Power^{IT} MV Air Insulated Switchgear

Technical Information and Application Guide Featuring Advance™ and SafeGear™ Technology

Industrial IT enabled™

Advance™ metal-clad switchgear

SafeGear® metal-clad switchgear

ABB

Introduction

Millions of ABB circuit breakers are installed and operating worldwide, giving SafeGear and Advance switchgear a proven record of dependability that assures maximum uptime in any environment. Superior safety and low maintenance are achieved by customer-focused design innovations, such as a breaker-mounted, closed-door racking system with fully automatic connections. To provide maximum protection for equipment and personnel, SafeGear adds the advantages of arc-resistant construction.

SafeGear and Advance metal-clad switchgear are manufactured from a wide array of standard modules for fast, efficient delivery of custom switchgear. Quality is assured by extensive design and production tests, coupled with manufacturing in facilities that have been certified in compliance with ISO 9001.

General Description

ABB offers medium voltage metal-clad switchgear for the ANSI market utilizing modern manufacturing techniques.

Design details like optional arc resistance, closed door racking, fully automatic disconnects and safety interlocking inside the cell, give operators superior protection and minimize the risk of errors and injuries. Other details reduce maintenance efforts. The modular design allows for compact space-saving arrangements. Bolted construction enables faster replacement and modification in the field. All these features lead to lower ownership cost and reduced risk.

SafeGear and Advance metal-clad switchgear are available in one-high and two-high configurations. Galvalume®, a self-healing, coated sheet metal, is used throughout the product. Its superior corrosion resistance provides for a long life of the switchgear. Indoor and outdoor enclosures, as well as placement in power distribution centers, allow installation in any environment.

Ratings and Dimensions

Transition sections are available for simple close coupling to ABB's SafeGear or Advance medium voltage motor control center lineups or previous ABB product lines like HK™ or HK II™.

The standardized cubicle sizes and modular design allow for simplified engineering. Basic frames are 36" wide, 95" high and 85" deep. The compartment modules stand 19", 38" or 57" tall. The reference section provides details on standard and optional frame dimensions.

SafeGear and Advance metal-clad switchgear are rated for voltage levels up to 27 kV maximum. Circuit breakers and main bus are rated at 1200 A, 2000 A, 3000 A and 4000 A. Interrupting ratings range up to 50 kA or 1000 MVA. Consult ABB for or higher current and voltage ratings.

The product offerings conform to the appropriate IEEE, ANSI and NEMA standards and come with optional UL® or CSA listings. SafeGear and Advance metal-clad switchgear offer optional compliance with seismic requirements of UBC Zone 4.

Contemporary Design

Advance™ metal-clad switchgear

Advance metal-clad switchgear is the first switchgear with completely innovated modular, bolted design introduced in the ANSI market for more than a decade.

With more than 50 years of experience in power distribution systems design, ABB developed Advance for the ANSI market with the user in mind.

Arc Resistance

SafeGear® metal-clad switchgear

SafeGear metal-clad switchgear is a newly designed arc-resistant switchgear. All the design features of Advance are included in SafeGear, making this the most advanced switchgear product, with the best protection available today.

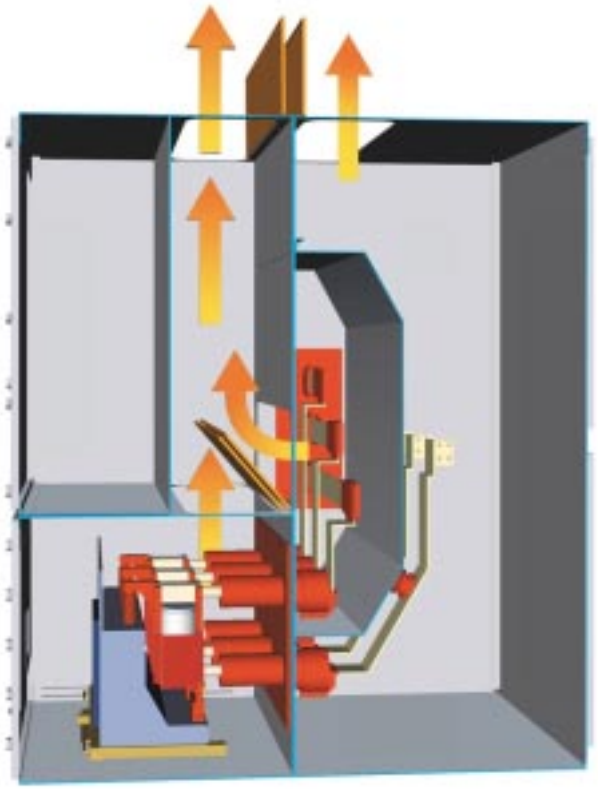
Arc resistance protects the operator from harm and limits damage to equipment in the case of an internal arc fault. Arc resistance of SafeGear metal-clad switchgear was developed utilizing decades of ABB experience with medium voltage power systems.

SafeGear is designed to comply with the arc-resistance testing requirements of EEMAC standard G14-1 (1987), IEEE standard C37.20.7 (2001), and AUSI C37.20.7 Type 1 and 2 standards.

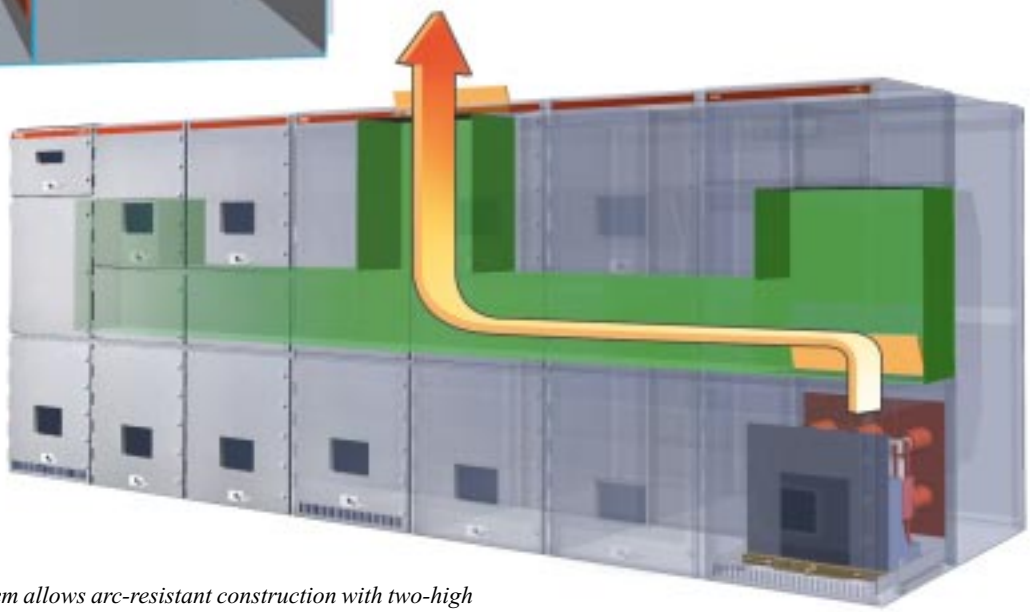
SafeGear metal-clad switchgear is of type B arc resistance according to EEMAC G14-1, *The Procedure of Arc-resistant Testing of Metal Clad Switchgear.* Type B arc resistance specifies protection from objects or hot gases that might be ejected during an arc fault on all accessible sides of the enclosure. In addition, type C arc resistance specifies that the arc may not propagate inside the enclosure into adjacent cells or other parts of the equipment. Type C arc resistance is available in most arrangements.

A system of chambers and tunnels inside the switchgear lineup serves as an exhaust system, venting gases in the case of an arc fault away from personnel and the affected cubicle. Vents and flaps are located inside the chamber system and on top of the enclosure to release the pressure. ABB developed this design and holds patents on many of the construction details of this truly innovative concept.

Arc resistance and closed-door racking significantly reduce operator risk during the handling and operation of the equipment. Installation, maintenance and operations personnel recognize the sturdiness and benefit of the design. Insurance companies recognize the reduced operational risk with lower contract rates. Owners realize the gain from reduced loss of revenue due to improved reliability of the power system.



Venting flaps and chimneys release excessive pressure during an arc event. Front, side and rear structures maintain their integrity.



Venting tunnel system allows arc-resistant construction with two-high arrangements for safe and compact power distribution equipment.

Modular Construction

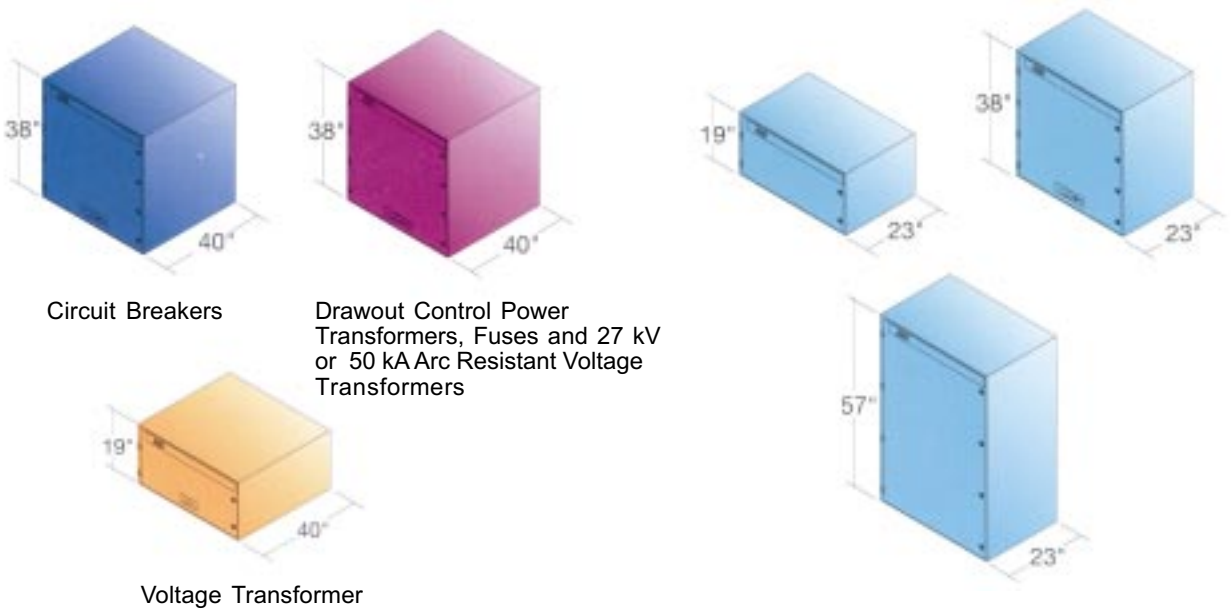
Complete sets of rugged, stackable circuit breaker and auxiliary equipment modules are assembled to form a SafeGear or Advance switchgear lineup. All modules are constructed from Galvalume® pre-coated steel for superior corrosion resistance.

Hem bending creates a rigid structure and sturdy construction in metal-clad switchgear (reinforced, arc-resistant door construction shown).

Hem bending is used to form a rigid, self-supporting structure. In addition to its outstanding structural benefits, hem bending results in rounded steel edges that greatly reduce the risk of injury during shop handling and assembly, as well as during field inspections and maintenance.

Typical Module Types

A complete set of primary and low-voltage modules is available. All modules are 36 inches wide.

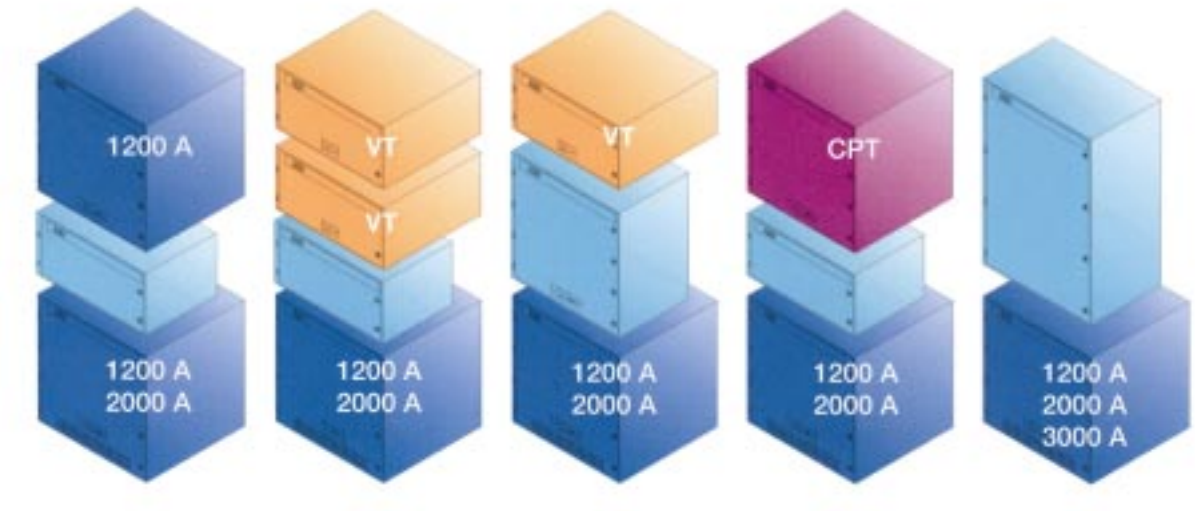


Primary Modules

Low Voltage Modules

Flexible Arrangements

Modules are stackable in a variety of one-high and two-high configurations. SafeGear and Advance allow the arrangement of one or two sets of voltage transformers on top of a circuit breaker, minimizing required floor space.



Typical Vertical Arrangement Options

Circuit Breaker Modules

ADVAC™ and AMVAC™ circuit breaker modules are designed for maximum operator safety by providing a large viewing window and three-position closed door racking, eliminating the need for a remote electrical racking device. The circuit breakers have self-aligning, fully automatic primary and secondary contacts. They incorporate distinctive features for ease of installation, operational safety and maintenance simplicity.

Unique Racking System

The racking system is unique and features a three position (Disconnected/Test/Connected) closed door system for all circuit breakers. The racking system is integral to the circuit breaker, so moving parts can be inspected and maintained outside the breaker compartment and away from energized primary and secondary circuits.

Operators are protected by the closed door racking system.

Interlocks

The racking system includes all necessary interlocks in accordance with ANSI / IEEE standards to assure proper sequencing and safe operation. For improved safety, the interlocking system prohibits operation of ADVAC or AMVAC breakers while in an intermediate position and prohibits insertion of an improperly rated breaker in a cell.

Device Mounting

Optional 10" front extensions enable relays, meters, switches, etc. to be mounted on circuit breaker doors in Advance switchgear only.

Circuit Breaker Grounding

A solid stationary ground contact engages the grounding contact of the circuit breaker. Ground connection is made prior to the coupling of the primary or secondary contacts and is continuous during the racking operation.

Interference Blocking

Interference blocking prevents insertion of improperly rated circuit breakers into the module. This decreases the risk of human error.

Secondary Disconnect System

A single, (25-pin) self-aligning secondary disconnect for control circuitry is provided as a standard feature. The female portion resides in the circuit breaker module. Potentially energized contacts are recessed and remain "touch safe."

To accommodate additional control features, the module can be equipped with a 50-pin disconnect (shown). Self-alignment and a locking system assure primary and secondary connections. By ensuring proper operation, the circuit breaker reliability is increased.

Primary Shutters

Primary shutters automatically cover primary contacts when the breaker is not in the connected position. The shutters may be grounded metal or optional insulating Lexan® material. Primary contact stabs can be visually inspected without opening the shutter.

Primary shutter opening and closing is mechanically forced by circuit breaker movement, rather than relying on springs or gravity. Personnel are assured that shutters are closed when removing the breaker from the cell. A locking mechanism prevents opening of the shutter when the circuit breaker is removed.

Primary Supports and Current Transformers

Primary contacts and current transformers (CTs) are supported by standard glass-polyester or optional porcelain bushings (standard for 27 kV).

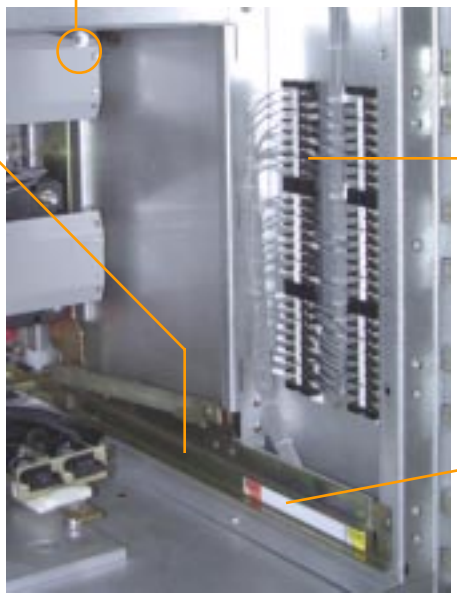
CTs can be mounted on both line and load primary bushings behind the shutter. Bushings accommodate up to four standard accuracy CTs per phase.

TOC Actuator

Switch contacts are actuated by the front panel as the breaker moves in and out of the connected position.

Dual Guide Rails

ADVAC/AMVAC circuit breakers lock securely into circuit breaker modules on both sides. Dual guide rails and self-aligning primary and secondary contacts assure smooth, consistent racking, and support the breaker firmly during peak short circuit conditions.



Terminal Block Mounting Space

Ample room is provided for connections to secondary wiring from circuit breakers, current transformers and other devices.

Position Indicator

A position decal indicates breaker position by alignment with the front panel of the breaker.

Auxiliary Primary Modules

Snuffer

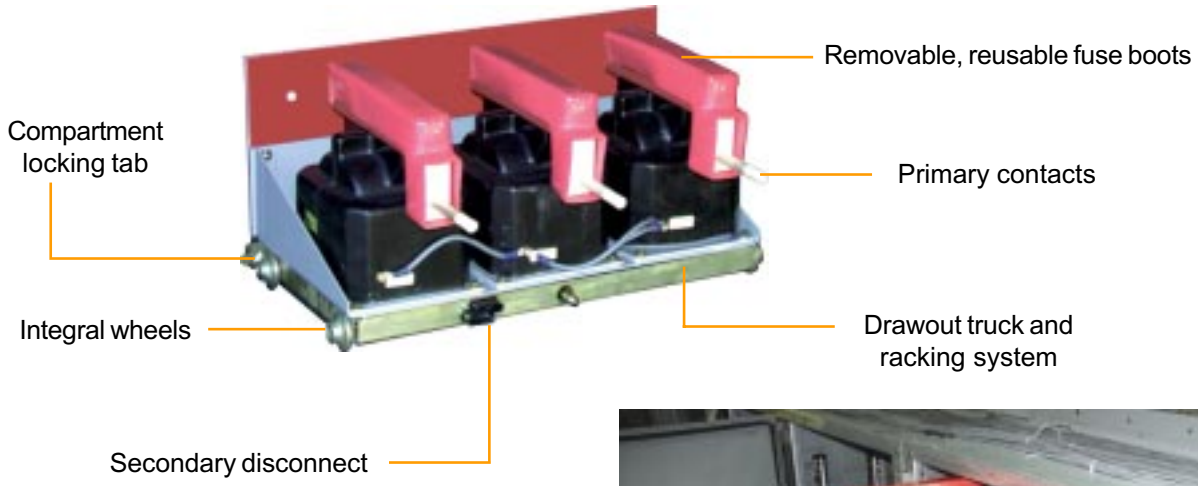
All primary auxiliary equipment utilizes arc quenching Delrin® technology. A Delrin® sleeve around a conductor probe is inserted into a Delrin® receptacle with recessed contacts. During load break, only a very small isolating gap is required between the sleeve and receptacle to contain the arc and extinguish it safely.

Closed Door Racking Automatic Secondary Disconnect

Primary modules for auxiliary equipment are equipped with similar technology as the circuit breaker cells. Consistent designs, with closed door racking system and automatic secondary disconnect, allow for operator familiarity. The cell interface uses the same accessories as the circuit breaker module. Secondary contacts engage/disengage automatically and interlocks ensure proper operation where applicable.

Voltage Transformer (VT)

VT modules accommodate industry-leading type VIY and VIZ switchgear style VTs from ABB. Each module accepts up to three transformers with line-to-line (L-L) or line-to-ground (L-G) connections. VTs are automatically grounded momentarily on withdrawal to discharge residual stored energy in the primary windings.



The fuses can be removed without removing the VT truck from the rails.

Control Power Transformer (CPT) Drawout Fuses

CPT modules provide convenient mounting and operation of single-phase control power transformers in ratings to 15 kVA, minimizing the possibility of inadvertent interruption of control power for AC operated switchgear.

Fuse modules accommodate up to three primary fuses for use with fixed-mount control power transformers and other primary voltage level circuit protection. Fuse modules are provided with stationary control power transformers in ratings up to 75 kVA.

Low Voltage Instrument Module

ABB mounts all protection and control devices in a dedicated low voltage compartment. Each low voltage instrument module is completely isolated and segregated from high voltage compartments. This ensures safety for operations and maintenance personnel while they work on control and auxiliary circuits.

Devices and control switches are mounted on the door for easy readability and convenient access. Those devices that do not require immediate access are mounted inside the compartment.

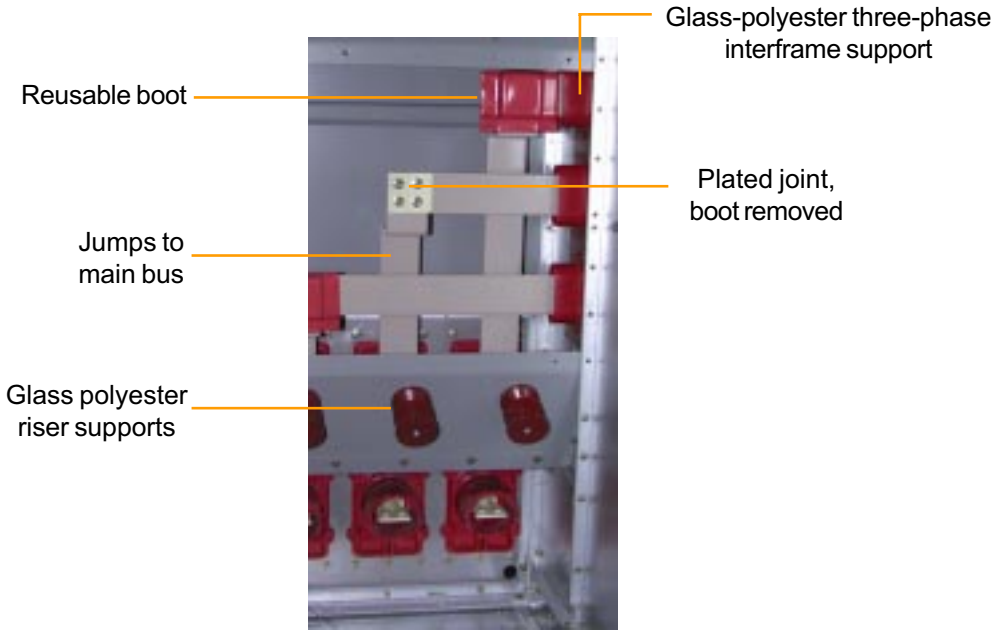
Isolated for maximum safety when working with low voltage circuits.

Primary Bus System

All primary bus is 100% copper with full round edges, and is available in 1200 A, 2000 A, 3000 A and 4000 A ratings. The bus is silver-plated at joints and bolted together with a minimum of two half-inch SAE grade 5 bolts. Proper torque is verified by calibrated tools for both safety and optimum performance. The main (horizontal) bus is not tapered and is easily extended at both ends to facilitate future expansions.

The bus is epoxy insulated with an advanced powder coat system that eliminates voids and other potential defects, resulting in maximum integrity of the insulation system. Removable, reusable boots are provided at each joint to simplify access and maintenance.

Insulating standoffs rigidly support the bus. This includes jumps, the connections from stationary primary contacts to the main bus and risers, and connections from stationary primary contacts to line or load terminations. Internal standoffs and interframe supports are glass-polyester in ratings through 2000 A. Porcelain supports are standard at 3000 A or 4000 A, and optional in other ratings.

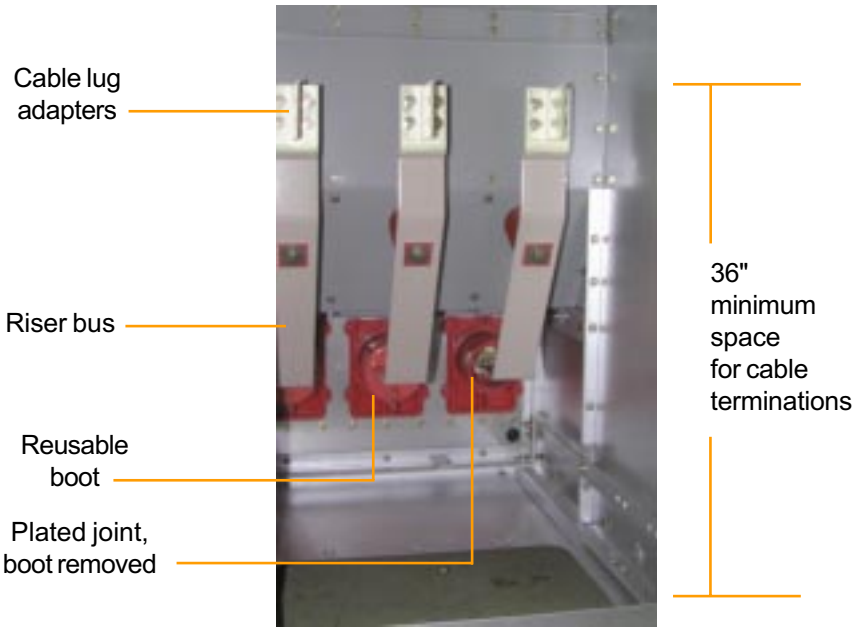


Main Bus Compartment
(End section - Cover removed)

Cable Compartments

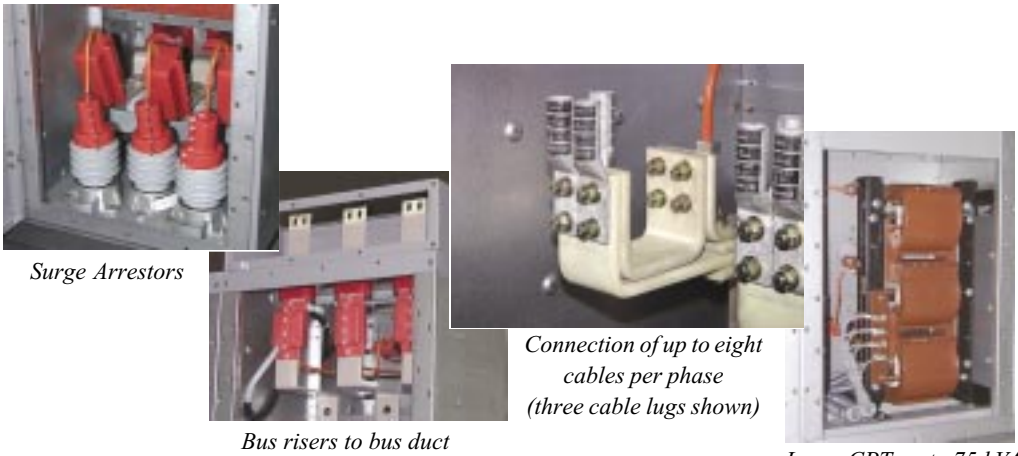
Well-designed cable compartments for both SafeGear and Advance provide an efficient layout with ample room for stress cones and a choice of cable terminations and lug types. Customers also have the flexibility of top or bottom cable entry. Top connections can also be made to bus duct or roof bushings. In two-high arrangements with stacked circuit breakers, steel barriers separate the compartments and isolate the primary circuits. Optional cable supports and lug boots are available to make field connections more efficient and secure.

Cable compartments are available with readily accessible zero-sequence current transformers, surge arresters and capacitors. When a drawout fuse compartment is installed in the front of the switchgear, the rear cable compartment offers room for a large three-phase floor-mounted control power transformer.



Cable Compartment
(Main bus - Cover installed)

Most cable terminations and auxiliary equipment can be installed in switchgear that is only 85 inches deep, even in two-high applications. This saves 2.5 square feet of costly floor space for each vertical section, when compared with conventional 95-inch deep switchgear. As an option, 92-inch deep switchgear is available. This option provides an additional 7-inches of depth in the cable compartment to accommodate unusual cable or equipment requirements.



Surge Arrestors

Bus risers to bus duct or roof busings

Connection of up to eight cables per phase (three cable lugs shown)

Large CPT up to 75 kVA

Various Application Designs in Cable Compartments

ADVAC Circuit Breakers

The ADVAC series of vacuum circuit breakers is a complete line of ANSI/IEEE-rated circuit breakers offering power distribution system customers the advantages of vacuum circuit breaker technology — *technology that reduces ownership costs through improved reliability and maintainability.* Vacuum interrupters are embedded in a proprietary epoxy material, achieving excellent dielectric and thermal capabilities. Eliminating mechanism operated cell switches, the ADVAC breaker packages all auxiliary control contacts on the circuit breaker.

Ratings

ADVAC is available in the full range of ANSI and IEEE ratings through 15 kV, with interrupting ratings to 50 kA and continuous currents through 3000 A (self-cooled) or 4000 A (force-cooled). A complete table of breaker types and ratings is provided in the Reference section. ADVAC circuit breakers have been fully tested to the most recent versions of ANSI/IEEE C37.04, C37.06, and C37.09. Using "k" factor equals 1 as the test criteria.

Operating Mechanism

ADVAC uses a simple, front-accessible stored-energy operating mechanism designed specifically for use with vacuum technology. This provides the benefits of dependable vacuum interrupters, with advanced contact design and proven reliability, without the complexity of mechanisms and linkages found in previous generation circuit breakers.

This simple concept uses only a small fraction of the moving parts found in conventional breakers, resulting in maximum reliability over a longer life — with added savings from easy, infrequent maintenance.

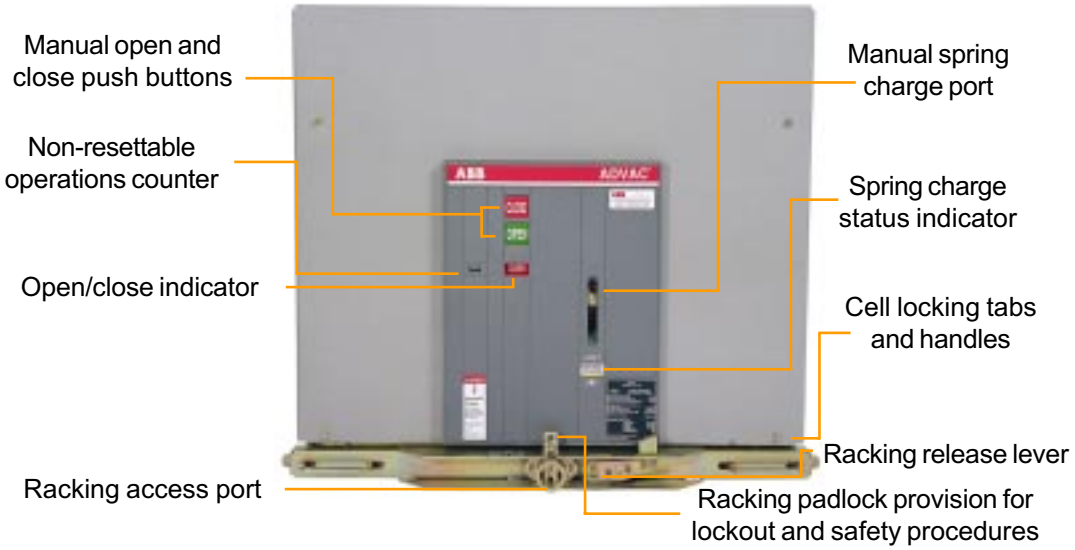
Control System

Control features of the ADVAC breaker emphasize convenience, maintainability and flexibility. Charge, close and trip functions can be accomplished both electrically and manually. All manual functions can be performed with great ease at the front of the breaker.

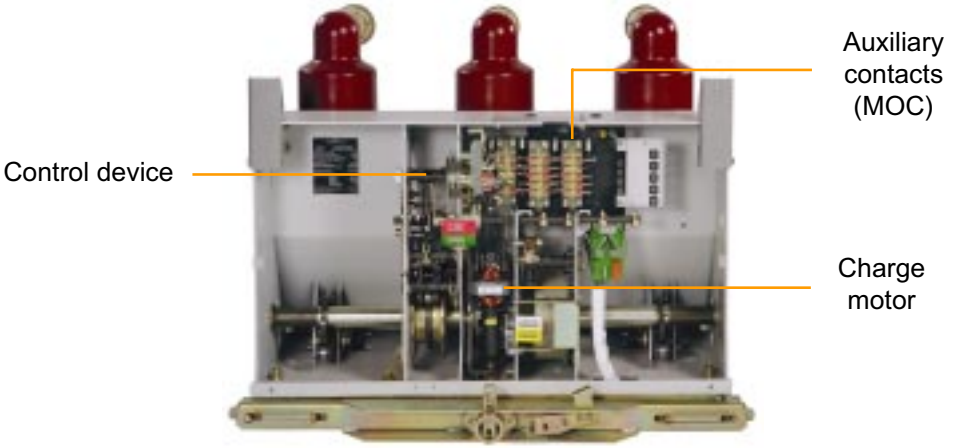
Control flexibility is the result of a wide range of standard and optional features, including independently selectable voltages for electric charge, close and trip functions. Eight auxiliary switch contacts (four "a", four "b") are mounted on-board and wired through the automatic secondary disconnect.

Several options are available with an additional secondary disconnect to offer a high degree of flexibility in control system design. Options include dual isolated shunt trip coils, a direct-acting undervoltage release and nine extra on-board contacts for a total of 17 auxiliary contacts (nine "a", eight "b"). Since all auxiliary contacts are on-board, they are automatic, operating with the breaker in either the "Test" or "Connected" position.

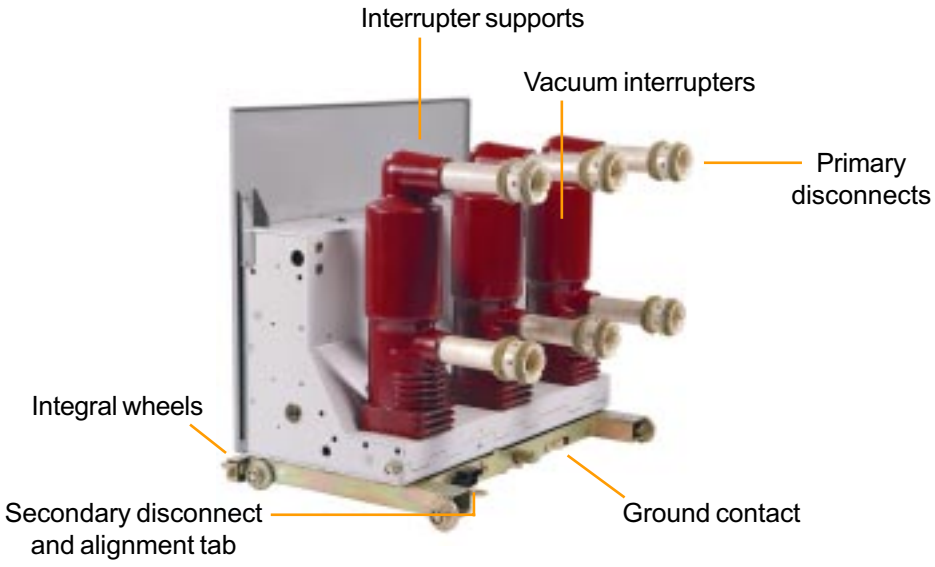
The ADVAC control system reduces ownership costs through greatly simplified inspection and maintenance procedures. The entire operating mechanism and its control components are front accessible. Modular construction and the use of common components result in fewer spare parts. The entire control package is removable for easy maintenance and functional changes.



Front view of ADVAC circuit breaker



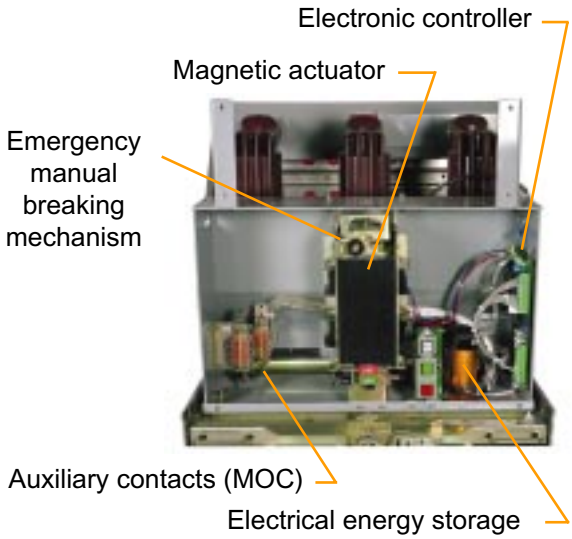
ADVAC circuit breaker with front panel removed



Rear view of ADVAC circuit breaker

AMVAC Circuit Breakers

The AMVAC is truly the next generation of circuit breakers. With the AMVAC, ABB is the first to combine the unique requirements of vacuum interrupter technology with a stored energy mechanism. Using a flux-shifting device with integral permanent magnets, the AMVAC mechanism has just one moving part. Having only open and close coils, an electronic controller, and capacitors for energy storage, the AMVAC circuit breaker mechanism is capable of 100,000 operations. Vacuum interrupters are embedded in a proprietary epoxy material, achieving excellent dielectric and thermal capabilities. Eliminating mechanism operated cell switches, the AMVAC breaker packages all auxiliary control contacts on the circuit breaker.



Ratings

AMVAC is available in the full range of ANSI and IEEE ratings through 27 kV. Through 15 kV, it has interrupting ratings to 50 kA and continuous currents through 3000 A (self-cooled) or 4000 A (force-cooled). In 27 kV, AMVAC is available with interrupting ratings to 25 kA and continuous currents through 2000 A. AMVAC circuit breakers have been fully tested to the most recent versions of ANSI/IEEE C37.04, C37.06, and C37.09. Using "k" factor equals 1 as the test criteria.

Universal Applications

- Medium voltage motor starting applications
- Capacitor switching
- Retrofit applications to replace existing circuit breakers in repetitive duty applications
- Mining applications where high reliability and resistance to dust and humidity are critical

AMVAC Specifications

- Interchangeable with ADVAC
- Completely concealed moving parts
- UL labeling and CSA compliance
- Low power consumption
- ANSI/IEEE compliance at 5, 15 and 27 kV

Summary of Benefits

- Simple mechanical operation
- Fewer than 10 moving parts
- Manual opening capability
- High reliability

Rating Structure

ADVAC* Circuit Breaker

Breaker Type	Nominal Voltage Class kV	Rated Maximum Voltage kV	Low Frequency Withstand Voltage kV rms	Impulse Level (BIL) kV Crest	Rated Short Circuit Current kA rms	Short Time Current kA rms 2 Sec.	Close and Latch kA Peak	Rated Voltage Range Factor K
5ADV25	4.16	4.76	19	60	25	25	82	1.0
5ADV31	4.16	4.76	19	60	31.5	31.5	82	1.0
5ADV40	4.16	4.76	19	60	40	40	104	1.0
5ADV50	4.16	4.76	19	60	50	50	130	1.0
7.5ADV40	7.2	8.25	36	95	40	40	104	1.0
15ADV20	13.8	15	36	95	20	20	52	1.0
15ADV25	13.8	15	36	95	25	25	65	1.0
15ADV31	13.8	15	36	95	31.5	31.5	82	1.0
15ADV40	13.8	15	36	95	40	40	104	1.0
15ADV50	13.8	15	36	95	50	50	130	1.0

*ADVAC circuit breakers are available in continuous current ratings of 1200, 2000 and 3000 A rms. A force cooled 4000 A rating is also available. Ratings are 50/60 Hz basis. Higher dielectric ratings are available for most classes.

AMVAC* Circuit Breaker

Breaker Type	Nominal Voltage Class kV	Rated Maximum Voltage kV	Low Frequency Withstand Voltage kV rms	Impulse Level (BIL) kV Crest	Rated Short Circuit Current kA rms	Short Time Current kA rms 2 Sec.	Close and Latch kA Peak	Rated Voltage Range Factor K
5AMV25	4.16	4.76	19	60	25	25	65	1.0
5AMV31	4.16	4.76	19	60	31.5	31.5	82	1.0
5AMV40	4.16	4.76	19	60	40	40	104	1.0
5AMV50	4.16	4.76	19	60	50	50	130	1.0
7.5AMV40	7.2	8.25	36	95	40	40	104	1.0
15AMV20	13.8	15	36	95	20	20	52	1.0
15AMV25	13.8	15	36	95	25	25	65	1.0
15AMV31	13.8	15	36	95	31.5	31.5	82	1.0
15AMV40	13.8	15	36	95	40	40	104	1.0
15AMV50	13.8	15	36	95	50	50	130	1.0
27AMV16	23	27	60	125	16	16	42	1.0
27AMV25	23	27	60	125	25	25	65	1.0

*AMVAC circuit breakers are available in continuous current ratings of 1200, 2000 and 3000 A rms up to 15 kV and 1200 and 2000 A rms at 27 kV. A force cooled 4000 A rating is also available at 15 kV. Ratings are 50/60 Hz basis. Higher dielectric ratings are available for most classes.

Capacitance Switching Ratings

ADVAC and AMVAC circuit breakers are suitable for "General Purpose" applications as defined by applicable ANSI/IEEE standards. Contact ABB for availability of non-standard ratings. Capacitance switching ratings are as specified in the tables below and are subject to the following conditions.

1. The transient voltage from line-to-ground shall not exceed three times the maximum design line-to-ground crest voltage as measured at the circuit breaker terminals.
2. The number of re-strikes or re-ignitions shall not be limited as long as the transient voltage-to-ground does not exceed the value given in number 1 above.
3. The capacitor rating applies only to "Single Bank Switching".

Interrupting time is in accordance with the rated interrupting time of the circuit breaker.

ADVAC

Rated Maximum Voltage kV rms	Rated Short Circuit Current kA rms	ADVAC Continuous Current Rating					
		1200 A		2000 A		3000 A	
		General Purpose A	Definite Purpose A	General Purpose A	Definite Purpose A	General Purpose A	Definite Purpose A
4.76	31.5	400	630	400	630	400	630
4.76	40	400	630	400	630	400	630
4.76	50	400	1000	400	1000	400	1000
8.25	40	250	630	250	630	250	630
15	20	250	630	250	630	250	630
15	25	250	630	250	630	250	630
15	31.5	250	630	250	630	250	630
15	40	250	630	250	630	250	630
15	50	250	1000	250	1000	250	1000

AMVAC

Rated Maximum Voltage kV rms	Rated Short Circuit Current kA rms	AMVAC Continuous Current Rating					
		1200 A		2000 A		3000 A	
		General Purpose A	Definite Purpose A	General Purpose A	Definite Purpose A	General Purpose A	Definite Purpose A
4.76	25	400	630	400	630	400	630
4.76	31.5	400	630	400	630	400	630
4.76	40	400	630	400	630	400	630
8.25	40	250	630	250	630	250	630
15	20	250	630	250	630	250	630
15	25	250	630	250	630	250	630
15	31.5	250	630	250	630	250	630
15	40	250	630	250	630	250	630
27	16	160	400	160	400	N/A	N/A
27	25	160	400	160	400	N/A	N/A

ADVAC/ AMVAC Circuit Breaker

ADVAC and AMVAC circuit breakers are subjected to extensive testing for durability in accordance with ANSI/IEEE standards. This information is provided as a guide to maintenance planning under normal operating conditions. Actual experience may vary based on operational conditions and maintenance practices.

Mechanical Endurance

ADVAC

Continuous Current Interrupting Current	1200 & 2000 A Less than 50 kA	1200 & 2000 A 50 kA	3000 A ALL
No-load mechanical operations	10,000	5,000	5,000
Between servicing operations	2,000	1,000	1,000
Full load current operations	1,000	500	500
Rated KSI	800%	800%	800%

AMVAC

Interrupting Current Continuous Current	Less than 50 kA 1200 & 2000 A	50 kA 1200 & 2000 A	ALL 3000 A
No-load mechanical operations	30,000	10,000	10,000
Between servicing operations	3,000	2,000	2,000
Full load current operations	1,000	500	500
Rated KSI	800%	800%	800%

Altitude Rating Correction Factors

This table must be used in accordance with ANSI C37.04 to correct published circuit breaker ratings for operation at altitudes over 3,300 feet above sea level.

Altitude Feet (m)	Rating Correction Factor*	
	Continuous Current	Voltage & Dielectric Withstand
3,300 (1,000) and below	1.00	1.00
5,000 (1,500)	0.99	0.95
10,000 (3,000)	0.95	0.80

* Values for intermediate altitudes may be derived from linear interpolation.

Auxiliary (MOC) and Truck Operated Contact (TOC) Switches

Circuit breaker auxiliary switches operate whenever the breaker opens or closes. Contacts are compression type, mounted on the breaker and wired to switchgear terminal blocks through the secondary disconnect system. Contacts are operated through simple mechanical links from an auxiliary drive shaft which rotates in conjunction with the main drive shaft. Switch contacts are silver-plated.

The standard contact configuration is four “a” contacts (normally open when the breaker is open), and four “b” contacts (normally closed when the breaker is open). An optional dual secondary disconnect enables the addition of five “a” contacts and four “b” contacts, for a total of nine “a” and eight “b” contacts. The contacts are not field reversible.

Optional TOC switches are actuated by movement of the circuit breaker to indicate when the breaker is in the "Connected" position. TOC switch contacts are mounted in an isolated low voltage area at the top of the breaker compartment. TOC switches are available with four, eight or twelve contacts, with an even number of “a” contacts (normally open when breaker is not connected) and “b” contacts (normally closed with breaker is not connected). Contacts are not field-reversible.

Auxiliary Contact (MOC) Current Ratings	Continuous (A)	Switching (A)
@ 250 VDC	10	2.0
@ 125 VDC	10	4.0
@ 48 VDC	10	6.0
@ 24 VDC	10	7.7
@ 240 VAC	10	10.0
@ 120 VAC	10	10.0

TOC Switch Current Ratings	Continuous (A)	Switching (A)
@ 250 VDC	20	5.0
@ 125 VDC	20	10.0
@ 48 VDC	20	12.0
@ 24 VDC	20	15.0
@ 240 VAC	20	10.0
@ 120 VAC	20	15.0

Close and Trip Coils

ADVAC circuit breaker close and trip coils are reliable solenoids with a rotary movement that actuates appropriate operating mechanism linkages.

ADVAC

Nominal Coil Voltage (V)	Trip Coil		Close Coil		Impedance +/- 5% (Ohms)	Recommended Class RK-5 Fuse Size (A)
	Rated Voltage Range (V)	Nominal Current (A)	Rated Voltage Range (V)	Nominal Current (A)		
24 VDC	20-28	9.6	—	—	*	15
48 VDC	28-56	4.8	38-56	4.8	47	15
125 VDC	70-140	3.0	100-140	3.0	198	15
250 VDC	140-280	1.5	200-280	1.5	8	15
120 VAC	104-127	3.0	104-127	3.0	198	15
240 VAC	208-254	1.5	208-254	1.5	8	15

*Contact factory for impedance value

Note that the minimum value for the 24 VDC trip coil is higher (more restrictive) than the normal range defined by ANSI/IEEE standards.

Unless near the battery source, or unless a special effort is made to ensure adequacy of conductors, 24 and 48 VDC control functions are not recommended.

AC trip voltages are not recommended under any conditions, due to the reliability of AC power sources. If the only available control power source is AC, the recommended procedure is to use a capacitor trip device for each trip circuit.

Second Trip Coil

ADVAC circuit breakers are available with a second trip coil option. This option uses the standard coil, except that a different control voltage may be selected. A dual secondary disconnect must be used whenever a second shunt trip is specified. This provides complete redundancy of the trip circuit from the trip coil, through the secondary disconnect system, to the switchgear terminal blocks.

AMVAC

The AMVAC electronic controller will operate on AC or DC control power because it utilizes an AC to DC converter internally.

	Control Power Voltage Range	Tripping Voltage Range	Closing Voltage Range	Capacitor Charging	Continuous Power
Low Voltage Board	20 - 53 VAC	20 - 264 VAC	20 - 264 VAC	100 Watts	10 Watts
	17 - 75 VDC	20 - 264 VDC	20 - 264 VDC	100 Watts	10 Watts
High Voltage Board	85 - 264 VAC	20 - 264 VAC	20 - 264 VAC	100 Watts	10 Watts
	77 - 280 VDC	20 - 264 VDC	20 - 264 VDC	100 Watts	10 Watts

ADVAC and AMVAC circuit breakers are also available with an optional undervoltage trip feature. This is a direct acting trip coil that actuates the trip linkage when the control voltage drops below 35 to 70% of the nominal range. This prevents a condition from happening in which control voltage is no longer available to trip a breaker. This feature is not available for 24 VDC trip circuits.

ADVAC Charging Motor

ADVAC circuit breakers use a reliable and durable motor for electrically charging the toroidal spring in the stored energy operating mechanism. The two-pole universal motor is suitable for AC or DC voltages at each nominal rating. The motor is rated at 0.35 horsepower and uses a 100:1 internal gear reduction.

ADVAC

Charge Motor	Nominal Voltage Range (V)	Nominal Current (A)	Inrush Current	Stalled Current (A)	No Load Current (A)	Charging Time (Nominal)	Recommended Class RK-5 Fuse Size (A)
48 VDC	38-56	8	6-8 x nominal current	25.0	3.5	8-9 seconds	15
125 VDC	100-140	4		12.5	1.5		
250 VDC	200-280	2		6.5	0.8		
120 VAC	104-127	4		12.5	1.5		
240 VAC	208-254	2		6.5	0.8		

Electric charging requires eight to nine seconds at nominal control voltage. The 48 VDC motor voltage is not recommended unless located near a battery or a special effort is made to assure the adequacy of the conductors. Manual charging is also quick and convenient, requiring approximately 25 easy strokes of a manual charging handle inserted at the front panel of the circuit breaker. The manual procedure takes about 25 seconds to complete.

Timing Characteristics

	ADVAC	AMVAC
Nominal closing time	60 ms	45-60 ms
Nominal opening time	35-40 ms	35-45 ms
Arcing time	< 15 ms	< 15 ms
Nominal interrupting time	< 55 ms	< 55 ms
Motor charging time	8-9 seconds *	N/A
Manual charging time	~ 25 seconds **	N/A

* at nominal control voltage

** requires approximately 25 strokes of charging handle

Vacuum Interrupters

ADVAC and AMVAC circuit breakers use superior quality vacuum interrupters with proven reliability over a long life. All interrupters use advanced copper-chrome contact material for superior performance and minimum current chop.

ADVAC & AMVAC Breakers 5-15 kV

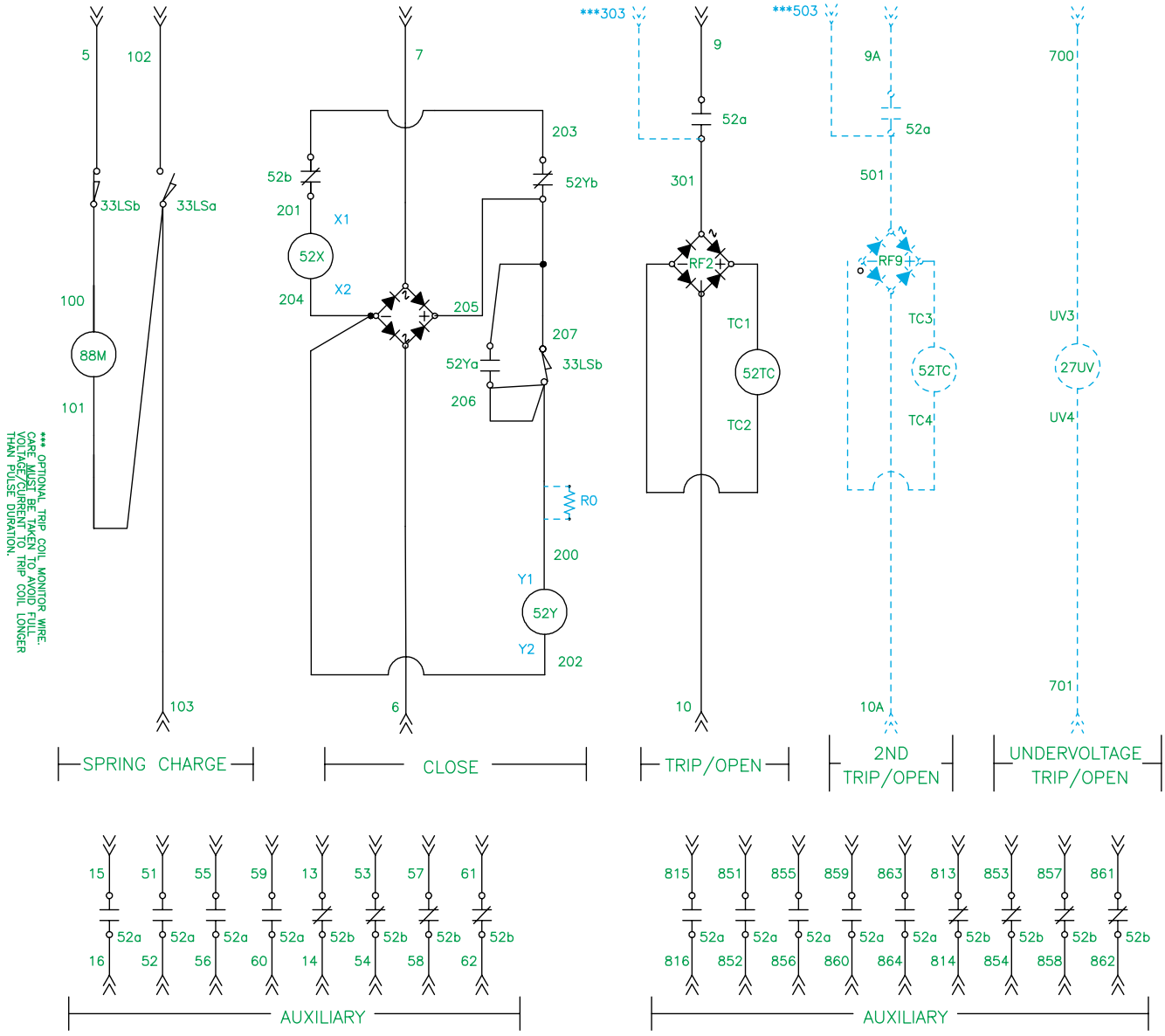
Continuous current rating	1200 A	1200 A	1200 A	2000 A	2000 A	2000 A	3000 A
Interrupting rating	20-25 kA	31.5 kA	40 kA	20-31.5 kA	40 kA	50 kA	20-50 kA
Contact shape	Spiral						
Contact resistance @ rated current (micro-ohms)	17-19	16-18	12-14	10-13	12-14	9-12	10-12
Field design	Radial						
No-load mechanical life operations**	10,000	10,000	5,000	10,000	5,000	5,000	5,000
Vacuum (Torr)	10^{-8} to 10^{-7}						
Maximum chop current*	3-5 A						

* Overvoltages are dependent on the surge impedance of the circuit.

** Requirements by ANSI/IEEE standards. Actual life is significantly greater.

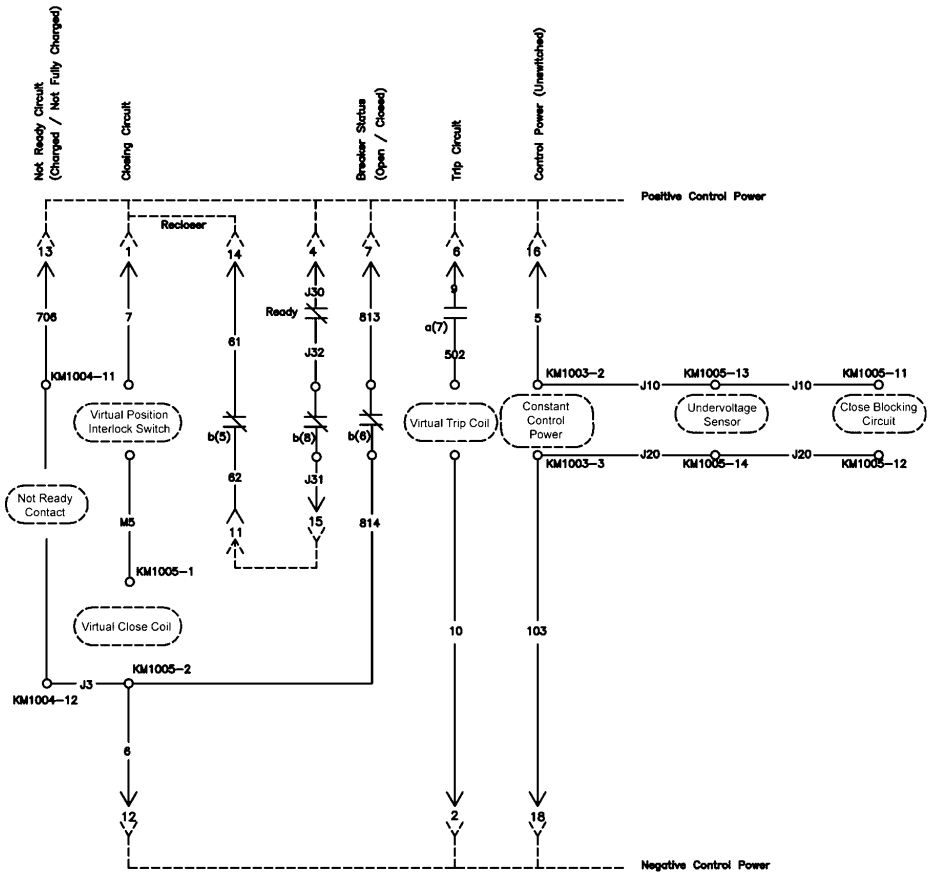
ADVAC Schematic Diagram

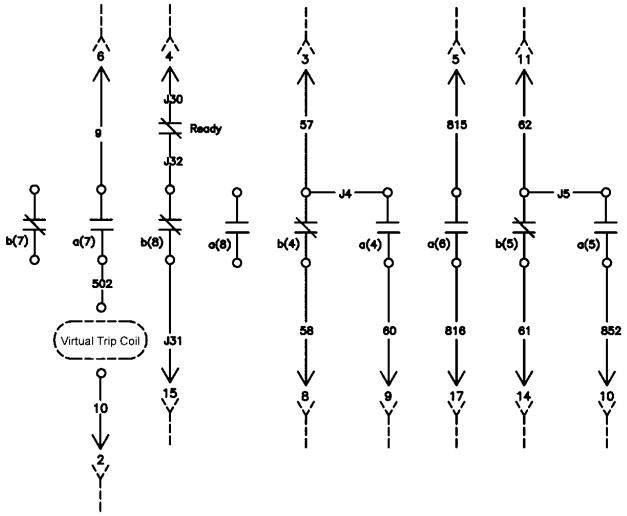
ADVAC circuit breakers are available with two schematic diagrams. The basic schematic diagram is supplied with a single secondary disconnect. Additional auxiliary contacts, a second shunt trip device and an undervoltage trip device are options available with the dual secondary disconnect.



AMVAC Schematic Diagram

AMVAC circuit breakers are available with two schematic diagrams. The basic schematic diagram is supplied with a single secondary disconnect. Additional auxiliary contacts are available with the dual secondary disconnect.



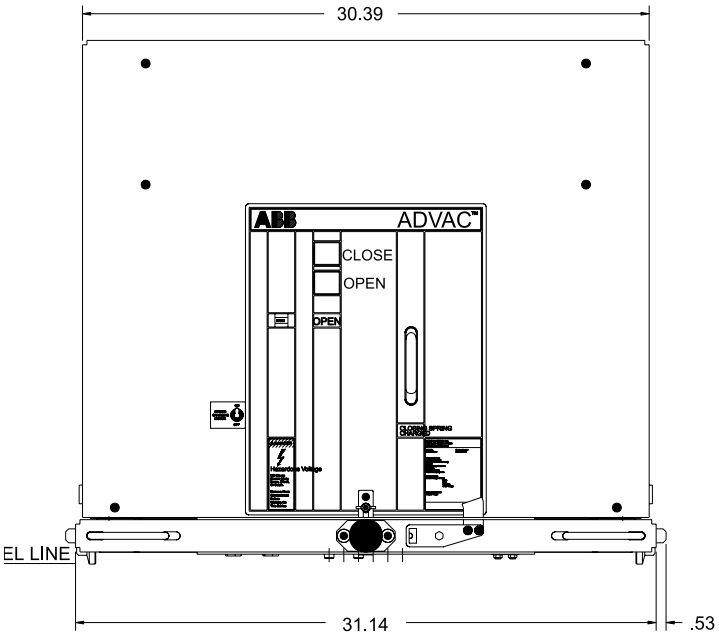


NOTES:

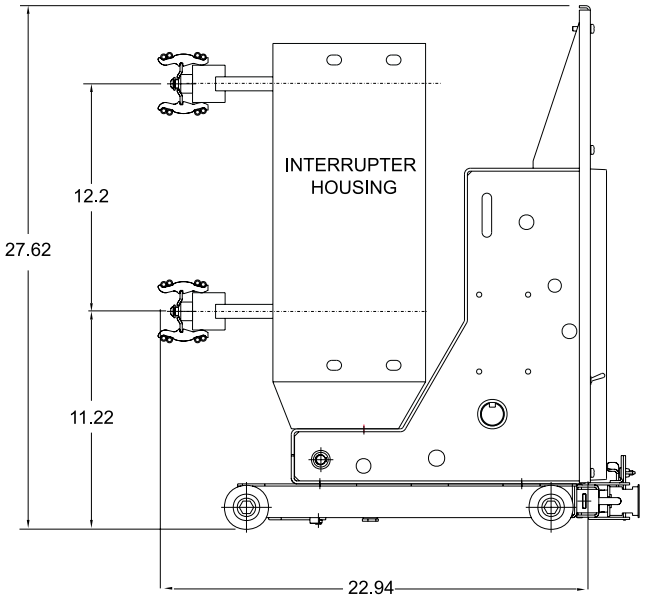
- Virtual Close Coil includes Anti-Pump circuitry
- Not Ready Contact open when sufficient operating energy is stored (similar to springs charged).
- Virtual Position Interlock Switch is Closed only in Test or Connect racking position.

Outline and Dimensions

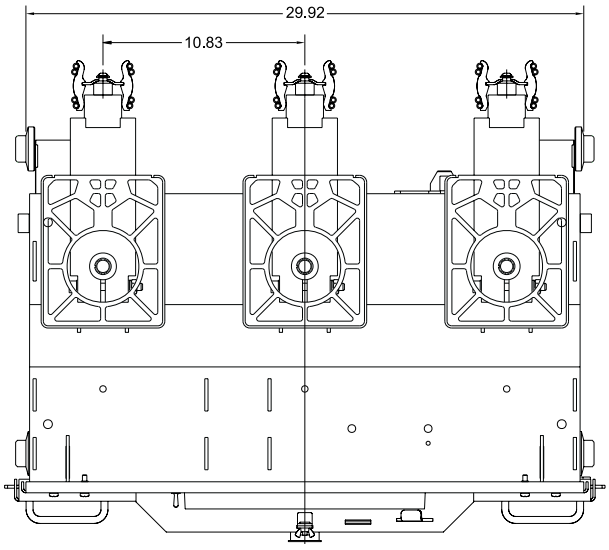
ADVAC (featured below) and AMVAC circuit breaker dimensions are similar for all 36-inch wide compartments and ratings. The operating mechanism, control components, racking system and accessories are the same for all ratings. Breakers with higher interrupting and continuous current ratings use various primary lead assemblies and interrupter housings with different appearances, but cell interface dimensions are identical.



Front View



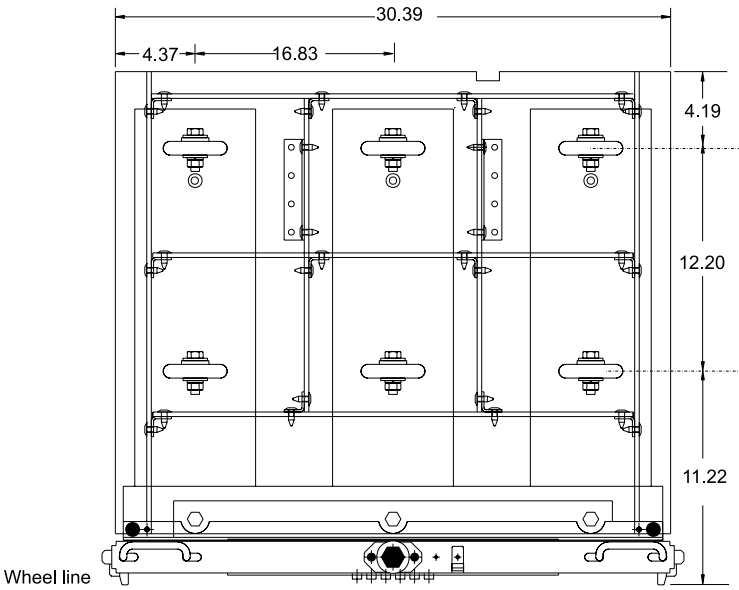
Side View



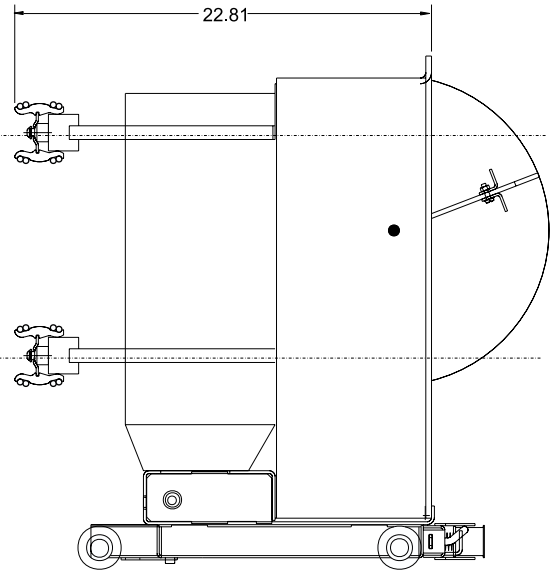
Top View

Ground and Test Device (G&T)

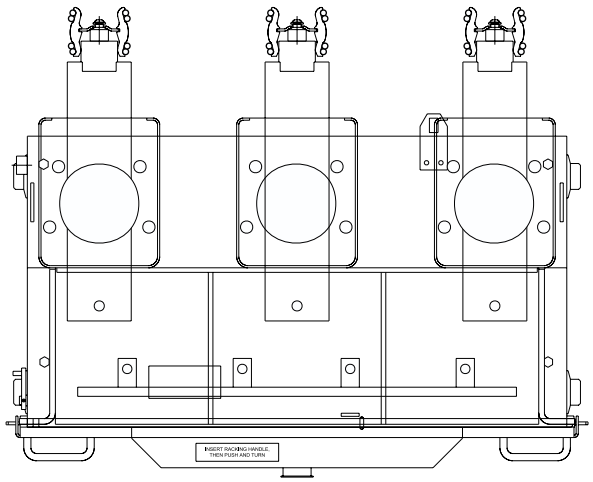
G&T devices are interchangeable with ADVAC and AMVAC circuit breakers in appropriately rated compartments. These devices provide a manual means to select and test primary circuits in a controlled manner, and then ground a set of de-energized primary contacts to the switchgear ground bus. The racking system can be padlocked to keep the G&T in the grounded position during maintenance activity. G&T devices are available with six terminals. Ground leads are individually removable from terminals, allowing use as a three-terminal device or in other grounding configurations. G&T devices are not rated for switching or interrupting duty. A single device can be used for both 1200 A and 2000 A compartments, and a separate G&T is required for 3000 A compartments.



Front View



Side View



Top View

NOTES:

1. The device is for use with cells designed for ADVAC and AMVAC breakers.
2. Two sets of cables are furnished. The short set attaches to the lower terminal set, and the long set attaches to the upper terminal set.
3. This device is designed for use with only one set of cables attached to a terminal set at any given time. Either the upper terminals are grounded through their cable set, or the lower terminals are grounded through their cable set.
4. Position stops are provided in the "Connected" and "Disconnected" positions. To assure that the device is in the fully "Connected" position, the "Connect" label must be in the correct position.
5. Device cannot be stored in breaker compartments.

Current Transformer Ratings

Current transformers (CTs) are the low voltage ring core type, for front-accessible mounting on the primary contact support bushings. Standard accuracy CTs are 3.5 inches deep, and up to four of these CTs can be installed for each phase (two on each bushing).

5, 7.5 & 15 kV

CURRENT TRANSFORMER RATINGS Standard Accuracy Two per Bushing, Four per Phase							
Single Ratio XXXX:5A	Relaying Accuracy		Metering Accuracy				
	1200/2000 A 5.25" Window	3000 A 6.50" Window	B0.1	B0.2	B0.5	B0.9	B1.8
50	C10	N/A	2.4	4.8	N/A	N/A	N/A
75	C10	N/A	1.2	2.4	4.8	N/A	N/A
100	C20	N/A	1.2	2.4	4.8	N/A	N/A
150	C20	N/A	0.6	0.6	1.2	2.4	4.8
200	C50	N/A	0.3	0.3	0.6	1.2	2.4
250	C50	N/A	0.3	0.3	0.3	1.2	1.2
300	C50	N/A	0.3	0.3	0.3	1.2	1.2
400	C100	N/A	0.3	0.3	0.3	0.3	0.6
500	C100	N/A	0.3	0.3	0.3	0.3	0.6
600	C100	N/A	0.3	0.3	0.3	0.3	0.3
800	C100	N/A	0.3	0.3	0.3	0.3	0.3
1000	C100	N/A	0.3	0.3	0.3	0.3	0.3
1200	C200	N/A	0.3	0.3	0.3	0.3	0.3
1500	C200	C200	0.3	0.3	0.3	0.3	0.3
2000	C200	C200	0.3	0.3	0.3	0.3	0.3
2500	C400	C200	0.3	0.3	0.3	0.3	0.3
3000	C400	C200	0.3	0.3	0.3	0.3	0.3
4000	C400	C200	0.3	0.3	0.3	0.3	0.3
5000	C400	C200	0.3	0.3	0.3	0.3	0.3

Multi Ratio XXXX:5A	Relaying Accuracy		Metering Accuracy				
	1200/2000 A 5.25" Window	3000 A 6.50" Window	B0.1	B0.2	B0.5	B0.9	B1.8
600	C100	N/A	0.3	0.3	0.3	0.6	0.6
1200	C200	N/A	0.3	0.3	0.3	0.3	0.3
2000	C400	C200	0.3	0.3	0.3	0.3	0.3
3000	C400	C200	0.3	0.3	0.3	0.3	0.3
4000	C400	C200	0.3	0.3	0.3	0.3	0.3
5000	C400	C200	0.3	0.3	0.3	0.3	0.3

27 kV

CURRENT TRANSFORMER RATINGS Standard Accuracy Two per Bushing, Four per Phase						
Single Ratio XXXX:5A	Relaying Accuracy	Metering Accuracy				
	1200/2000 A 6.50” Window	B0.1	B0.2	B0.5	B0.9	B1.8
1500	C200	0.3	0.3	0.3	0.3	0.3
2000	C200	0.3	0.3	0.3	0.3	0.3
2500	C200	0.3	0.3	0.3	0.3	0.3
3000	C200	0.3	0.3	0.3	0.3	0.3
4000	C200	0.3	0.3	0.3	0.3	0.3
5000	C200	0.3	0.3	0.3	0.3	0.3

Multi Ratio XXXX:5A	Relaying Accuracy	Metering Accuracy				
	1200/2000 A 6.50” Window	B0.1	B0.2	B0.5	B0.9	B1.8
2000	C200	0.3	0.3	0.3	0.3	0.3
3000	C200	0.3	0.3	0.3	0.3	0.3
4000	C200	0.3	0.3	0.3	0.3	0.3
5000	C200	0.3	0.3	0.3	0.3	0.3

High accuracy CTs are 7.0 inches deep, and up to two of these can be installed for each phase (one on each bushing). The CTs are mounted around the primary bushings on threaded rods that are securely fastened to the base of the bushings. Note that 3000 A bushings have a larger overall diameter than 1200 or 2000 A bushings, and therefore require CTs with a larger window diameter. Refer to the following tables for the accuracy ratings and dimensions for each available CT ratio.

CURRENT TRANSFORMER RATINGS
High Accuracy One per Bushing, Two per Phase

Single Ratio XXXX:5A	Relaying Accuracy		Metering Accuracy				
	1200/2000 A 5.25" Window	3000 A 6.50" Window	B0.1	B0.2	B0.5	B0.9	B1.8
50	C20	N/A	2.4	4.8	•	•	•
75	C20	N/A	1.2	2.4	4.8	•	•
100	C50	N/A	0.6	1.2	2.4	4.8	4.8
150	C50	N/A	0.3	0.6	1.2	1.2	2.4
200	C100	N/A	0.3	0.6	1.2	1.2	2.4
250	C100	N/A	0.3	0.3	0.6	0.6	1.2
300	C100	N/A	0.3	0.3	0.3	0.6	1.2
400	C200	N/A	0.3	0.3	0.3	0.3	0.6
500	C200	N/A	0.3	0.3	0.3	0.3	0.3
600	C200	N/A	0.3	0.3	0.3	0.3	0.3
800	C200	N/A	0.3	0.3	0.3	0.3	0.3
1000	C200	N/A	0.3	0.3	0.3	0.3	0.3
1200	C400	N/A	0.3	0.3	0.3	0.3	0.3
1500	C400	C400	0.3	0.3	0.3	0.3	0.3
2000	C400	C400	0.3	0.3	0.3	0.3	0.3
2500	C800	C400	0.3	0.3	0.3	0.3	0.3
3000	C800	C400	0.3	0.3	0.3	0.3	0.3
4000	C800	C400	0.3	0.3	0.3	0.3	0.3
5000	C800	C400	0.3	0.3	0.3	0.3	0.3

Multi Ratio XXXX:5A	Relaying Accuracy		Metering Accuracy				
	1200/2000 A 5.25" Window	3000 A 6.50" Window	B0.1	B0.2	B0.5	B0.9	B1.8
600	C200	N/A	0.3	0.3	0.3	0.3	0.3
1200	C400	N/A	0.3	0.3	0.3	0.3	0.3
2000	C800	C400	0.3	0.3	0.3	0.3	0.3
3000	C800	C400	0.3	0.3	0.3	0.3	0.3
4000	C800	C400	0.3	0.3	0.3	0.3	0.3
5000	C800	C400	0.3	0.3	0.3	0.3	0.3

Standard Control Power Transformer (CPT) Ratings

CPTs are designed to provide control power in medium voltage switchgear. Units are available in both single and three phase configurations. All CPTs are manufactured to meet the requirements of IEEE C57.12.01. Primary windings are vacuum cast for high dielectric strength and ruggedness. Transformers are constructed with high quality grain-oriented core steel and copper conductor.

Single Phase, 60 Hz, 240/120 V Secondary, Epoxy - Cast

Primary Voltages	BIL kV	Available kVA
2400, 4160, 4800	60	3, 5, 10, 15, 25, 37.5, 50, 75
7200, 7620, 8320	95	3, 5, 10, 15, 25, 37.5, 50, 75
12000, 12470, 13200, 13800	95	3, 5, 10, 15, 25, 37.5, 50, 75
12000, 14400	125	3, 5, 10, 15, 25, 37.5, 50, 75

Three Phase, 60 Hz, 208/120 V Secondary, Epoxy - Cast

Primary Voltages	BIL kV	Available kVA
2400, 4160, 4800	60	9, 15, 30, 45, 60, 75
7200, 7620, 8320	95	9, 15, 30, 45, 60, 75
12000, 12470, 13200, 13800	95	9, 15, 30, 45, 60, 75
19920, 24000	125	9, 15, 30, 45, 60, 75

Standard Voltage Transformer (VT) Ratings

VTs are indoor type, designed for metering and relaying applications. The primary and secondary coils of the transformer are wound using special winding and shielding techniques for improved voltage stress distribution. The entire assembly is cast in polyurethane under vacuum for added insulation and protection.

Voltage transformers are supplied with primary fusing to take the transformer off-line in the event of an internal failure and to protect the transformer from partial primary and secondary short-circuit.

60 Hz, 120 V Secondary, Polyurethane and Epoxy - Cast

Primary Voltages	BIL	Ratios	Metering Accuracy
2400, 4200, 4800	60	20:1, 35:1, 40:1	0.3 W, X, M, Y, Z and 0.6ZZ burdens at 120 V
7200, 8400, 12000, 14400	110	60:1, 70:1, 100:1, 120:1	0.3 W, X, M, Y and 1.2Z at 69.3 V
12000, 14400, 24000	125	100:1, 120:1, 200:1	

1500 VA thermal at 30ºC ambient. 1000 VA thermal at 55ºC ambient.

SafeGear Arc-Resistance Ratings

SafeGear is designed to comply with the arc-resistance testing requirements of EEMAC standard G14-1 (1987) as well as IEEE standard C37.20.7 (2001). The IEEE standard reflects the arc-resistant switchgear types and requirements of EEMAC G14-1, as shown below.

SafeGear Arc Resistance Ratings		
EEMAC G14-1 1987	IEEE C37.20.7 2001	Protection Specification
A	Type 1	Front only
B	Type 2	Front, sides and back
C	Type 2C	Front, sides and back; between adjacent compartments within a section or between adjacent vertical sections*

* In to-high circuit breaker configurations, the cable modules are rated Type 2 because the lower cable module vents through the upper cable module.

Main Bus Sizes

SafeGear and Advance metal-clad switchgear design certifications are based on 100% copper bus, with full round edges and sizes as shown in the following table. The main horizontal bus is not tapered. Connection joints are silver-plated and at least two properly-torqued half-inch SAE grade 5 steel bolts and split lock washers are used at each joint. The bus is epoxy insulated and removable boots cover the joints.

Main Bus Sizes			
Continuous Current	Rating	Quantity	Size
1200 A	< 46 kA	1	.25" x 4"
1200 A	= > 40 kA	1	.75" x 4"
2000 A	All	1	.75" x 4"
3000 A	All	2	.75" x 4"

Bus Support Materials

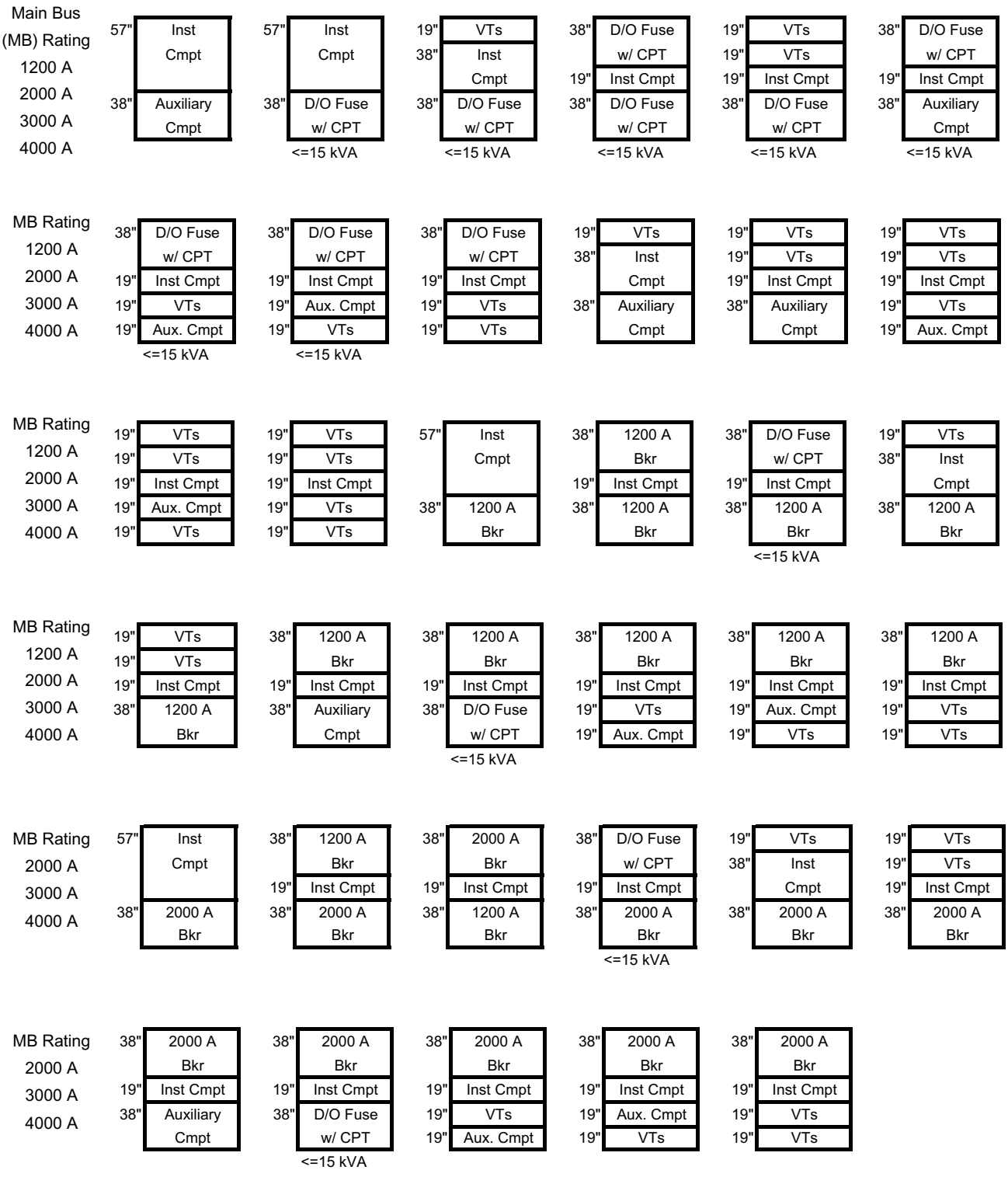
SafeGear and Advance metal-clad switchgear design certifications are based on glass-polyester and porcelain primary bus supports. Glass-polyester is standard for bus rated at 1200 A and 2000 A, and porcelain is standard at the 3000 A and 4000 A ratings. Porcelain supports are also available at 1200 A and 2000 A. Separate drawings are available to indicate the position and dimensions of the compartment-mounted primary contact supports, inter-frame horizontal bus supports, and Class A-20 standoff insulators. Physical characteristics of glass-polyester and porcelain are provided in the following table.

Characteristic	Glass Polyester	Porcelain
Flexural Strength, psi	15 - 27,000	10,500
Tensile Strength, psi	14,000	6,000
Izod Impact, ft-lb. per inch of notch	6 - 12	1.5
Thermal Shock, cycles 32° - 2300°F	100+	1
Dielectric Strength (Short Time), vpm .125" thick, 25°C	350 - 375	300
Dielectric Constant	4 - 6	6

Modules and Enclosures

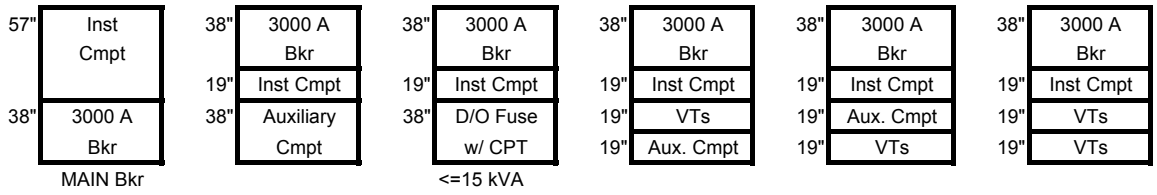
Sample general arrangements show base configurations of SafeGear and Advance metal-clad switchgear. Lineups can be expanded on either side by removing dress panels.

Advance 5, 7.5 & 15 kV Single Frame Cubicle Arrangements

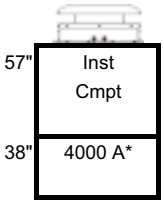


Note: CPTs greater than 15 kVA require a drawout fuse unit with stationary mounted CPT in the rear.

MB Rating
3000 A
4000 A



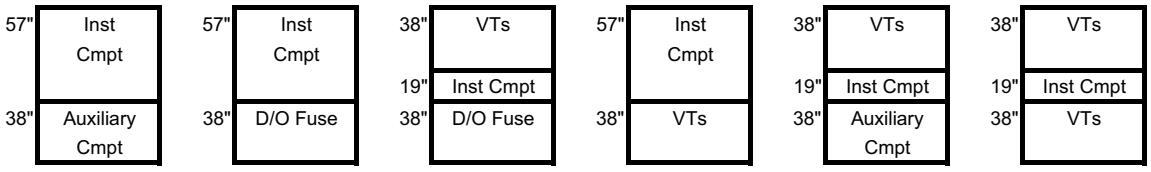
MB Rating
4000 A



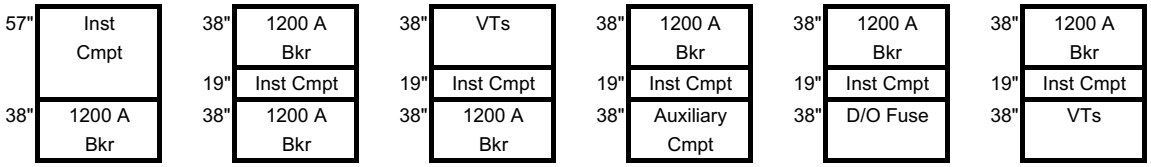
**3000 A Bkr force cooled to 4000 A*

Advance 27 kV Single Frame Cubicle Arrangements

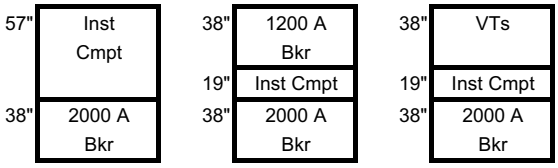
MB Rating
1200 A
2000 A



MB Rating
1200 A
2000 A

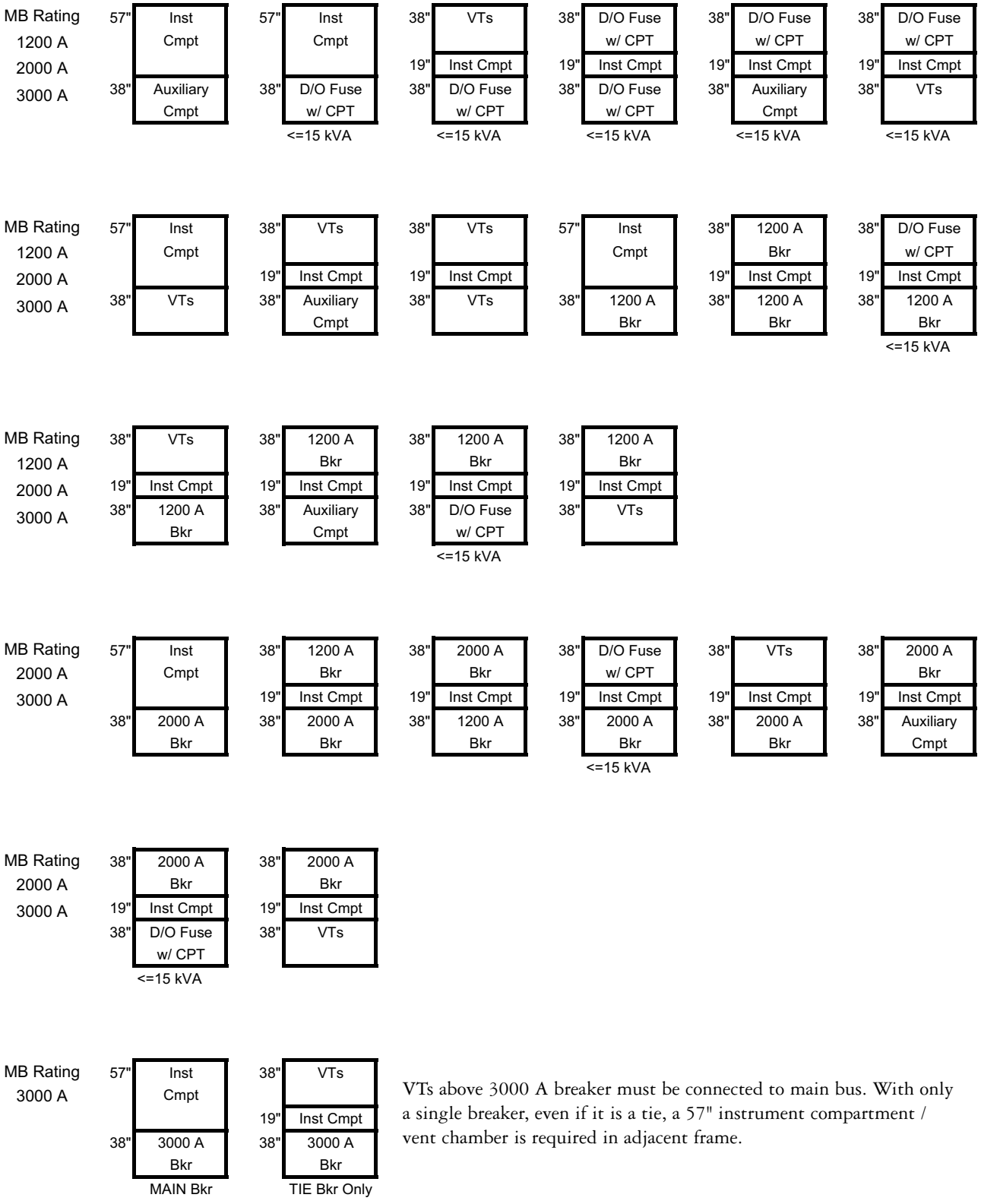


MB Rating
2000 A



Note: All CPTs require a drawout fuse unit with stationary mounted CPT in the rear.
All VTs and CPT/Fuse trucks are 38" high.
VTs and CPT Fuses only have lower terminal connections.
VTs in upper compartments connect to main bus only.
VTs and CPT fuses in lower compartments connect to rear compartment only.

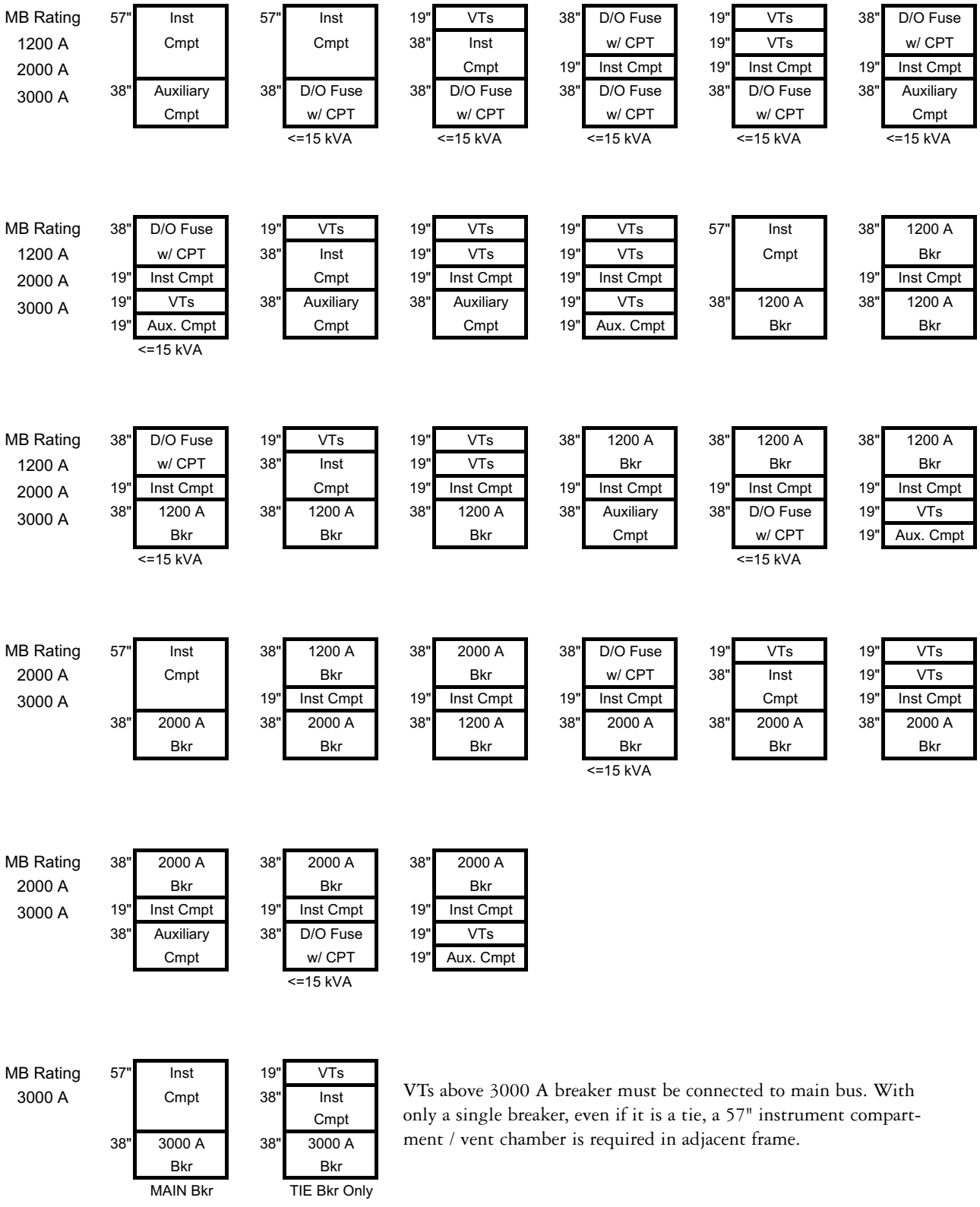
SafeGear 5, 7.5 & 15 kV 50 kA Single Frame Cubicle Arrangements



VTs above 3000 A breaker must be connected to main bus. With only a single breaker, even if it is a tie, a 57" instrument compartment / vent chamber is required in adjacent frame.

Note: Each line-up must contain one 57" instrument compartment. CPTs greater than 15 kVA require a drawout fuse unit with stationary mounted CPT in the rear.

SafeGear 5, 7.5 & 15 kV 36 kA and below Single Frame Cubicle Arrangements



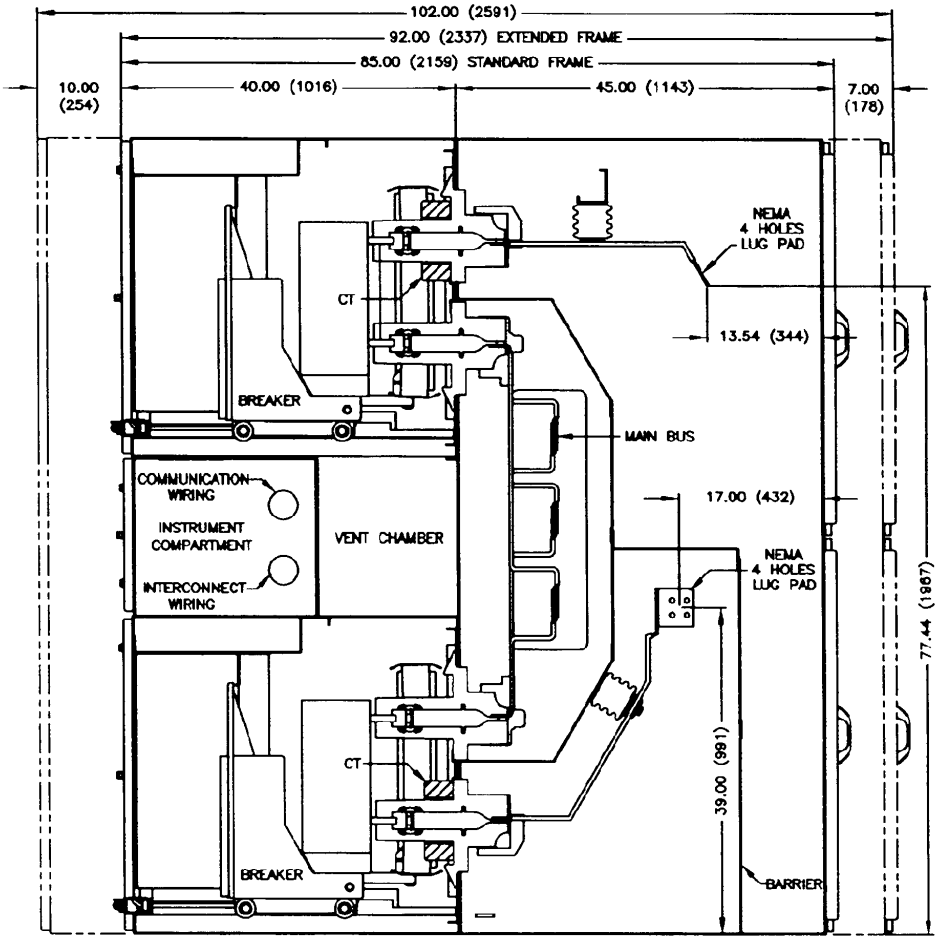
VTs above 3000 A breaker must be connected to main bus. With only a single breaker, even if it is a tie, a 57" instrument compartment / vent chamber is required in adjacent frame.

Note: Each line-up must contain one 57" instrument compartment. CPTs greater than 15 kVA require a drawout fuse unit with stationary mounted CPT in the rear.

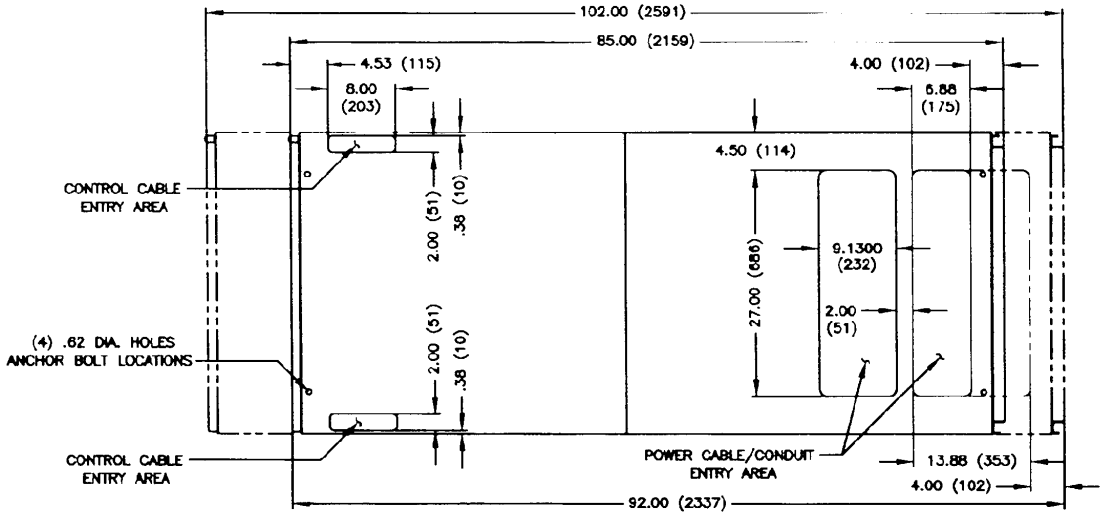
SWITCHGEAR/TWO-HIGH **The front extension is available for Advance only.**

Circuit Breaker: 1200/2000 A

See configuration sheet for available arrangements



SIDE SECTION



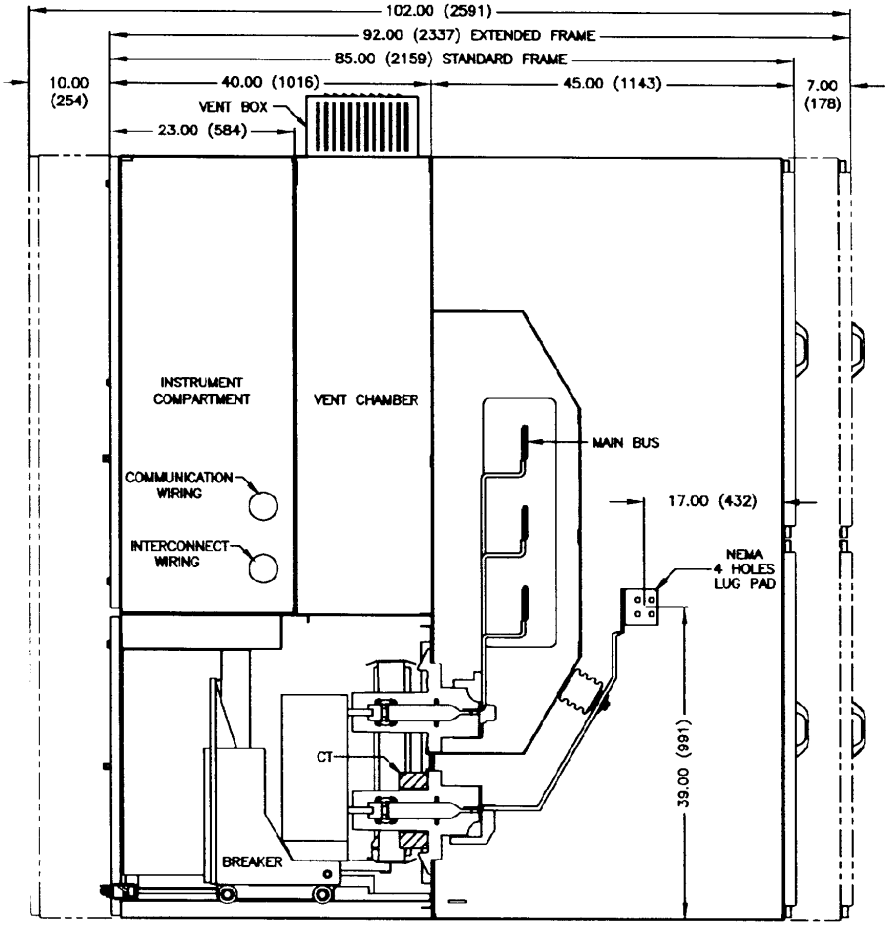
FLOOR PLAN

SWITCHGEAR/ONE-HIGH

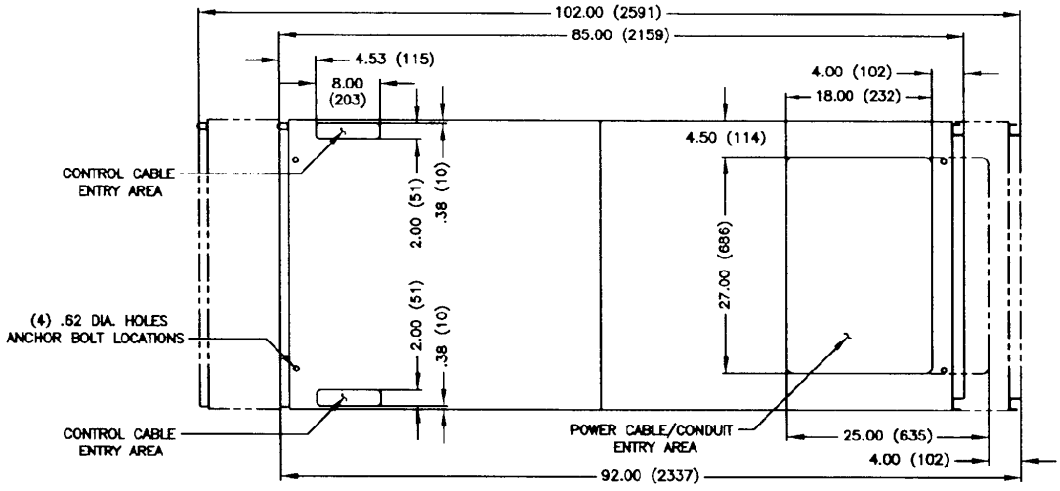
The front extension is available for Advance only.

Circuit Breaker: 1200 A

See configuration sheet for available arrangements



SIDE SECTION

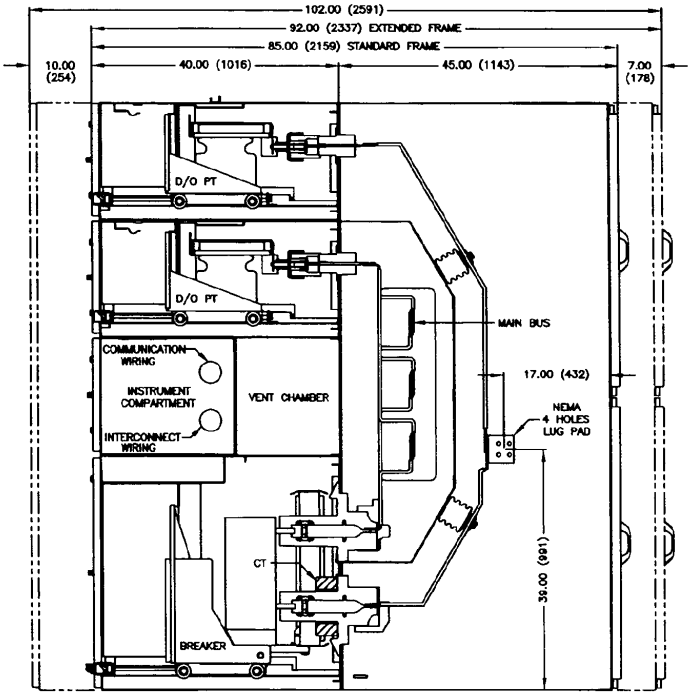


FLOOR PLAN

NOTE: Dimensions: INCHES (MM)

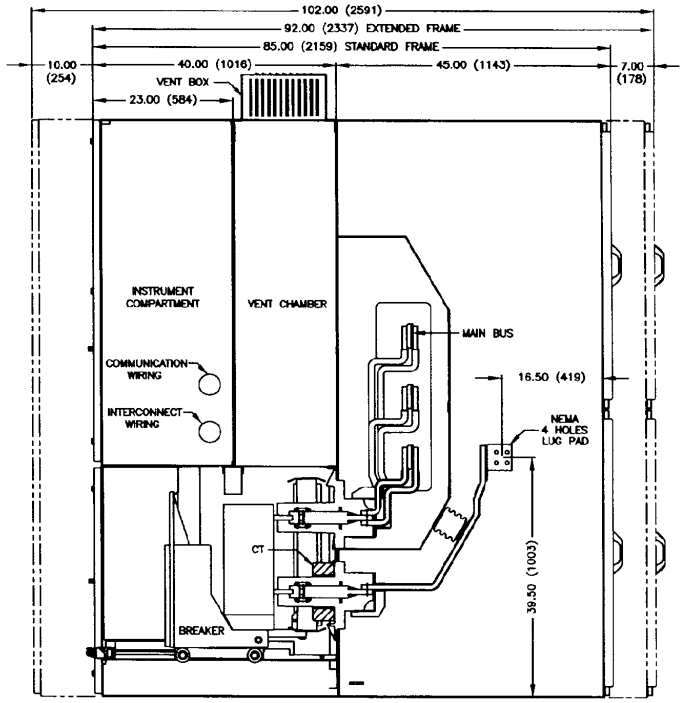
Typical for all one high breakers

SWITCHGEAR/ONE-HIGH, TWO VTs **The front extension is available for Advance only.**
Circuit Breaker: 1200 A
See configuration sheet for available arrangements



SIDE SECTION

SWITCHGEAR/ONE-HIGH **The front extension is available for Advance only.**
Circuit Breaker: 2000 or 3000 A (4000 A add 22" to roof height for fan package
See configuration sheet for available arrangements)



SIDE SECTION

Module Combinations and Dimensions

Based on its modular design, project engineers may combine and stack modules in many ways. SafeGear and Advance switchgear are constructed from a family of 36-inch wide modules that are stackable to a total height of 95 inches. While the standard depth for both types of switchgear is very compact at 85 inches, various front and rear extensions provide extra depth to meet special requirements. Both SafeGear and Advance are extendable to the rear for additional cable termination space and other special needs.

Frame Style	Frame Dimensions INCHES (mm)						
	Width per Frame	Indoor*		Outdoor Non Walk-In		Outdoor Single Row Walk-in	
		Height**	Depth	Height	Depth	Height	Depth
SafeGear Standard	36 (914)	95 (2413)	85 (2159)	Not Available		124 (3150)	186 (4724)
Advance Standard				122 (3099)	111 (2819)		
Advance Front Extended			95 (2413)		121 (3073)		196 (4978)
SafeGear and Advance Rear Extended			92 (2337)		118 (2997)		193 (4902)
Advance Front and Rear Extended			102 (2591)		128 (3251)		203 (5156)

* A one inch dress panel is added to each end of a SafeGear or Advance lineup.

** Add 7.5 inches (190 mm) for ventilation hoods on 2000 A and 3000 A systems.

When necessary, Advance is also extendable to the front, to accommodate protective relays and instruments on primary compartment doors. Note that ABB recommends that all instruments be mounted on isolated low voltage panels.

Module Weights

The weight of a switchgear frame can be calculated from the base weights of its modules given in the table below. Module weights include typically required connection parts or other functionally required components. The weight of the circuit breaker module includes bus jumps and risers, even though they are located in other compartments. The CPT fuse compartment includes the weight of a three-phase 75 kVA CPT, which is typically installed in the cable compartment. Weights are given for indoor construction.

Module	Module Height inches (mm)	Circuit Rating A	Advance Weight lbs (kg)	SafeGear Weight lbs (kg)
ADVAC Circuit Breaker	N/A	1200	450 (204)	450 (204)
		2000	525 (238)	525 (238)
		3000	575 (261)	575 (261)
AMVAC Circuit Breaker	N/A	1200	400 (182)	400 (182)
		2000	425 (193)	425 (193)
		3000	600 (273)	600 (273)
Circuit Breaker Module (including bus risers, jumps and supports)	38 (965)	1200	516 (234)	549 (249)
		2000	730 (331)	763 (346)
		3000	1050 (476)	1083 (491)
Low Voltage Module (empty, not including wiring, controls and instruments)	19 (483)	N/A	140 (64)	140 (64)
	38 (965)		208 (94)	208 (94)
	57 (1448)		278 (126)	278 (126)
Bus and Cable Module (including shipping base, rating is for main bus)	95 (2413)	1200	658 (298)	746 (338)
		2000	787 (357)	875 (397)
		3000	1307 (593)	1395 (633)
Drawout VT Module (including 3 VTs)	19 (483)	N/A	487 (221)	487 (221)
	38 (965)		837 (380)	837 (380)
Drawout CPT Module (including removable 15 kVA CPT)	38 (965)	N/A	1140 (517)	1325 (601)
Drawout CPT Fuse Module (including removable fuses)	38 (965)	N/A	520 (236)	705 (320)
Auxiliary Module, front and rear (rating is for main bus)	N/A	No Bus	1178 (534)	1266 (574)
		1200	1309 (594)	1397 (634)
		2000	1438 (652)	1526 (692)
		3000	1958 (888)	2046 (928)
Front Extension, per frame	N/A	N/A	60 (27)	N/A
Rear Extension, per frame	N/A	N/A	36 (16)	40 (18)
End Panels, per lineup	95 (2413)	N/A	360 (163)	1000 (454)

The following weights are independent of switchgear construction:
Circuit breaker lift truck: 500 lbs. (227 kg)
Stationary three-phase CPT, 75 kVA: 2000 lbs. (907 kg)

Typical Frame Weights Calculation

To calculate the weight of a frame, identify the current rating for each module. Select the weights from the appropriate column in the table below for arc-resistant or conventional construction.

A frame consists of one bus and cable module and the appropriate circuit breaker and auxiliary modules. The weight of the circuit breaker is given separately and must be added. Per frame adders apply for front and rear extensions.

Low voltage modules may contain significant amount of secondary equipment and wiring. Depending on the extent of secondary protection and control equipment, ABB recommends adding 20% to 50% of the empty weight of the module.

The weight of the end panels has to be considered per lineup of switchgear. Weights given are for two end panels, one on each end of the switchgear lineup.

Typical frame weights are listed below. Detailed drawings for the arrangements are located at the end of this section. Weights include all modules and components as listed above.

Frame Style	Circuit Breaker Rating	Advance Weight lbs (kg)	SafeGear Weight lbs (kg)
One Circuit Breaker	1200	1902 (863)	2023 (918)
	2000	2320 (1052)	2441 (1107)
	3000	3210 (1456)	3331 (1511)
Two Circuit Breakers	1200/1200	2859 (1297)	3013 (1367)
	1200/2000	3148 (1428)	3302 (1498)
One Circuit Breaker, One VT	1200	2319 (1052)	2440 (1107)
	2000	2737 (1241)	2858 (1296)
	3000	3627 (1645)	3748 (1700)
One Circuit Breaker, Two VTs	1200	2738 (1242)	2859 (1297)
	2000	3156 (1432)	3277 (1486)
One Circuit Breaker, One VT	1200	2904 (1317)	3210 (1456)
	2000	3322 (1507)	3628 (1646)
One Circuit Breaker, One CPT Fuse	1200	2284 (1036)	2590 (1175)
	2000	2702 (1226)	3008 (1364)

Civil Engineering

The drawing on the next page details minimum recommended distances to ceilings, walls or other equipment for indoor installation. Where power cables enter the switchgear at the top, the values refer to the distance between the top of switchgear and the cable tray.

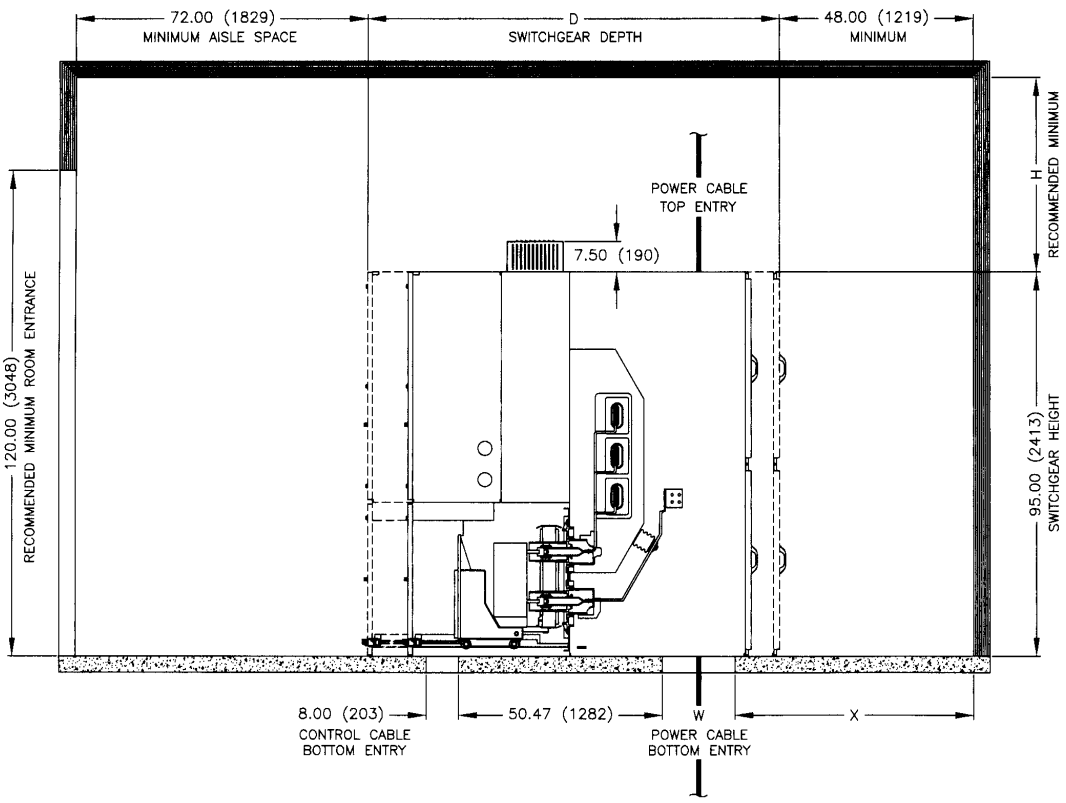
The next table provides recommendations for the minimum distance to the ceiling for SafeGear installations. The recommended height depends on the switchgear rating, and is intended to establish a height at which the pressurized gases will not be deflected on nearby equipment and personnel.

If the recommended height is not practical for a specific installation, a plenum can be mounted across the top of the switchgear to collect and control the exhaust gases from an arc fault, and to safely vent those gases out of the building. This practice reduces the overhead clearance requirements and provides other valuable benefits. Contact the factory for specific application information.

Installation expertise is required to properly install and commission arc-resistant metal-clad switchgear. Consult with the factory for assistance.

Interrupting Rating	Recommended Minimum Distance to Ceiling (H)* Inches (mm)
SafeGear, 25 kA	48 (1220)
SafeGear, 36 kA	72 (1829)
SafeGear, 50 kA	96 (2432)

* Maintain approximately four feet from the top of the equipment to any obstruction.



Typical Civil Engineering Dimensions Inches (mm)			
Frame Style	**Depth D**	**Opening W**	**Distance X**
SafeGear Standard	85 (2159)	18 (457)	59 (1499)
Advance Standard			
Advance Front Extended	95 (2413)		
SafeGear and Advance Rear Extended	92 (2337)	25 (635)	52 (1321)
Advance Front and Rear Extended	102 (2591)		

Indoor and Outdoor Enclosures

Both SafeGear and Advance are available in a choice of indoor or outdoor enclosures. All types of enclosures offer the flexibility of one-high or two-high construction.

Standard indoor construction meets the requirements of ANSI and IEEE standards and complies with NEMA 1 criteria. The extensive application of gaskets and flaps, inherent in SafeGear's arc-resistant construction, result in an indoor enclosure that is similar to NEMA 12. Advance metal-clad switchgear can also be supplied with optional gaskets on doors and panels. This minimizes exposure to dust and contaminants, resulting in less frequent requirements for maintenance and cleaning.

Non Walk-in and Single Row Walk-in Designs

Outdoor switchgear is available in weatherproof non walk-in or single row walk-in arrangements. Non walk-in enclosures use double access door construction, gaskets and a separate, sloped roof. This type of outdoor construction provides the most compact footprint.

Single row walk-in construction also offers an economical approach for outdoor installations, incorporating the many features of non walk-in construction with a pre-assembled front aisle and personnel access doors.

Both non walk-in and single row, aisle type switchgear have rear doors that provide direct access to the cable compartment from the exterior. Rear doors are weatherproof and can be individually padlocked.

Outdoor, non walk-in enclosure. A separate, sloped roof and overhangs protect from precipitation.

Outdoor, single row walk-in enclosure. Front aisle provides space for convenient operation and inspection protected from weather. Shipping section includes assembled aisle, minimizing field installation work.

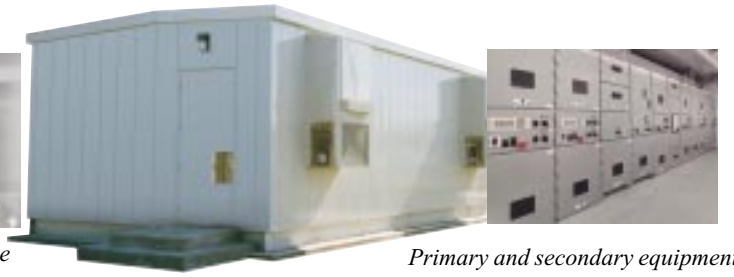
Power Distribution Center

Power Distribution Centers (PDCs) are prefabricated, modular, skid-mounted enclosures for switchgear and auxiliary equipment such as batteries, SCADA systems and unit substation transformers. A plenum installed on SafeGear arc-resistant switchgear provides a path for arc propagation outside the building, protecting personnel, equipment and the PDC itself in the event of an arc fault.

As a self-contained unit, the PDC and all enclosed equipment are completely coordinated, assembled and tested in a controlled factory environment. This offers many advantages over conventional types of outdoor switchgear construction:

- Single source responsibility and accountability
- Reduced installation and ownership costs
- Application flexibility for a variety of equipment types, operating environments and changing system requirements.

Plenum provides an escape route for gases and protects people, equipment and the PDC.



Primary and secondary equipment, including control systems, installed in a PDC for turnkey delivery of a unit substation.

Accessories

The accessory group for SafeGear and Advance metal-clad switchgear and the ADVAC and AMVAC circuit breakers includes a complete array of required and optional special tools for proper handling, operation and maintenance. For maximum convenience, all withdrawable assemblies - circuit breakers, VTs, CPTs and fuses - use the same accessories. Required accessories include a handle for manually charging the circuit breaker operating mechanism and a racking crank for inserting and removing primary assemblies. A standard 16 mm socket wrench with a swivel adapter can be conveniently used for racking.

Lift Truck

A lift truck is required for all primary devices. The lift truck docks with the switchgear, allowing a primary device to be raised or lowered to the appropriate height and safely rolled into the compartment. The lift truck has wheels for easy maneuvering in restricted aisle space that is common to switchgear installations. A motor lift is available as an option. For one high construction without VTs, ramps can be supplied, eliminating the need for a breaker lift truck. The lift truck is not needed for slide rail VTs.

Test Jumper

A test jumper is an extension cord. It allows the connection of secondary contacts on a circuit breaker to the switchgear, while outside a breaker compartment. This enables the breaker to be electrically operated using controls in the switchgear, or electrically charged after manual operation of the breaker in a switchgear aisle.

Test Cabinet

A test cabinet is a wall-mounted control cabinet connected to a separate power source, containing switches to open and close a breaker. The test cabinet has a female connector and an umbilical cord (stored inside the cabinet) for connection to the breaker, and serves as an aid to breaker inspection and maintenance in switchgear aisles or work areas.

Ground and Test Devices

A Ground and Test (G&T) device is a drawout assembly compatible with circuit breaker compartments. The G&T provides a means to select and test primary circuits in a controlled manner, then connect de-energized primary circuits to the switchgear ground bus to support maintenance activity. The racking system of the grounded G&T device can then be padlocked or Kirk Key interlocked in the "Connected" position in accordance with lock-out and tag-out safety procedures.

Dummy Circuit Breakers

A dummy breaker is a no-load disconnect device, similar to a drawout circuit breaker, but without an operating mechanism, controls or interrupters. It provides a three-phase short circuit current path between upper and lower terminals, and usually serves to isolate entire switchgear lineups or specific loads for maintenance work. Dummy devices do not have load interrupting capability, and must be Kirk Key interlocked with the switchgear power source to prevent racking when primary circuits are energized.

Slow Close Device

The slow close device for ADVAC breakers allows the contacts inside the vacuum interrupter to be closed manually in a controlled manner. By measuring the point where continuity between contacts is achieved, the amount of contact wear and contact spring compression ("wipe") can be determined.

Electric Racking Device

The Electric Racking Device is a portable, remote racking device for Advance and SafeGear switchgear. It allows the customer to remotely rack an ADVAC or AMVAC circuit breaker at distances of 10 to 20 feet.

This product has been certified by ABB Group as Industrial IT Enabled™ - Information Level 0. All product information is supplied in interactive electronic format, based on ABB Aspect Object™ technology. The Industrial IT commitment from ABB ensures that every enterprise building block is equipped with the integral tools necessary to install, operate, and maintain it efficiently throughout the product lifecycle.

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