupled to Eaton's Type MVS, Type VCP-W or AMPGARD motor control center via an 18.00-inch transition section

- Supplied with manually or motor operated switches
- Supplied with non-fused or fused switches with 5 kV BHLE 10–450 A or 15 kV BHLE 10–250 A or BHCL 300 A primary fuses
- Optional auxiliary switch with up to 5a/5b contacts
- Optional space heaters for indoor switchgear
- Supplied with key interlocks to force a desired sequence of operation
- Surge arresters (optional) can be added to the line or load side

## Standard Features

- Air insulated three-pole, gang-operated, quick-make, quick-break load interrupter switch mechanism provides speed of operation that is independent of the operator for safe and reliable switching
- Proven load interrupter switch design that uses main and flicker blade technology
- A through-the-door switch operation from the front of the switchgear
- A door interlock prevents inadvertent opening of the enclosure's front door while the load interrupter switch is in the closed position
- A switch interlock prevents inadvertent closing of the switch when the enclosure's front door is open
- Viewing window provides clear, visible confirmation of opened and closed switch contacts

- Mechanical indicators show whether the switch mechanism is open or closed
- Provisions for padlocking the switch in open or closed position
- Provision for padlocking the main door in closed position
- Space heaters are provided as standard for outdoor switchgear (120 V or 240 Vac control supply is to be provided by the purchaser)

## Instrumentation, CTs, VTs and CPT

Due to compact dimensions, MVS-ND units are not designed for mounting of CTs, VTs or a CPT. If the application requires CTs, VTs or a CPT, a conventional 36.00-inch-wide MVS unit is required, which can be close-coupled to the MVS-ND unit through an 18.00-inch transition section.

## Standards and Certifications

Eaton's MVS-ND load interrupter switchgear meets or exceeds the requirements of the following industry standards:

- IEEE Standard C37.20.3
- ANSI C37.57
- NEMA SG5
- Canadian Standard CAN/CSA C22.2 No. 31

Type MVS-ND switches meet or exceed the requirements of the following industry standards:

- IEEE Standard C37.20.4
- ANSI C37.58
- ANSI C37.22
- NEMA SG6
- Canadian Standards CAN/CSA C22.2 No. 193 and CAN/CSA C22.2 No. 58

## Third-Party Certification

5/15 kV MVS-ND load interrupter switchgear can be provided with UL or CSA listing.

## Seismic Qualification



5/15 kV MVS-ND load interrupter switchgear has been qualified for seismic applications by actual testing to meet requirements of IBC 2006 and CBC 2007. Refer to **Tab 1** for information for this and other Eaton products.

## Technical Data

### Technical Data

#### Available Ratings

Refer to **Table 8.0-20** for available Type MVS-ND switchgear assembly and **Table 8.0-21** for MVS-ND switch ratings.

**Table 8.0-20. Type MVS-ND Metal-Enclosed Load Interrupter Switchgear Assembly Main Cross Bus Ratings**

Rated Maximum Voltage	Power Frequency Withstand Voltage, 60 Hz, 1 Minute	Lightning Impulse Withstand Voltage (LIWV) (BIL)	Rated Main Bus Continuous Current	Rated Short-Time Short-Circuit Current Withstand (2 Second)	Rated Momentary Short-Circuit Current Withstand (10 Cycle) (167 ms)	
kV rms	kV rms	kV Peak	Amperes	kA rms sym	kA rms Asym	kA Peak
4.76 4.76	19 19	60 60	600, 1200 600, 1200	25 38	40 61	65 99
15.00 15.00	36 36	95 95	600, 1200 600, 1200	25 38	40 61	65 99

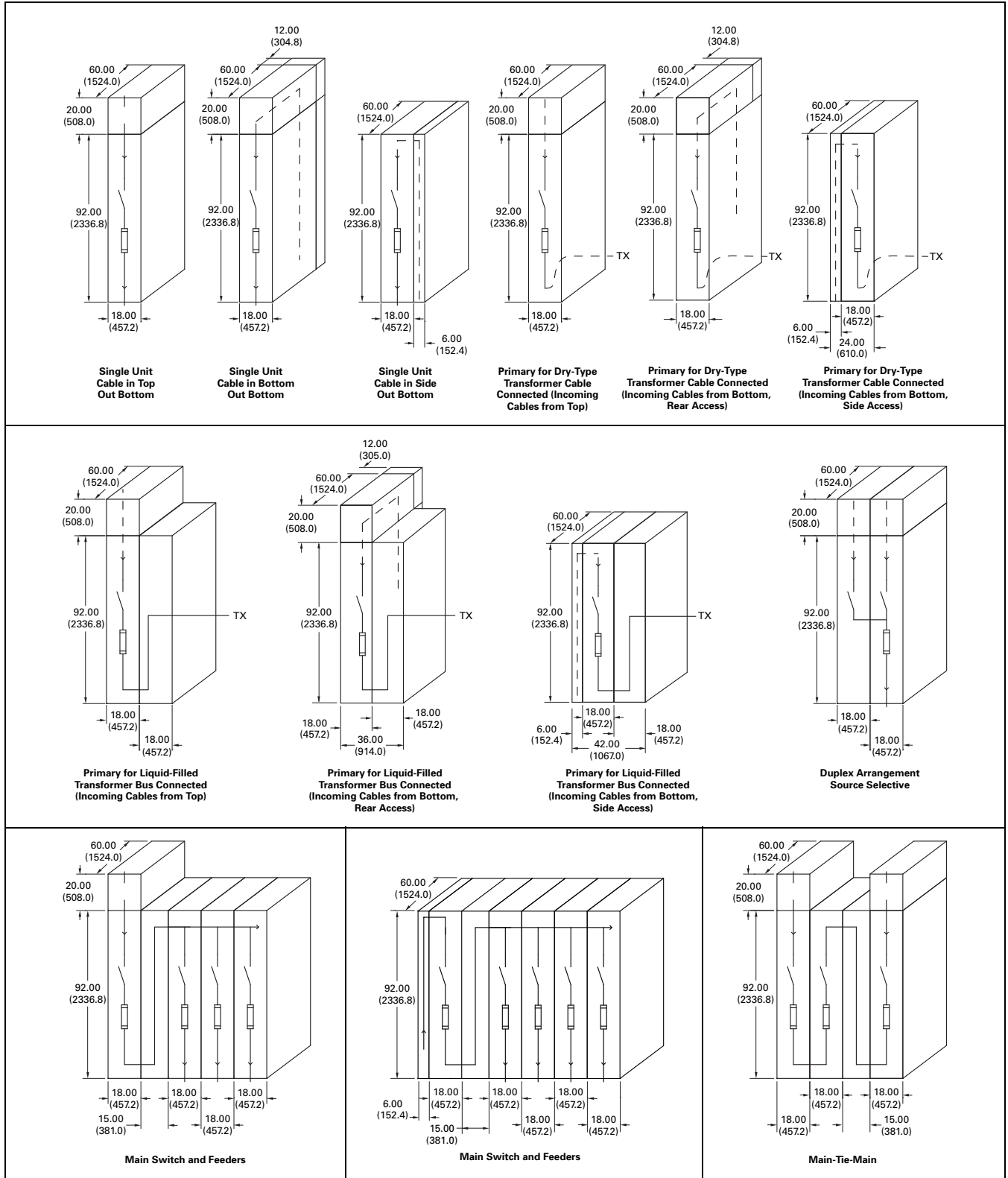
**Table 8.0-21. Type MVS-ND Non-Fused Load Interrupter Switch Ratings <sup>①</sup>**

Rated Maximum Voltage	Power Frequency Withstand Voltage, 60 Hz, 1 Minute	Lightning Impulse Withstand Voltage (LIWV) (BIL)	Rated Continuous and Load Break Current	Rated Short-Time Short-Circuit Current Withstand (2 Second)	Rated Fault-Close and Momentary Short-Circuit Current (10 Cycle) (167 ms)		Rated Magnetizing Current	Rated Load Break Current Operations
kV rms	kV rms	kV Peak	Amperes	kA rms sym	kA rms Asym	kA Peak	Amperes	
4.76 4.76 4.76 4.76	19 19 19 19	60 60 60 60	600 600 1200 1200	25 38 25 38	40 61 40 61	65 99 65 99	12 12 24 24	50 50 20 20
15.00 15.00 15.00 15.00	36 36 36 36	95 95 95 95	600 600 1200 1200	25 38 25 38	40 61 40 61	65 99 65 99	12 12 24 24	30 30 10 10

<sup>①</sup> Fault-close rating of MVS-ND when supplied with 5BHLE 10–450 A and 15BHLE 10–250 A or 15BHCL 300 A fuses is 160.6 kA peak.

**Layouts—Dimensions**

**Typical Arrangements—5 and 15 kV**



**Figure 8.0-31. 5 and 15 kV**

*Dimensions in inches (mm).  
Not to be used for construction purposes unless approved.*

Layouts—Dimensions

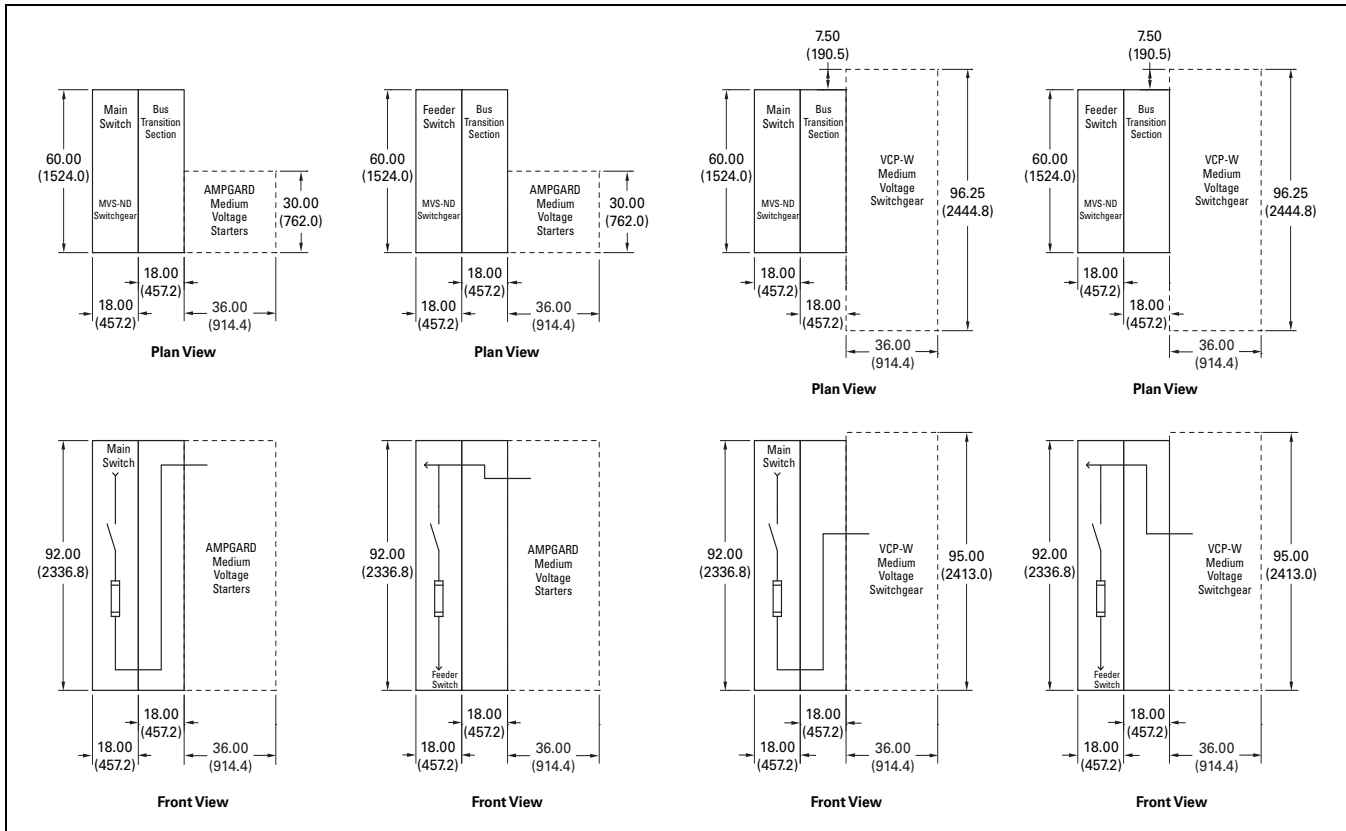
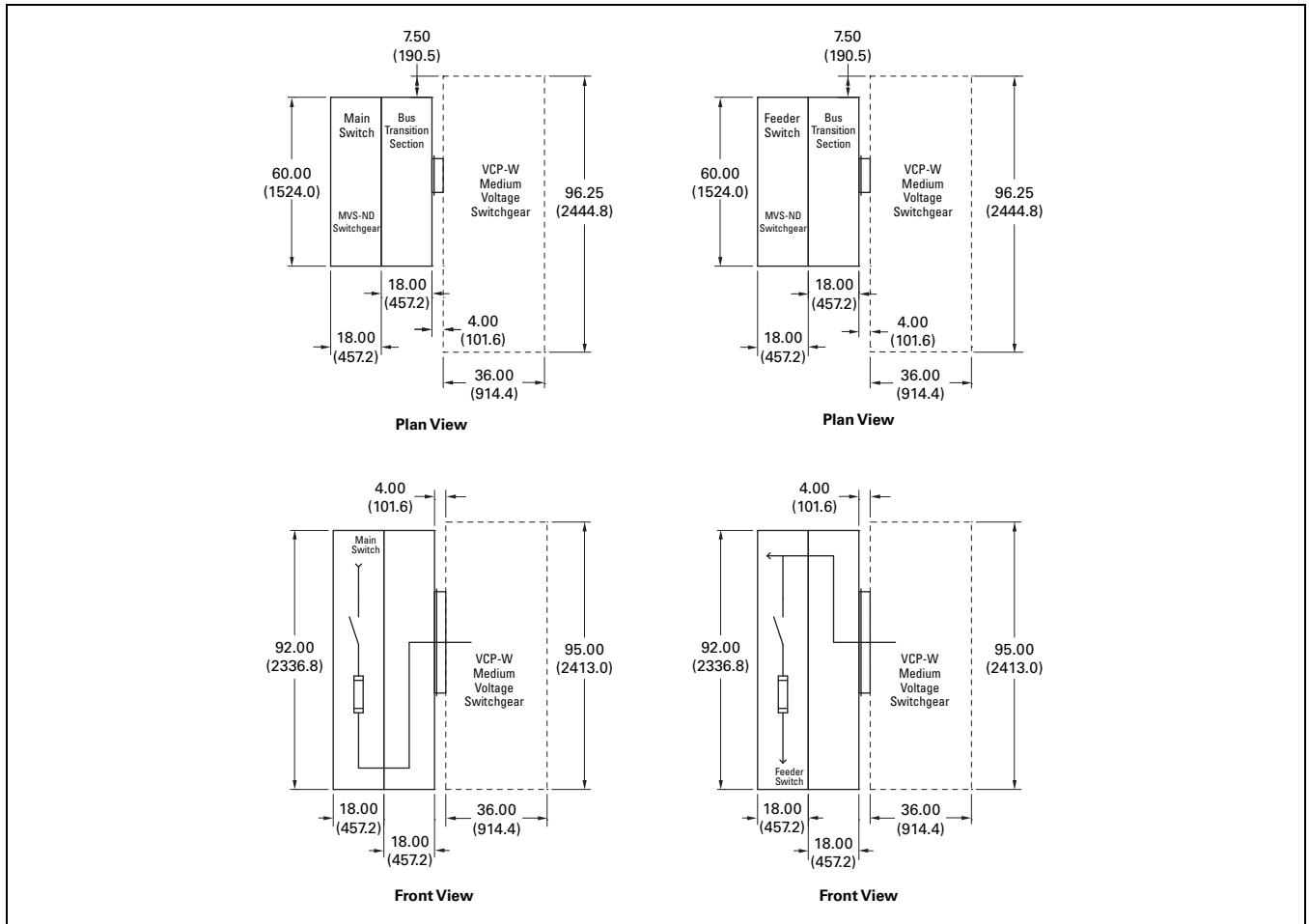


Figure 8.0-32. MVS Connecting to Other Switchgear (Indoor)

*Dimensions in inches (mm).  
Not to be used for construction purposes unless approved.*



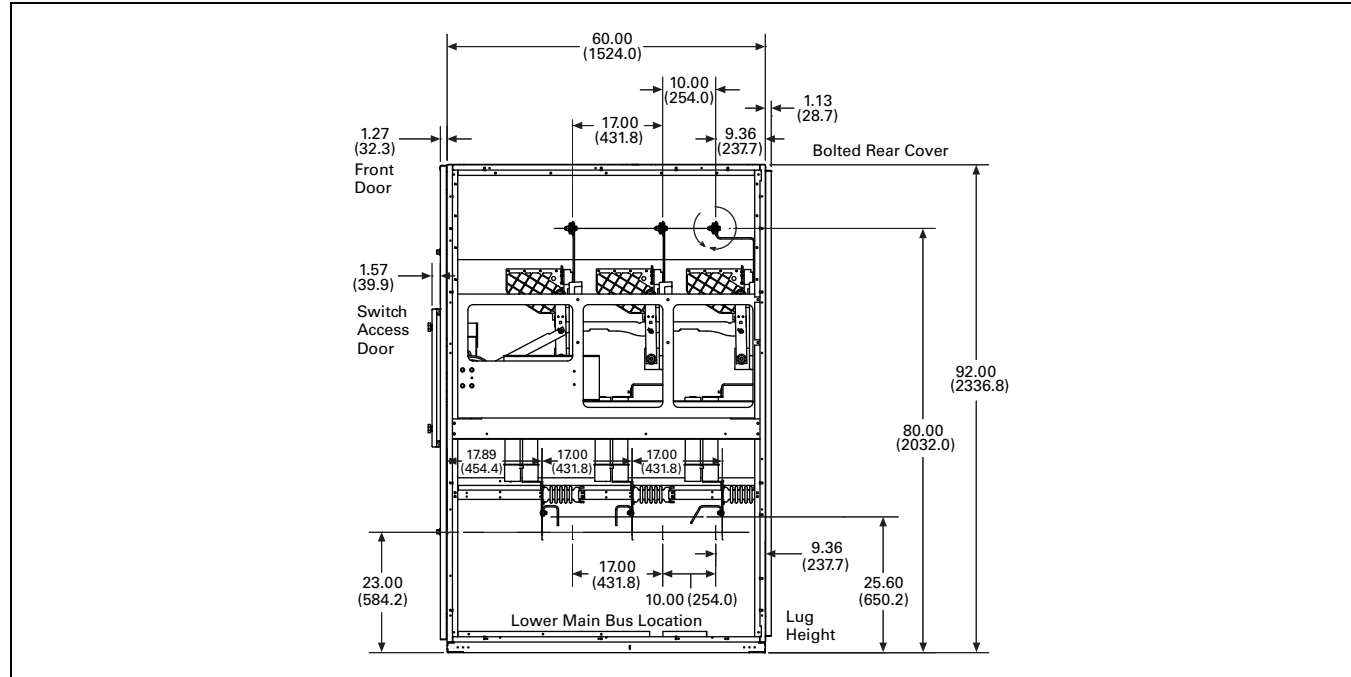
**Layouts—Dimensions**



**Figure 8.0-33. MVS Connecting to Other Switchgear (Outdoor)**

*Dimensions in inches (mm).  
Not to be used for construction purposes unless approved.*

**Typical Sectional Side Views**



8

**Figure 8.0-34. 5 and 15 kV Standard Switch Unit Detail**

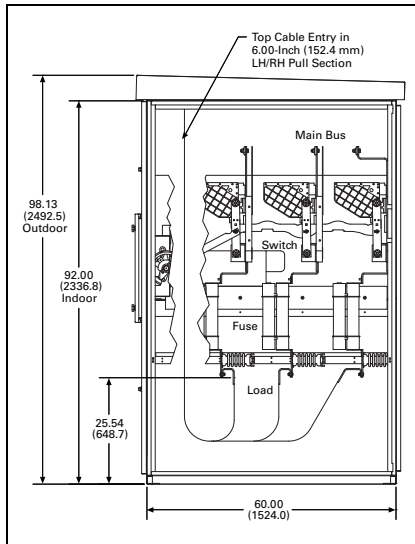
*Dimensions in inches (mm).*

*Not to be used for construction purposes unless approved.*

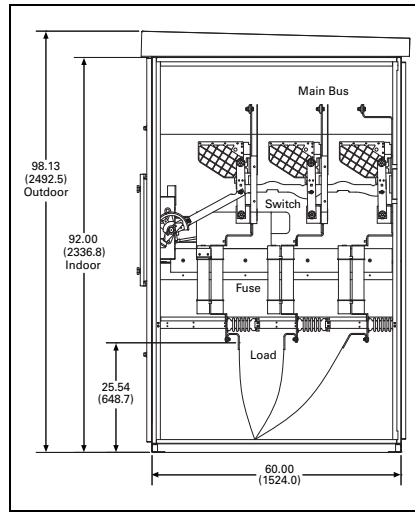
**outs—Dimensions, 5 and 15 kV**

035

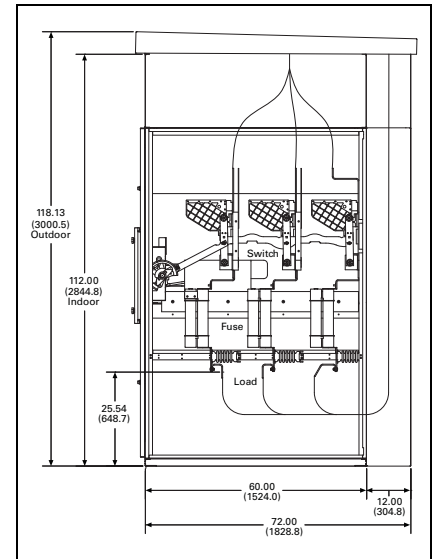
**5 and 15 kV Standard Switch Unit Detail Typical Sectional Side Views Layouts**



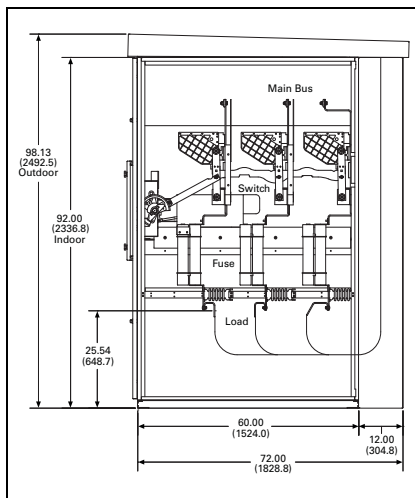
**Figure 8.0-35. Front/Side Access Feeder Circuit—Fused or Unfused Top Cable Entry**



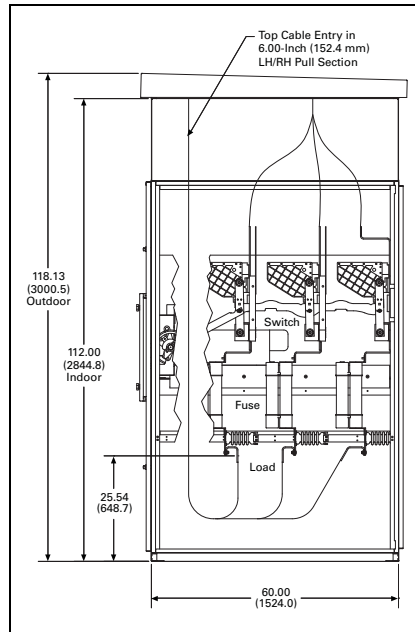
**Figure 8.0-37. Front/Side Access Feeder Circuit—Fused or Unfused Bottom Cable Entry**



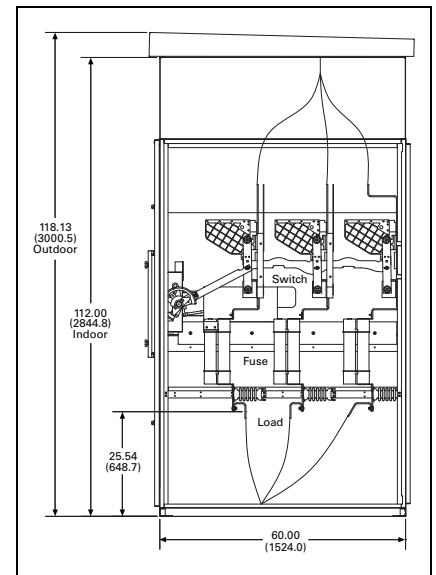
**Figure 8.0-39. Front/Side Access Cable In/Cable Out—Fused or Unfused**



**Figure 8.0-36. Front/Side Access Feeder Circuit—Fused or Unfused Top Cable Entry**



**Figure 8.0-38. Front/Side Access Cable In/Cable Out—Fused or Unfused**



**Figure 8.0-40. Front/Side Access Cable In/Cable Out—Fused or Unfused**

*Dimensions in inches (mm).*

*Not to be used for construction purposes unless approved.*

Layouts—Dimensions, 5 and 15 kV

8

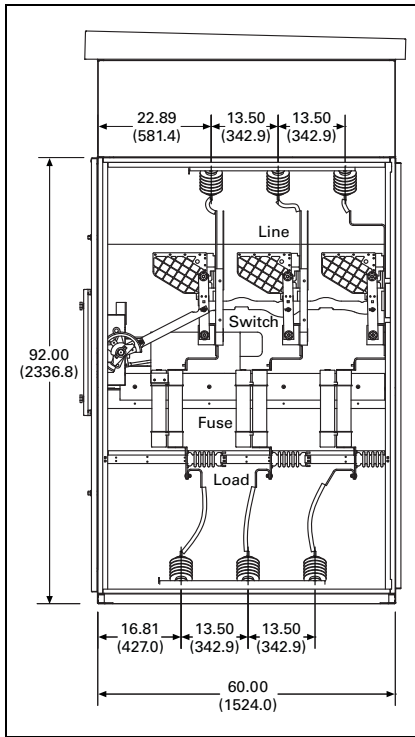


Figure 8.0-41. Typical Arrester Mounting

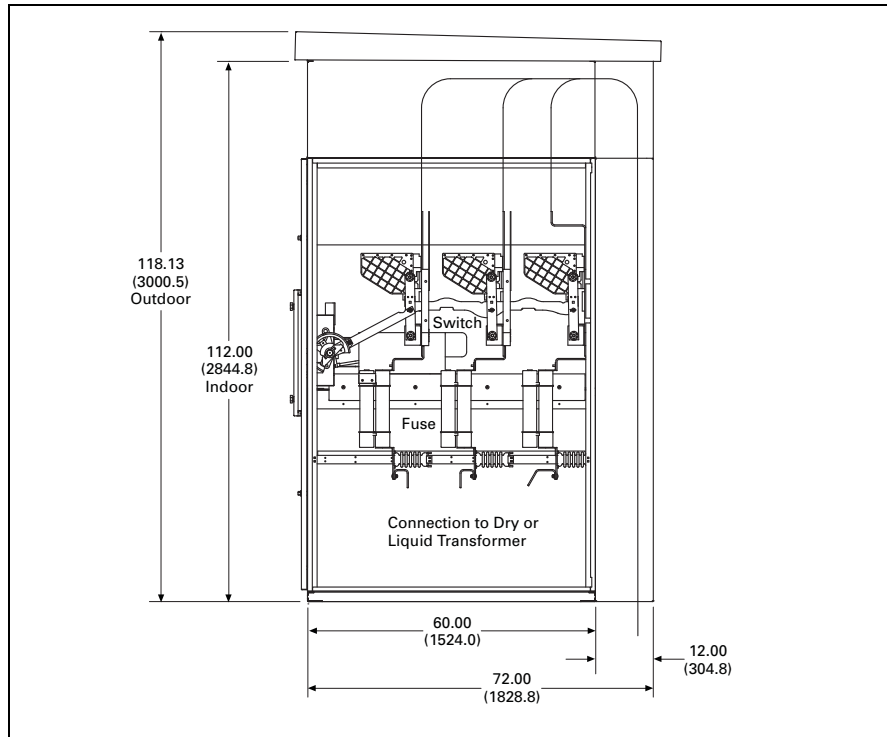


Figure 8.0-42. Close-Coupled to Dry and Liquid Transformers with 12-Inch Rear Extension, Bottom Incoming, Rear Access

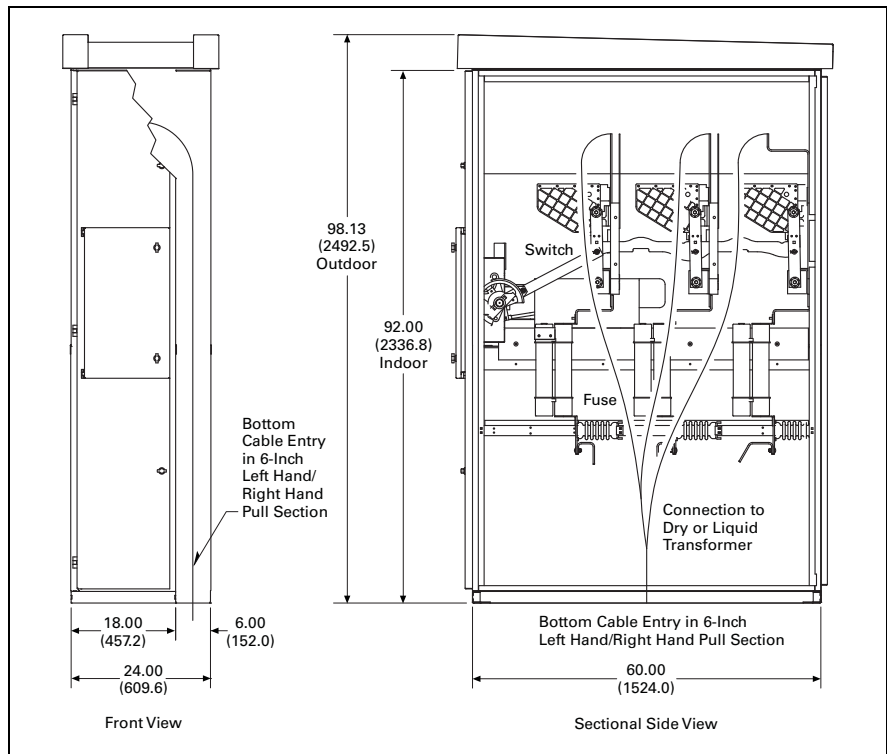
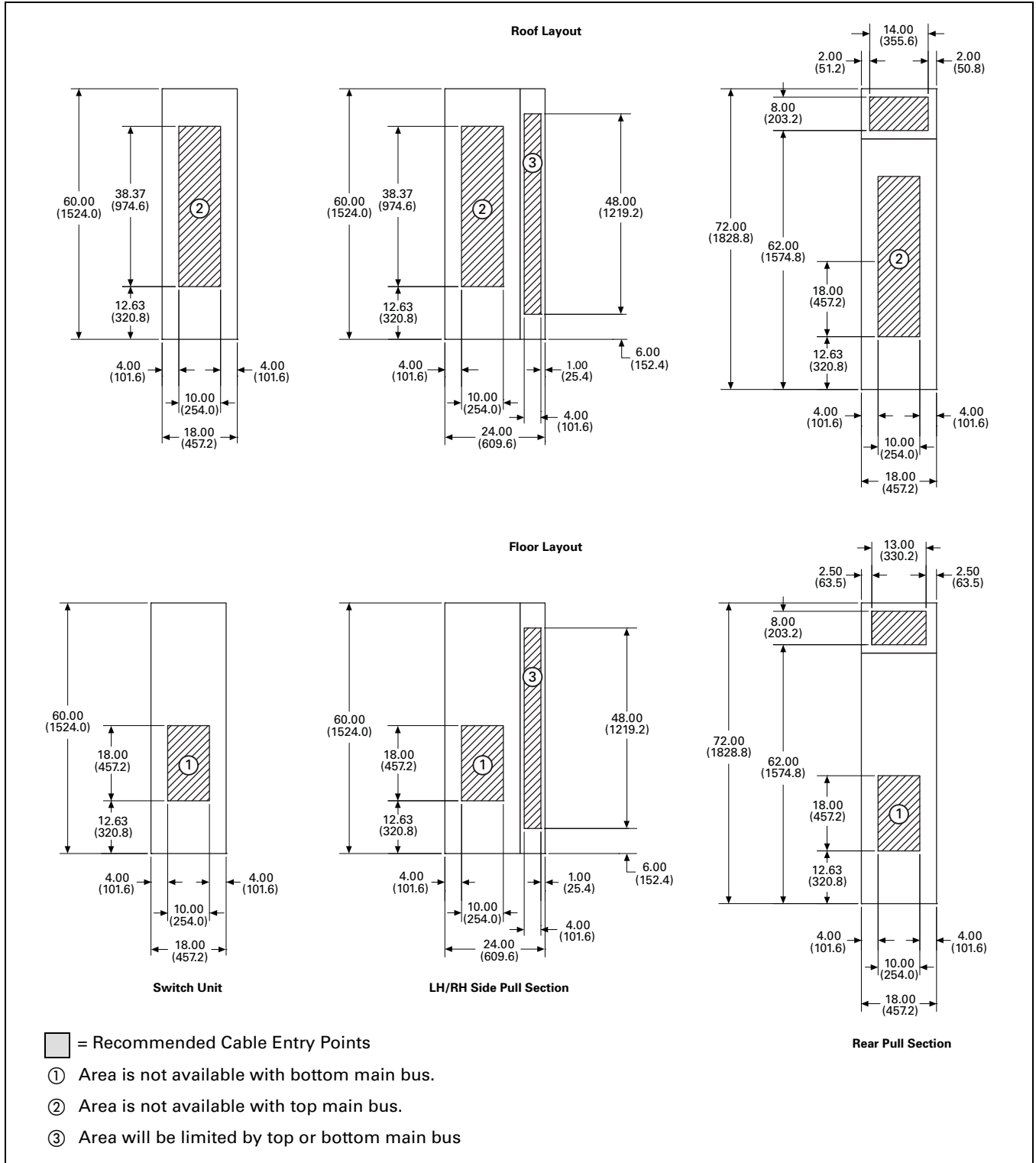


Figure 8.0-43. Close-Coupled to Dry and Liquid Transformers with 6-Inch Side Pull Section, Bottom Incoming, Side Access

*Dimensions in inches (mm).  
Not to be used for construction purposes unless approved.*

**Typical Base Plan and Recommended HV Cable Entry/Exit Locations**

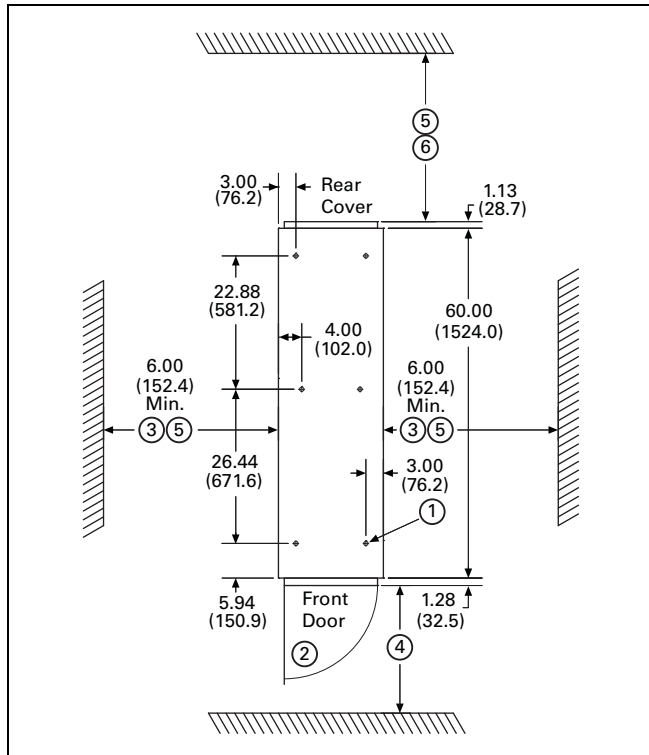


**Figure 8.0-44. Recommended HV Cable Entry/Exit Locations**

*Dimensions in inches (mm).*

*Not to be used for construction purposes unless approved.*

## Typical Anchor Plan



- ① Locations for tie-down 0.75 (19.0) diameter holes in six places. Customer provided bolts for anchoring should be 0.50–13 min. Grade 5 (M12 x 1.75 CL 10.9) and tightened to 75 ft-lb (101.7 Nm).
- ② Door swing equals unit width at 90°.
- ③ The standard minimum clearances on side. The authority having jurisdiction may require a larger distance.
- ④ Minimum clearances in front is the width of the widest vertical section plus 1.00 inch (25.4 mm). The authority having jurisdiction may require a larger distance.
- ⑤ The standard minimum recommended distance is 36.00 inches (914.4 mm) for assemblies requiring rear or side access for installation and maintenance. The authority having jurisdiction may require a larger distance.
- ⑥ For MVS-ND only. The application is specifically provided by contract as not requiring rear access as stated in Note 5, then the minimum recommended distance is 6.00 inches (152.4 mm).
- ⑦ Finished foundation's surface shall be level within 0.06-inch (1.5 mm) in 36.00 inches (914.4 mm) left-to-right. Front-to-back and diagonally as measured by a laser level.

Figure 8.0-45. Typical Anchor Plan

Table 8.0-22. Type MVS-ND Fused Load Interrupter Switch Structures—Approximate Weights

Structure Type	Dimensions—Inches (mm)			Weight—lb (kg)	
	Width	Depth	Height	Indoor Unit	Outdoor Unit
Switch without Top Hat	18.00 (457.2)	60.00 (1524.0)	92.00 (2336.8)	800 (363)	900 (408)
	18.00 (457.2)	72.00 (1828.8)	92.00 (2336.8)	950 (431)	1100 (499)
	24.00 (609.6)	60.00 (1524.0)	92.00 (2336.8)	875 (397)	1000 (454)
	24.00 (609.6)	72.00 (1828.8)	92.00 (2336.8)	1025 (465)	1200 (544)
Switch with Top Hat	18.00 (457.2)	60.00 (1524.0)	112.00 (2844.8)	900 (408)	1000 (454)
	18.00 (457.2)	72.00 (1828.8)	112.00 (2844.8)	1050 (476)	1200 (544)
	24.00 (609.6)	60.00 (1524.0)	112.00 (2844.8)	975 (442)	1100 (499)
	24.00 (609.6)	72.00 (1828.8)	112.00 (2844.8)	1125 (510)	1300 (590)
Main Bus Transition	15.00 (381.0)	60.00 (1524.0)	92.00 (2336.8)	500 (227)	600 (272)
Transition Unit	18.00 (457.2)	60.00 (1524.0)	92.00 (2336.8)	800 (363)	900 (408)
Duplex Unit with Top Hat	36.00 (914.0)	60.00 (1524.0)	112.00 (2844.8)	1700 (771)	1900 (862)
	36.00 (914.0)	72.00 (1828.8)	112.00 (2844.8)	1850 (839)	2050 (930)
Duplex Unit without Top Hat	48.00 (1219.2)	60.00 (1524.0)	92.00 (2336.8)	2200 (998)	2500 (1134)

Dimensions in inches (mm).

Not to be used for construction purposes unless approved.

## General Description

## Arc-Resistant MVS Metal-Enclosed Load Interrupter Switchgear—5 and 15 kV



*Arc-Resistant MVS Metal-Enclosed Load Interrupter Switchgear*

## General Description

Eaton's 5/15 kV MVS metal-enclosed load interrupter switchgear is now available with arc-resistant construction with accessibility Type 2B in accordance with IEEE Std C37.20.7-2007. Type MVS arc-resistant switchgear is designed for indoor use. It can also be used outdoor (37-, 53-, 68- and 82-inch deep units only) with space heaters. It can be configured for a variety of applications. Switches can be supplied with manual or electrical operating mechanism and with or without primary fuses. Type 2B accessibility provides arc-resistant features and protection at the freely accessible exterior (front, back and sides) of the equipment as well as in front of the instrument/control compartment with the instrument/control compartment door opened while the equipment is energized and operating normally.

Arcing faults can occur within the switchgear as a result of insulation failure or human error. Arcing faults occurring in air between phases or phase and ground within the confines of the switchgear produce a variety of physical phenomena, including tremendous release of heat at the point of fault and sudden pressure increase. Heat from the arc may decompose or vaporize materials involved in its path. The effects of this type of fault vary depending on enclosure volume, arc duration, arc voltage and available short-circuit current. If an internal arcing fault occurs within the switchgear that is not designed and tested to withstand effects of such a fault, its parts could blow off along with discharge of hot decomposed matter, gaseous or particulate, causing injury to personnel who may be present in the vicinity of the switchgear.

Arc-resistant MVS metal-enclosed load interrupter switchgear is designed and tested to withstand the effects of an internal arcing fault by controlling and directing the effects of the arc away from personnel in a safe manner. 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 it is operating under normal conditions. The normal operating conditions for proper application of arc-resistant switchgear designs are as follows:

- All doors and covers providing access to high-voltage components are properly closed and latched
- Pressure-relief devices are free to operate
- The fault current discharged into the equipment does not exceed the rated internal arc short-circuit current and duration of the equipment
- There are no obstructions around the equipment that could direct the arc fault products into an area intended to be protected
- The equipment is properly grounded

The user should also refer to documents such as NFPA 70E, for safety training and safe work practices and for methods of evaluating safe work distances from energized equipment based on the potential flash hazard, and use proper PPE when working on or near energized equipment with the door/cover opened or not properly secured.

## Standards and Certifications

Eaton's arc-resistant MVS metal-enclosed load interrupter switchgear meets or exceeds the requirements of IEEE Std C37.20.7-2007, Guide for Testing Metal-Enclosed Switchgear for Internal Arcing Faults. It also meets or exceeds the following industry standards:

- IEEE Standard C37.20.3
- ANSI C37.57
- NEMA SG5
- Canadian Standard CAN/CSA C22.2 No. 31

Type MVS switches meet or exceed the requirements of the following industry standards:

- IEEE Standard C37.20.4
- ANSI C37.58
- ANSI C37.22
- NEMA SG6
- Canadian Standards CAN/CSA C22.2 No. 193 and CAN/CSA C22.2 No. 58

## Third-Party Certification

5/15 kV arc-resistant MVS metal-enclosed load interrupter switchgear can be provided with CSA (Canada or USA) or UL (USA only) listing. Contact Eaton for available ratings.

## Seismic Qualification



5/15 kV arc-resistant MVS metal-enclosed load interrupter switchgear has been qualified for seismic applications by actual testing to meet requirements of IBC 2006 and CBC 2007. Refer to **Tab 1** for information for this and other Eaton products.

## Technical Data

### Technical Data

#### Available Ratings

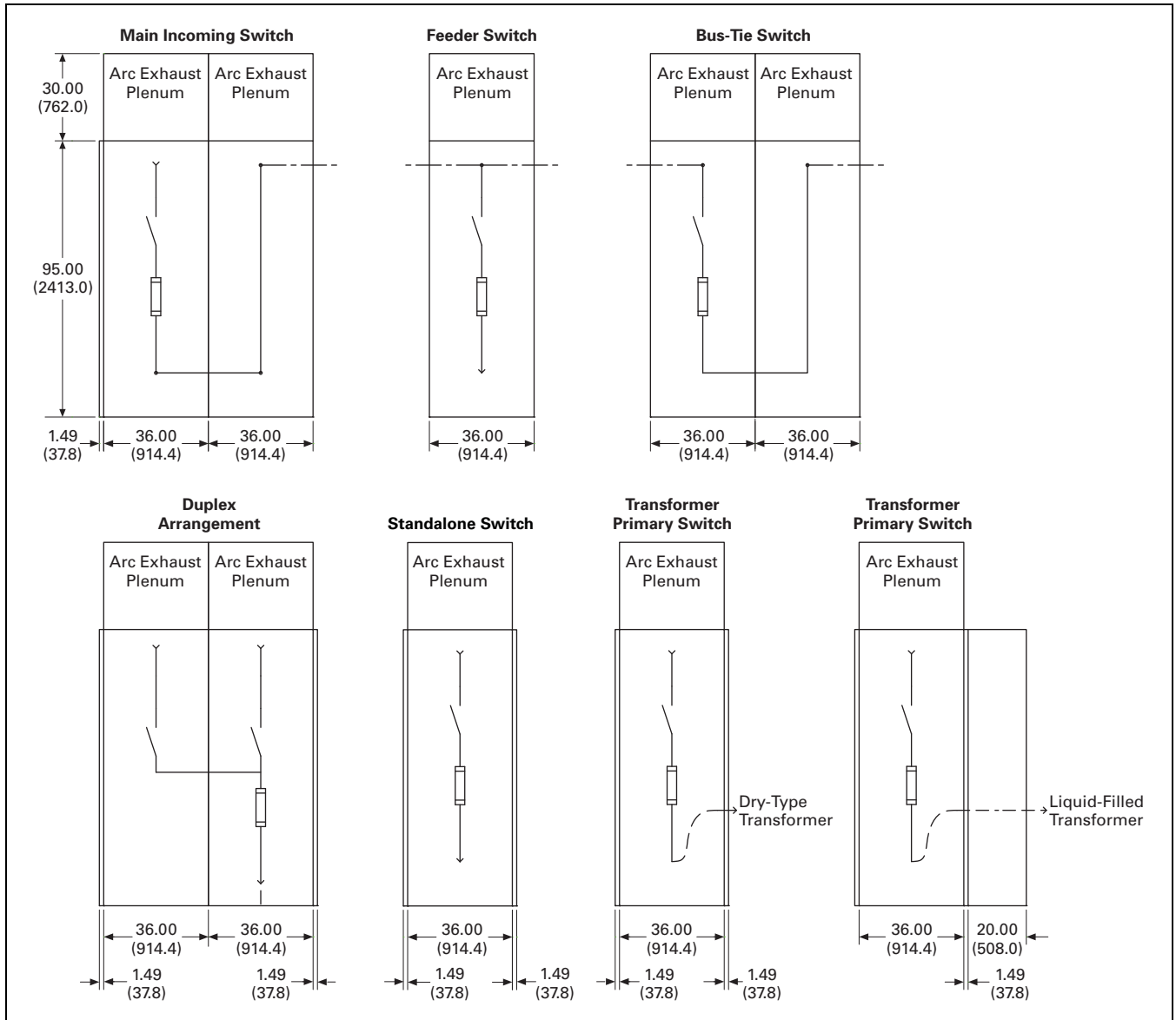
Refer to **Table 8.0-23** for available arc-resistant MVS metal-enclosed load interrupter switchgear assembly ratings. Refer to **Table 8.0-1** and **Table 8.0-6** for non-fused and fused MVS switch ratings. Refer to **Table 8.0-2** and **Table 8.0-3** for MVS switch duty cycle ratings.

**Table 8.0-23. Arc-Resistant MVS Metal-Enclosed Load Interrupter Switchgear Assembly Ratings**

Switchgear Assembly Main Cross Bus Ratings per IEEE C37.20.3-2001							Switchgear Assembly Internal Arc Withstand Ratings per IEEE C37.20.7			
Rated Maximum Voltage	Power Frequency Withstand Voltage, 60 Hz, 1 Minute	Lightning Impulse Withstand Voltage (LIWV) (BIL)	Rated Main Bus Continuous Current	Rated Momentary Short-Circuit Current Withstand (10 Cycle) (167 ms)		Rated Short-Time Short-Circuit Current Withstand (2 Second)	Accessibility Type	Rated Internal Arc Short-Circuit Withstand Current		Rated Internal Arc Short-Circuit Duration
				kA rms Asym	kA Peak			kA rms Sym	kA rms Sym	
kV rms	kV rms	kV Peak	Amperes	kA rms Asym	kA Peak	kA rms Sym		kA rms Sym	kA Peak	Seconds
4.76	19	60	600, 1200	40	65	25	2B	25	65	0.5
4.76	19	60	600, 1200	61	99	38	2B	40	104	0.5
4.76	19	60	2000	61	99	38	2B	40	104	0.5
4.76	19	60	600, 1200	80	130	50	2B	40	104	0.5
4.76	19	60	2000	80	130	50	2B	40	104	0.5
4.76	19	60	2000	101	164	63	2B	40	104	0.5
15	36	95	600, 1200	40	65	25	2B	25	65	0.5
15	36	95	600, 1200	61	99	38	2B	40	104	0.5
15	36	95	600, 1200	80	130	50	2B	40	104	0.5
15	36	95	600, 1200	101	164	63	2B	40	104	0.5



**Typical Arrangements**

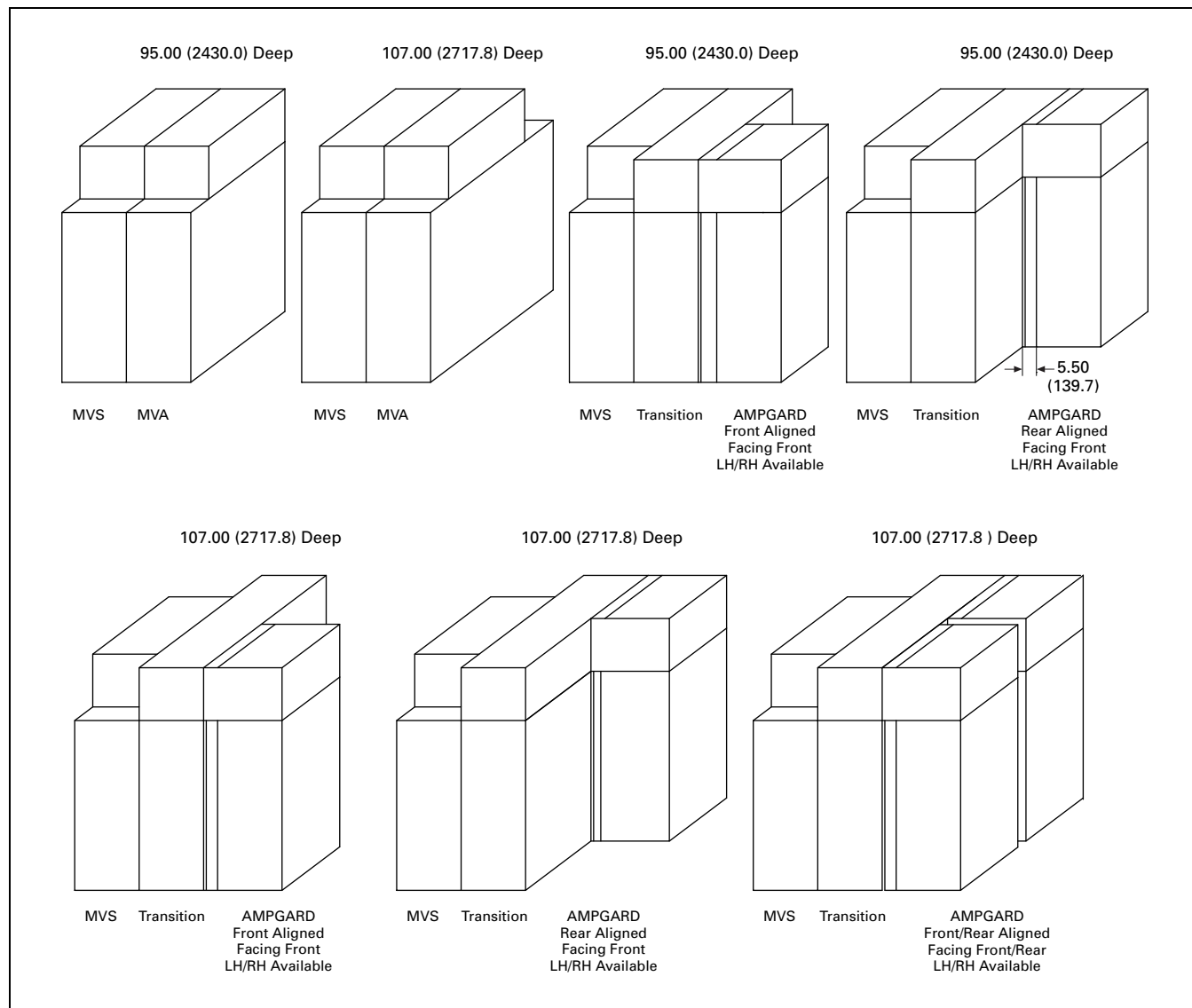


**Figure 8.0-46. Available Configurations—Typical One-Line Arrangements**

- ① Each end of lineup contains a 1.49 inch (37.8) endskin.
- ② Depth of units will vary due to cable entrance and exit requirements, the addition of lightning arresters, instrument transformers, special cable terminators, etc.
- ③ Minimum depth of MVS unit: up to two 500 kcm per phase: 53.00 inches (1346.2 mm); three or four 500 kcm per phase: 68.00 inches (1727.2 mm); five or six 500 kcm per phase: 82.00 inches (2082.8 mm).

Layouts—Dimensions

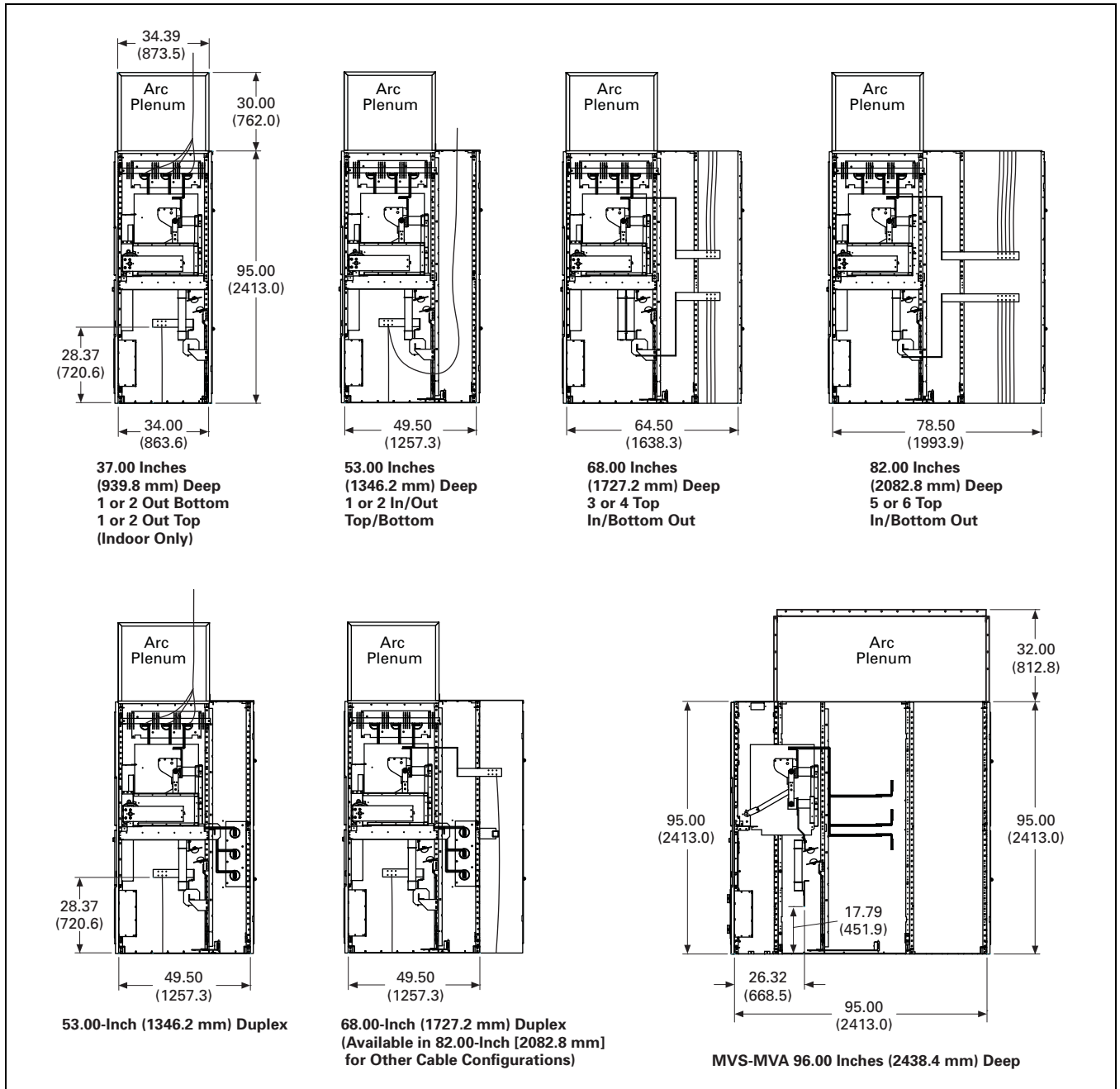
**Typical Arrangements (Continued)**



**Figure 8.0-47. Available Configurations—Close-Coupling to Arc-Resistant MVA and AMPGARD**

8

**Typical Layout Dimensions: 5/15 kV**

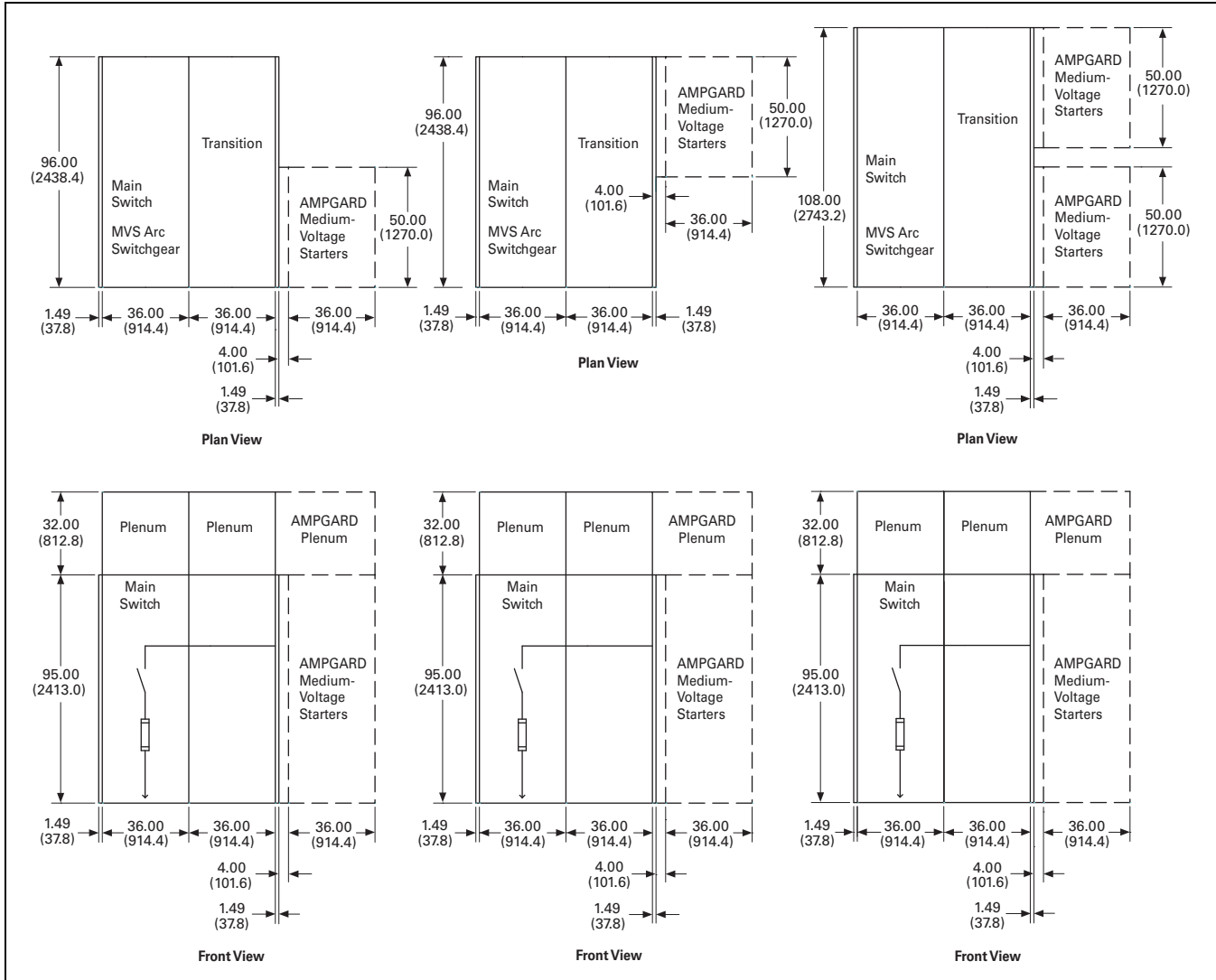


**Figure 8.0-48. Typical Sectional Side Views—5/15 kV Arc-Resistant MVS**

**Note:** Number of cables are based on 500 kcm.

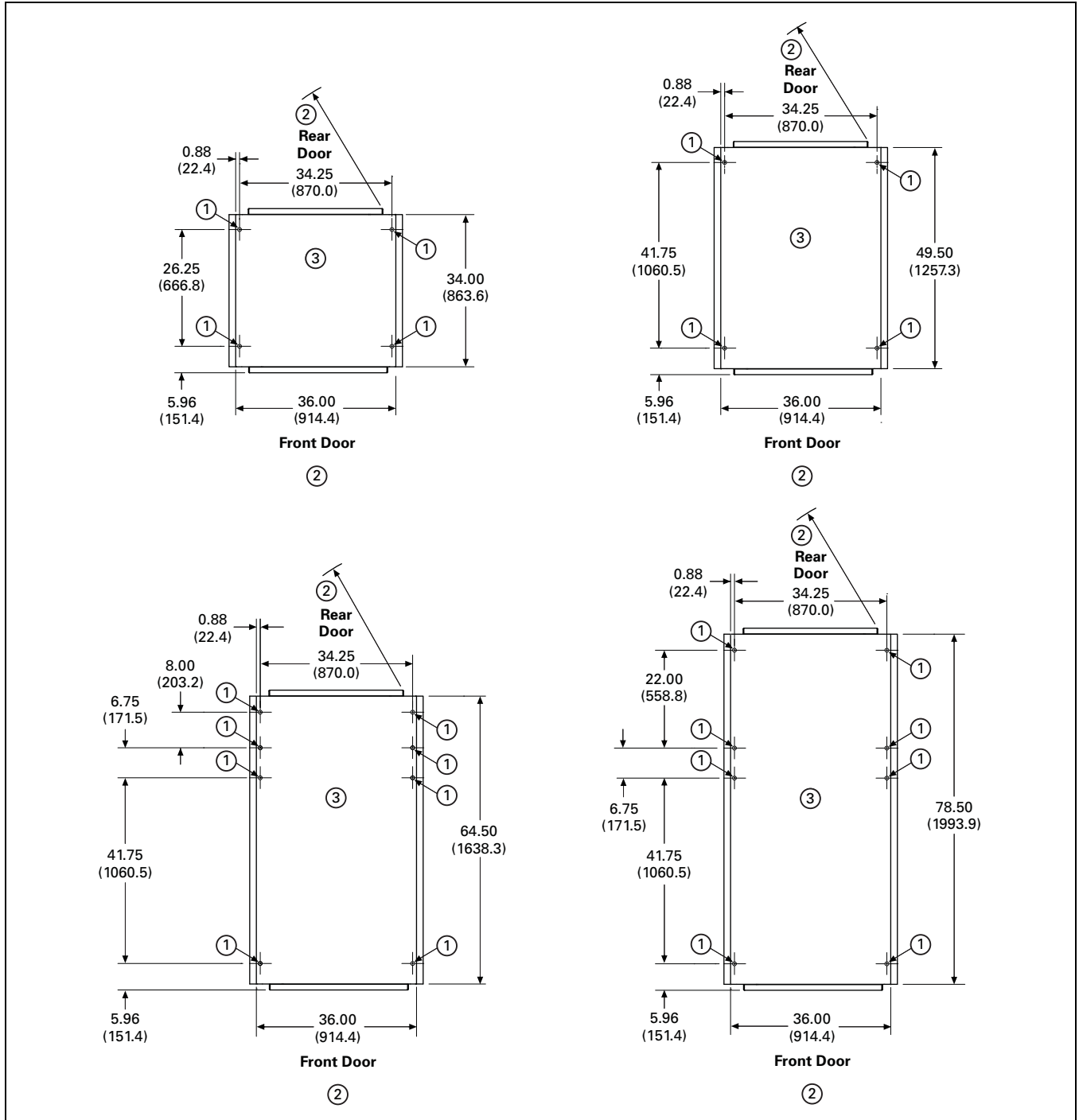
Layouts—Dimensions

**Typical Layout Dimensions: 5/15 kV (Continued)**



**Figure 8.0-49. Typical Layout Dimensions—Indoor Arc-Resistant MVS Close-Coupled to Indoor Arc-Resistant AMPGARD**

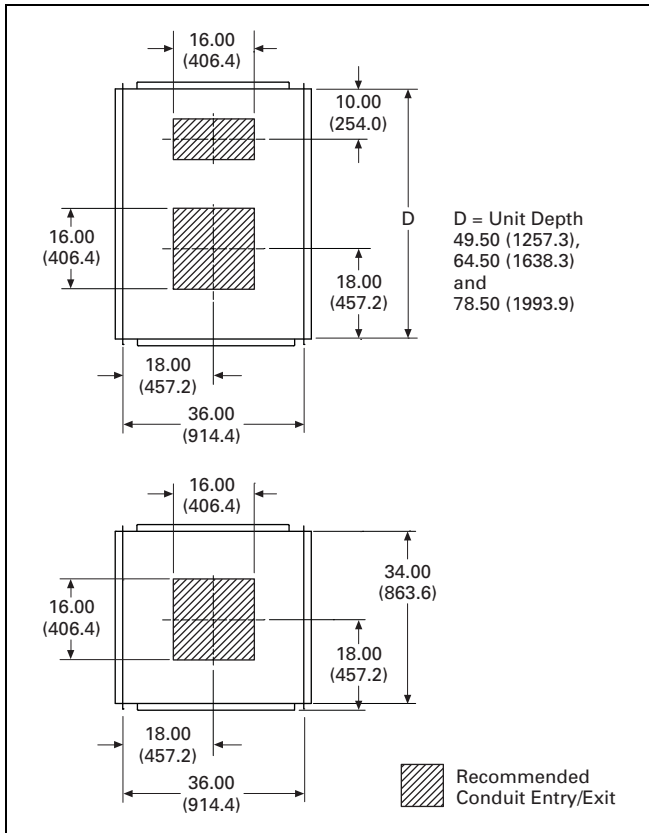
**Typical Anchor Plan**



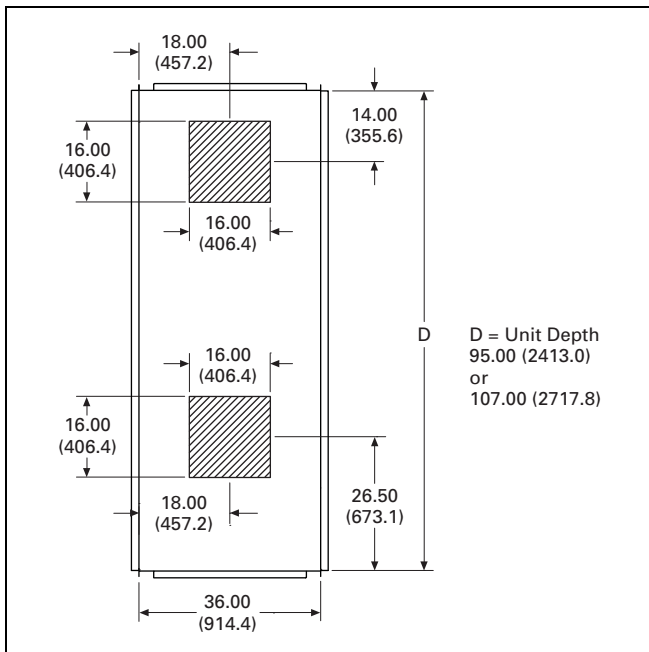
**Figure 8.0-50. Typical Anchor Plan—5/15 kV Arc-Resistant MVS Units**

- ① Locations for tie-down 0.87 (22.1) diameter holes. Customer-provided bolts for anchoring should be 0.50–1.3 minimum SAE Grade 5 (M12 x 1.75 minimum CL 10.9) and tightened to 75 ft-lb (101.7 Nm).
- ② Door swing equals unit width at 90°.
- ③ Finished foundation's surface shall be level within 0.06 inch (1.5 mm) in 36.00 inches (914.4 mm) left-to-right, front-to-back and diagonally, as measured by a laser level.

**Layouts—Dimensions**



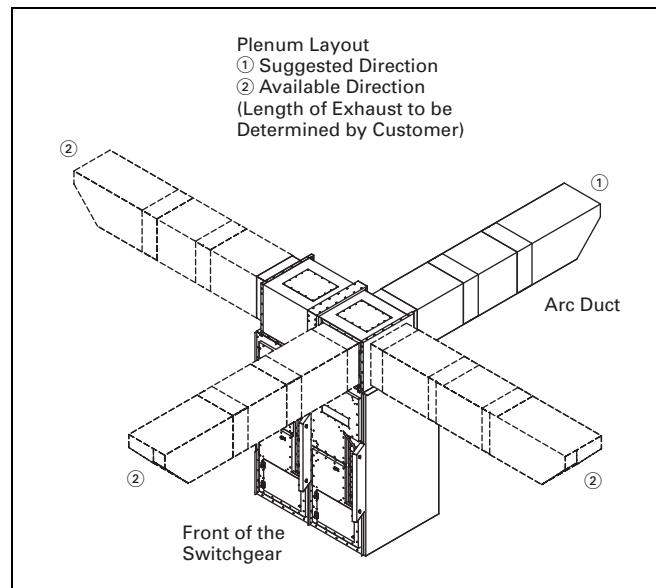
**Figure 8.0-51. Recommended HV Cable Exit/Entry Locations (37.00-, 53.00-, 68.00- and 82.00-Inch [939.8-, 1346.2-, 1727.2- and 2082.8-mm] Deep MVS Units)**



**Figure 8.0-52. Recommended HV Cable Exit/Entry Locations (95.00- and 107.00-Inch [2413.0- and 2717.8-mm] Deep MVS Units)**

**Arc Duct Layout**

Type MVS arc-resistant switchgear is supplied with an arc exhaust plenum fitted on top of the switchgear. To maintain Type 2B accessibility, one arc duct is required to direct the arc exhaust out of the common plenum to the outside. Arc duct can be supplied by Eaton when included in its scope of supply or it can be supplied by the customer. When supplied by the customer, it must be made and installed in accordance with basic minimum design requirements provided by Eaton. Arc duct can be fitted on the left end, right end, rear or front of the exhaust plenum as shown in **Figure 8.0-53**. Arc duct can consist of straight pieces or 90 or 45 degree bends as required to suit the installation layout.



**Figure 8.0-53. Typical Arc Duct Layout**