
TECHNICAL AND APPLICATION GUIDE

SafeGear®

5/15 kV, up to 50 kA arc-resistant
switchgear



SafeGear is ABB's ANSI arc-resistant metal-clad switchgear line for short circuit currents up to 50 kA at rated maximum voltages of 5 and 15 kV

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General overview

SafeGear® 5/15 kV, up to 50 kA arc-resistant switchgear

SafeGear is ABB's ANSI arc-resistant metal-clad switchgear line for short circuit currents up to 50 kA and below at rated maximum voltages of 5 and 15 kV.

Certifications

SafeGear arc-resistant metal-clad switchgear is seismic certified to IBC region D with importance factor of 1.5. The manufacturing location for SafeGear is ISO 9001 certified. SafeGear switchgear is available with UL label or as a CSA certified lineup.

Applicable standards

SafeGear is built and tested per IEEE C37.20.2 metal-clad switchgear construction standards and tested per IEEE C37.20.7 for arc-resistance.

Arc-resistant accessibility types

Per NFPA 70E 2015 edition, Table 130.7(c)(15)(A) (a), arc-flash PPE is not required for arc-resistant switchgear tested in accordance with IEEE C37.20.7 for racking of circuit breakers, the ground and test device or the voltage transformers as long as the following is true: clearing times are less than the rated arc-duration with the prospective fault current not to exceed the arc-resistant rating of the equipment, the equipment is properly maintained and installed, all equipment doors are closed and secured, all covers are in place and secured, and there is no evidence of impending failure. Please see the NFPA 70E standard for more information including definitions for properly installed, properly maintained and evidence of impending failure. For 2B accessibility types, the instrument door is allowed to be open, but all other doors must be closed and secured and all other covers must be in place and secured.

Definitions are per IEEE C37.20.7 test guide.

- Type 2: Front, sides and rear protection with all doors closed
- Type 2B: Front, sides, rear and LV compartment. LV compartment door can be open. All other doors must be closed.
- Type 2C: Front, sides, rear and between adjacent compartments and sections within a lineup

- Type 2BC: Front, sides, rear, LV compartment and between adjacent compartments and sections within a lineup
- SafeGear is offered in accessibility types 2, 2B, 2C and 2BC.

Construction

SafeGear is manufactured of hem bent, 14-gauge galvanized steel for superior rust and scratch protection. All non-galvanized steel parts are treated and painted ANSI 61 gray. SaferGear's modular and bolted frame design with 19, 38, 57 or 95-inch compartment sizes, provides highly flexible design configurations and faster field changes to reduce downtime.

Outdoor enclosures

SafeGear can be supplied in outdoor sheltered-aisle enclosures or PDC (power distribution center) enclosures.

Breakers

The SafeGear platform uses AMVAC and ADVAC breakers. More details, including detailed ratings tables, timing tables and power requirements can be found in the AMVAC Breaker Technical Guide (1VAL050601-TG) and ADVAC Breaker Technical Guide (1VAL050501-TG).

Instrument transformers

SafeGear switchgear is available using SAB-1, SAB-1D, SAB-2 and SAB-2D CTs. Up to four SAB-1 and SAB-2 CTs can be fitted per phase. Higher accuracy SAB-1D and SAB-2D CTs are limited to two CTs per phase. SAB-2 and SAB-2D current transformers are used for 3000 A breakers. For ground CT requirements, SafeGear is available utilizing BYZ-S, BYZ-O or BYZ-L ground CTs. The type of CT is chosen based on the necessary window size required for cables and cable bending.

For 5 kV applications, SafeGear switchgear utilizes ABB VIY-60 potential transformers. For 15 kV applications, SafeGear uses ABB VIZ-11 and VIZ-75 PTs. All PTs are available in wye-wye, open delta, line to line and line to ground connections.

Rating tables and additional details for all instrument transformers can be found in the Switchgear Components and Accessories Technical and Applications Guide (1VAL104601-TG)

SafeGear ratings*

Characteristic	Unit	Rated maximum voltage level		
		5 kV	8.25 kV	15 kV
Rated nominal voltages	kV	2.4, 4.16, 4.8	4.8, 6.9, 7.2	6.9, 7.2, 8.4, 11, 12, 12.47, 13.2, 13.8, 14.4
Main bus continuous current	A	1200, 2000, 3000, 4000**		
Short term current (rms)	kA	25, 31.5, 40, 50		
Rated frequency	Hz	60***		
Low frequency withstand (rms)	kV	19	36	36
Impulse level (BIL,crest)	kV	60	95	95

* Ratings given are for service conditions within temperature and altitude limitations as defined by IEEE C37.20.2-2015 metal-clad standard.

** 4000 A is forced-air cooled.

*** Contact factory for 50 Hz applications

Accessories

SafeGear switchgear is available with the following accessories:

- Breaker accessory kit including breaker, PT and CPT, racking handle, and lifting yoke
- Lift truck
- Test cabinet and test jumper
- SmartRack™ remote racking device
- Electrically operated ground and test device
- Manually operated ground and test device

Testing

SafeGear is design tested per IEEE C37.20.2 and includes the following production tests:

- One second dielectric test of 1800 VAC for control circuits
- Control circuit verification
- Instruments energized via the low voltage winding of instrument transformers and operated through ratings ranges.
- Mechanical check for breaker alignment and interlock verification
- Power frequency withstand test from phase to phase and phase to ground
- Static circuit check
- Relays checked for proper performance characteristics
- Ratio and interconnection check for potential transformers
- Polarity verification for current transformers

Factory witness testing is also available on request.

Options

- Mechanical options
 - Tin plated bus
 - Mimic bus
 - Cable supports
 - Mechanical trip on breaker doors
 - IR windows (IRISS or Fluke)
 - Asset health monitoring of PD, bus temp, and humidity
 - REA or UFES active arc protection
- Electrical options
 - Separate or common pull-out fuse block or molded case circuit breaker for trip and close coil protection
 - Maximum 20% spare terminal blocks
 - Phase bus marking labels
 - Instrument door ground strap
 - 12 or 10 AWG CT wiring

Configuration software

Medium Voltage Pro (MVP) has been developed to be a switchgear design tool and helps design offices in creating a switchgear lineup including front elevations and floor plans. A version of this software is available for consultants and designers.

Please contact your local ABB representative for more information.

Other reference documents

Document	Document Number
SafeGear Descriptive Bulletin	1VAL108001-DB
SafeGear Flyer	1VAL108004-FL
Installation, Operation and Maintenance Manual for SafeGear	1VAL108001-MB
ADVAC Breaker Technical Guide	1VAL050501-TG
AMVAC Breaker Technical Guide	1VAL050601-TG
Switchgear Components and Accessories Technical Guide	1VAL104601-TG
Plenum Application Guide	1VAL104602-TG
REF615 Feeder Protection Relay Product Guide	1MAC105361-PG
REF620 Feeder Protection Relay Product Guide	1MAC506635-PG
REM615 Motor Protection Relay Product Guide	1MAC251744-PG
REM620 Motor Protection Relay Product Guide	1MAC609372-PG
RET615 Transformer Protection Relay Product Guide	1MAC204375-PG
RET620 Transformer Protection Relay Product Guide	1MAC554110-PG
REA Arc Fault Protection System Product Guide	1MRS756449

Arrangement rules

- Every lineup must contain at least one (1) 57-inch instrument compartment for every seven (7) frames in order to provide a path to the plenum for arc ventilation.
- 2000 A lineups require at least one (1) 57-inch instrument compartment for every two (2) 2000 A breakers in order to provide a path to the plenum for heat ventilation
- CPTs greater than 15 kVA single-phase require a draw-out fuse unit with stationary mounted CPT.
- 4000 A breakers must have located, in their own frame, a 57-inch instrument compartment directly above the breaker.

Construction

Doors

SafeGear front doors consist of the breaker compartment, auxiliary unit compartments and LV compartments.

—
01 Bolted doors

—
02 Multi-point latch doors

These doors are provided standard as bolted doors for 10-cycle, Type 2, 2B, 2C and 2BC with a multi-point latch (MPL) version as an option. For 0.5s arc duration, all doors are MPL type only. Doors with MPL utilize two viewing windows while bolted doors have only one. All doors are hinged on the left as standard (when facing the doors). Right-hand hinged doors are available as an option.

Rear doors on the SafeGear product are used to access the high voltage cable compartments. These doors are available in the following configurations:

- Split doors (top compartment/bottom compartment) hinged and bolted
- Bolted, non-hinged split doors are also available as an option

All front and rear doors are constructed using 12-gauge painted steel.



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Padlock provisions are available on all front and rear doors. These padlock provisions are used to lock the door closed to prevent access inside the compartment. On breaker compartment doors, padlock provisions are also supplied on the racking release lever, to prevent racking of the breaker.

Breaker and auxiliary unit doors include viewing windows used for observing the position and status of the components inside the compartment with the door closed. These doors can also be provided with the SmartRack mounting provisions for remote racking applications.

Due to the small footprint design, installation of protection and control devices on the breaker and auxiliary unit doors are not possible.



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Compartment types

Circuit breaker compartment

SafeGear circuit breaker compartments are designed for maximum operator safety by providing viewing windows and automatic latching, three-position closed door racking.

The circuit breakers have self-aligning, fully automatic primary and secondary contacts allowing operators to keep the door closed throughout the entire racking operation, which maintains the arc-resistant protection of the switchgear. These features make SafeGear easy to install, operate and maintain while making safety a priority.

Unique racking system and interlocks

The racking system is unique and features a three-position closed door system for all circuit breakers. The racking mechanism is integral to the circuit breaker, so all moving parts can be inspected and maintained outside the circuit breaker compartment and away from energized primary parts. A solid stationary ground contact engages the grounding contact of the circuit breaker prior to the coupling of both the primary and secondary contacts and is continuous during the racking operation.

The three racking positions are defined as follows:

- Disconnected: primary and secondary (control) contacts are disengaged
- Test: primary contacts are disengaged; secondary (control) contacts are engaged for in-cell breaker testing
- Connected: primary and secondary (control) contacts are engaged

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

Secondary disconnect system

A dual (50-pin) self-aligning secondary disconnect for control circuitry is provided as a standard feature. The female portion resides in the circuit breaker module. The secondary contacts are recessed and are touch safe. No manual connection of secondary contacts is required.

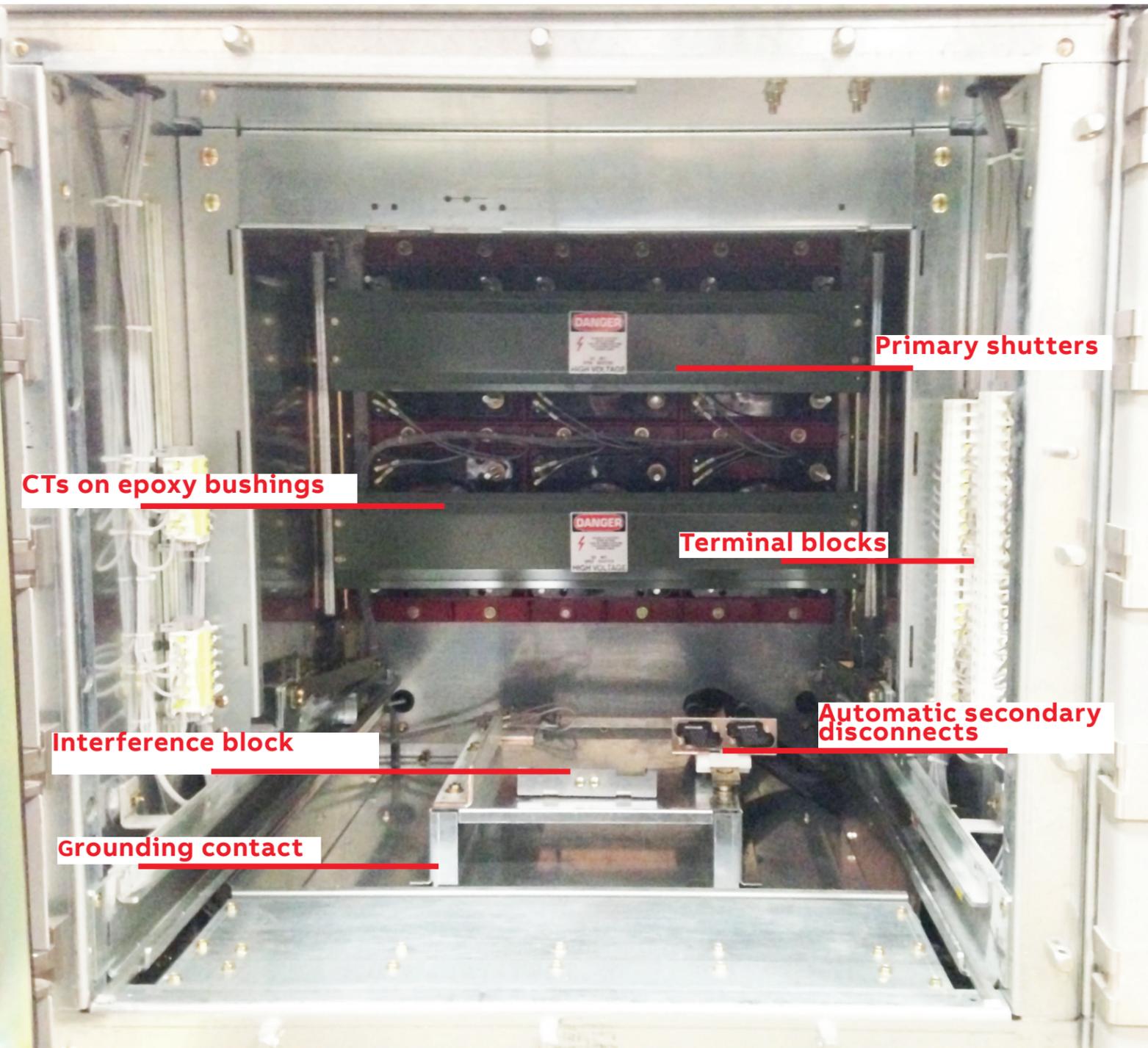
Primary shutters

Primary shutters automatically cover the primary contacts when the breaker is not in the connected position. The shutters may be grounded metal or optional Lexan material. Primary shutter opening and closing is forced by the circuit breaker movement, rather than relying on springs or gravity. An integral interlock prevents opening of the shutter when the circuit breaker is removed, and can be padlocked for added safety.



CIRCUIT BREAKER COMPARTMENT

Grounded metal barriers cover the terminal blocks located on the side. These barriers have been removed in this photo.



Compartment types

Auxiliary modules

- 01 Delrin primary probe and recessed contact assembly
- 02 PT drawout assembly with three voltage transformers - the fuses can be removed without removing the PT truck from the rails

PT/CPT/Draw-out fuse compartments

Similar to breaker compartments, potential transformer, control power transformer and draw-out fuse compartments are inserted via an automatic latching insertion mechanism which allows for closed door insertion of auxiliary equipment. The cell interface uses the same components as the circuit breaker module and is compatible with ABB's remote racking device, the SmartRack. Secondary contacts engage/disengage automatically and interlocks ensure proper operation where applicable.

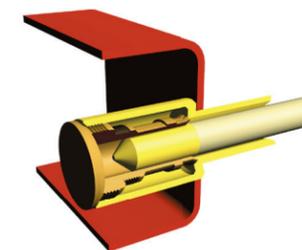
All primary auxiliary compartments, including potential transformers, control power transformers and draw-out fuse compartments, use arc-quenching Delrin® technology for primary contact assemblies (Delrin® is a registered trademark of DuPont). A Delrin® tipped conductor probe is inserted into a Delrin® receptacle with recessed contacts. During load break, localized heating of the Delrin® material due to arcing causes the material to release an inert gas which fills the small isolating gap to contain the arc and extinguish it safely.

The PT drawout units can be withdrawn beyond the front of the frame via integral rails, which allow easy access to the fuses for inspection or replacement.

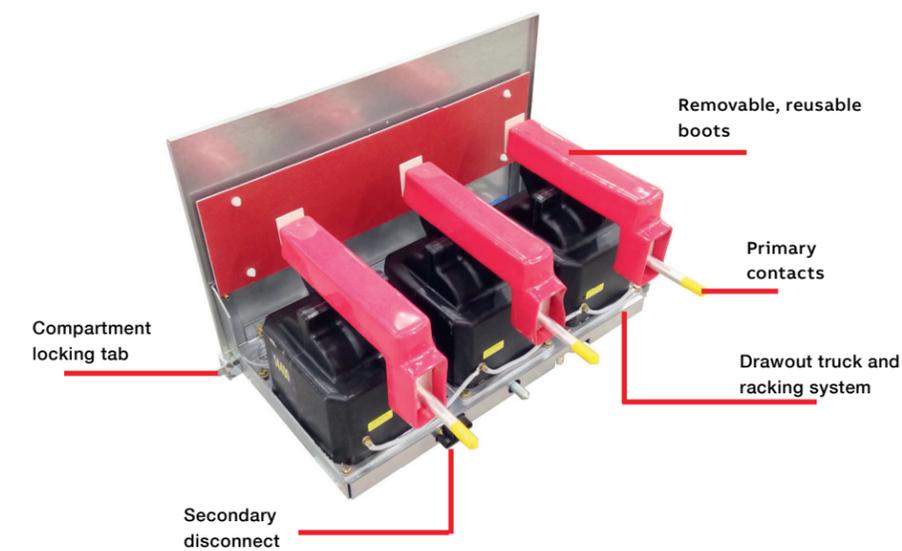
Control Power Transformer (CPT) and Draw-out fuses

CPT modules provide convenient mounting and operation of single-phase control power transformers in ratings up to 15kVA, 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. Fuse modules are provided with stationary control power transformers in ratings up to 75 kVA three-phase or 50 kVA single phase. Fixed mounted CPTs can be mounted in the rear lower cable compartment or at a remote location.



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Compartment types

Instrument compartment

— 01 Low voltage instrument module isolated for maximum safety when working with low voltage circuits

— 02 Low voltage cabinet door panel 19"

ABB mounts all protection and control devices in a dedicated low voltage compartment. Each low voltage instrument compartment is completely isolated and segregated from high-voltage components which ensures the safety of the operations and maintenance personnel while they work on control and auxiliary circuits.

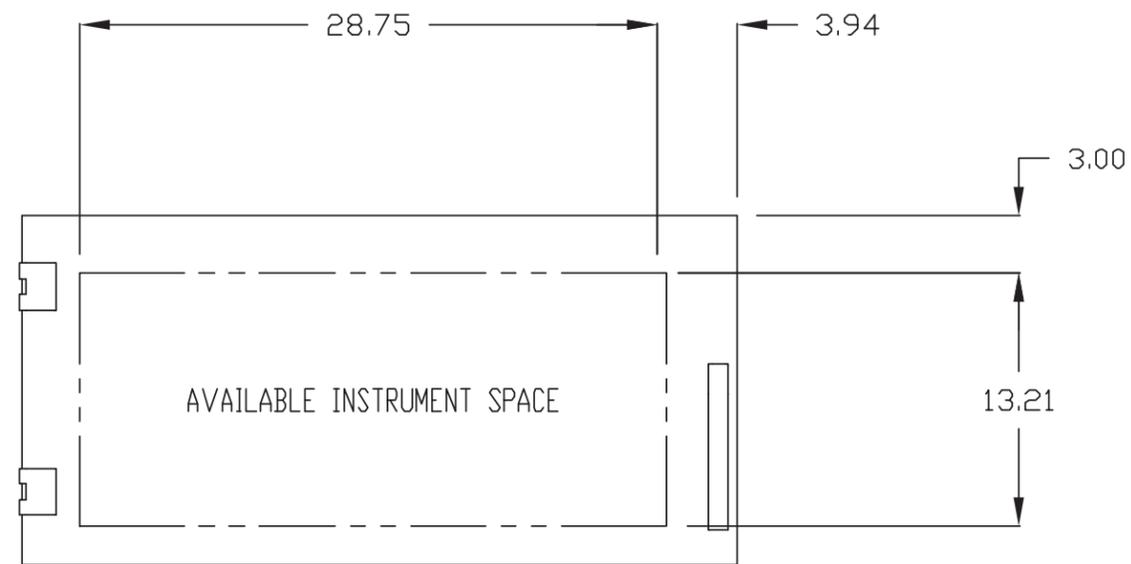
Plastic enclosed wireways are used to provide protection for the wiring, as well as a neat and organized appearance. This allows for easy addition of wiring, should it be needed.

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

Frame-to-frame interconnect wiring is achieved through openings located in the rear of the LV compartment. Each opening is 3" x 4" and provided with edge guard to ensure wires do not run over sharp edges.



— 01



LVC 19"

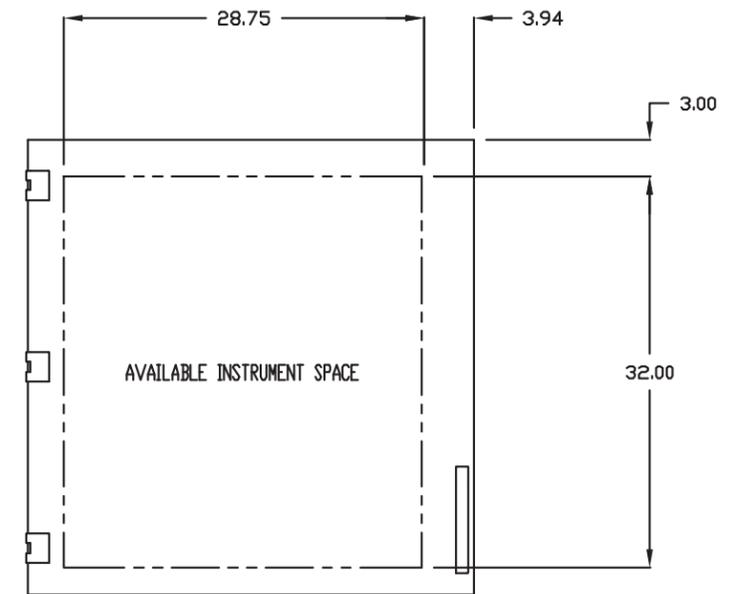
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Compartment types

Instrument compartment

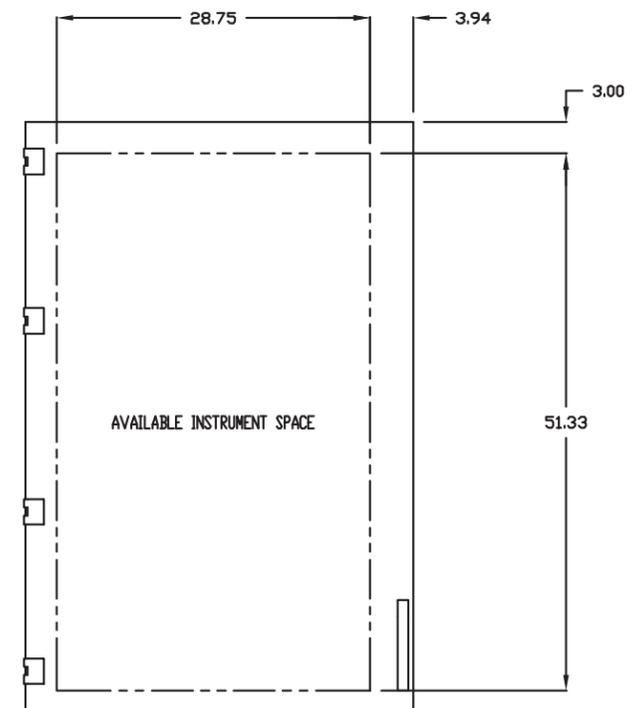
— 01 Low voltage door panel 38"

— 02 Low voltage cabinet door panel 57"



LVC 38"

— 01



LVC 57"

— 02

Compartment types

Bus compartment

Main bus compartment

All primary buses are copper with a corona-free design, and are available in 1200, 2000, 3000 and 4000 A ratings (4000 A rating achieved by forced air cooling). The bus is silver-plated at joints and bolted together with a minimum two (2) half-inch SAE grade 5 bolts. Proper torque is verified by calibrated tools for both safety and optimum performance. The main bus is not tapered and is easily extended at both ends to facilitate future expansions.

The bus is epoxy insulated with an advanced powder coating 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 risers, the connections from stationary primary contacts to the main bus and runbacks the connections from the stationary primary contacts to line or bus terminations. Internal standoffs and inter-frame supports are polyester for 1200 A and 2000 A applications, porcelain for 3000 A applications, and epoxy for 4000 A applications. Porcelain bus supports are available as an option.

SafeGear arc-resistant, metal-clad switchgear design certifications are based on both polyester and porcelain primary bus supports. Separate drawings are available to indicate the position and dimensions of the compartment-mounted primary contact supports, inter-frame horizontal bus supports, and standoff insulators.

Characteristic	Epoxy specification
Flexural strength, psi	17,400-21,700
Tensile strength, psi	10,150-13,050
Impact strength, ft-lb/in ²	4.75-7.15
Thermal class	F
Dielectric strength (short time), V/mil	> 580

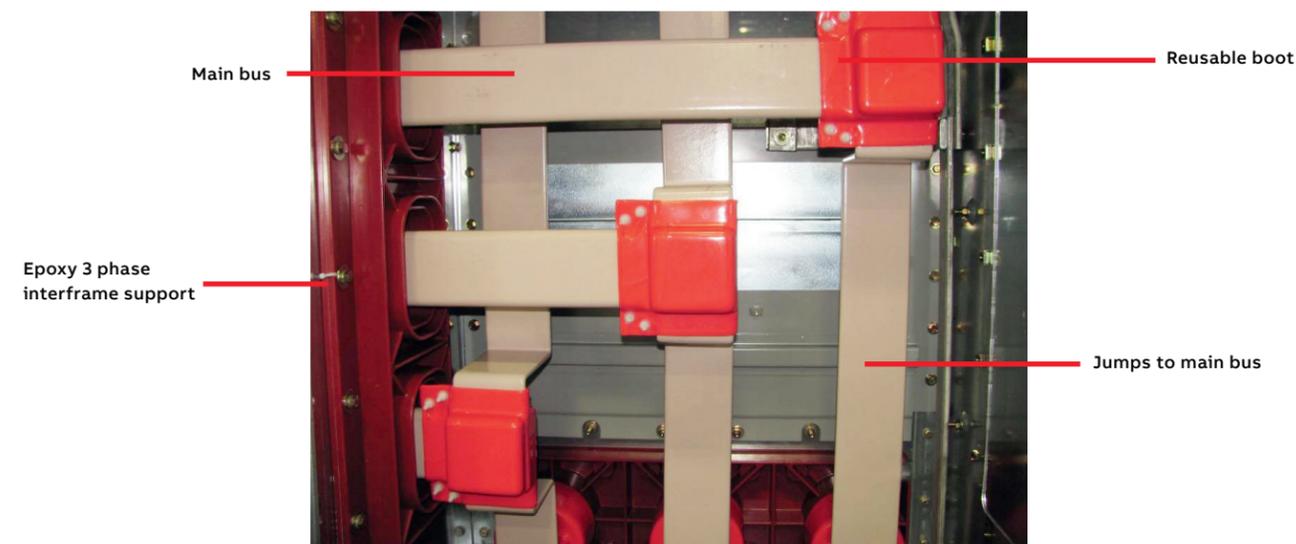
Characteristic	Glass polyester	Porcelain
Flexural strength, psi	15,000-27,000	10,500
Tensile strength, psi	14,000	6,000
Izod impact, ft-lb per inch of notch	6-12	1.5
Thermal shock, cycles 32°- 2300°F	100+	1
Dielectric strength (short time), V/mil	350-375	300
Dielectric constant	4-6	6

Insulators

	Rating		SafeGear (5/15 kV, 50 kA)
Bus Insulators (Stand off Post Insulators)		Standard	EC-A Epoxy
		Option	Porcelain
CPT Truck Post Insulators		Standard	EC-A Epoxy
		Option	Porcelain
CPT/PT Compartment through Bus Supports		Standard	Glass Polyester
		Option	Porcelain
Main Bus Support Insulator (Inter panel bushing)	1200 A	Standard	Glass Polyester
		Option	Porcelain
	2000A	Standard	Glass Polyester
		Option	Porcelain
	3000A	Standard	Porcelain
		Option	None
	4000A	Standard	EC-A Epoxy
		Option	None
Primary Disconnect Bushing	1200A	Standard	Glass Polyester
		Option	Porcelain
	2000A	Standard	Glass Polyester
		Option	Porcelain
	3000A	Standard	Porcelain
		Option	None
	4000A	Standard	Porcelain
		Option	None

Main bus compartment

Continuous current	Short-circuit rating (kA)	Quantity/phase	Size
1200 A	25, 31.5, 40, 50	1	1/4" x 4"
1200 A	50	1	3/4" x 4"
2000 A	25, 31.5, 40, 50	1	3/4" x 4"
3000 A	25, 31.5, 40, 50	2	3/4" x 4"
4000 A	25, 31.5, 40, 50	2	1/2" x 6"



Compartment types

Cable compartment

— 01 Cable compartment (main bus - cover installed) | Various application designs in cable compartments

The design of the cable compartments for SafeGear provides 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 and bottom connections can also be made to bus duct.

In two-high arrangements with stacked circuit breakers, steel barriers separate the upper and lower cable compartments to isolate the primary circuits. All configurations come standard with lug boots and have the option for cable supports to make field connections more secure.

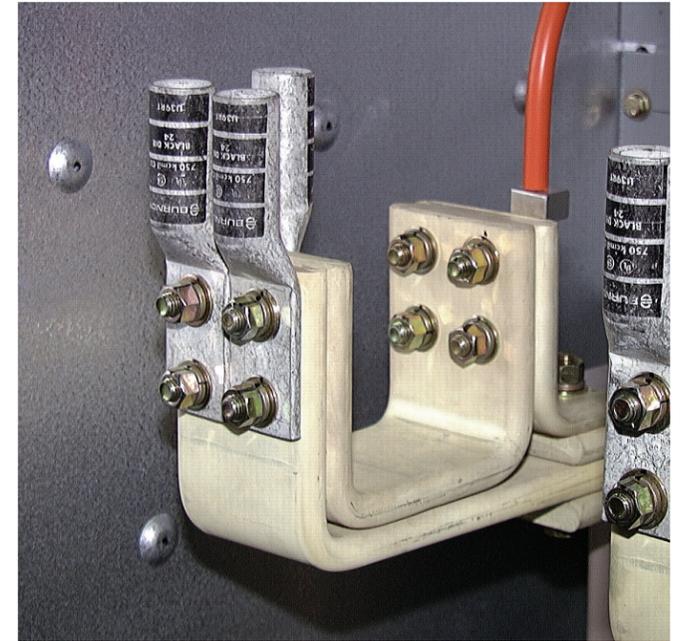
Cable compartments are available with optional readily accessible zero sequence (ground sensor) current transformers, surge arrestors or capacitors and/or ground studs on the bus risers. When a draw-out fuse compartment is installed in the front of the switchgear, the rear cable compartment offers room for a large three-phase floor-mounted control power trans-

former up to 75 kVA, 3-phase or 50 kVA single phase.

Primary cable compartments are provided with removable, non-painted stainless steel cover plates used to install conduit or cable sealing glands. 12-gauge type 304 stainless steel is used in SafeGear for the cover plates. Cover plates are required for top and bottom of the cable compartment. All conduit/cable entries must be sealed to prevent arc-faults from leaking through the installation at the cover plates. ABB recommends the use of sealing glands for all primary cables to ensure arc-resistant design integrity is not compromised.

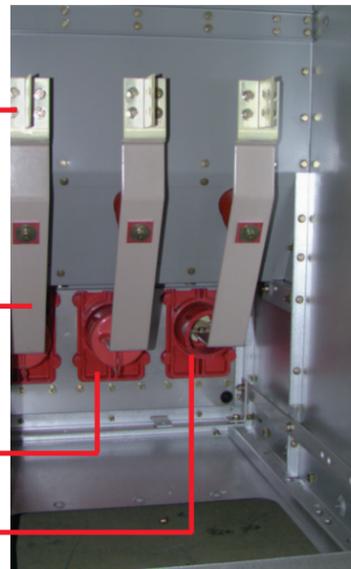


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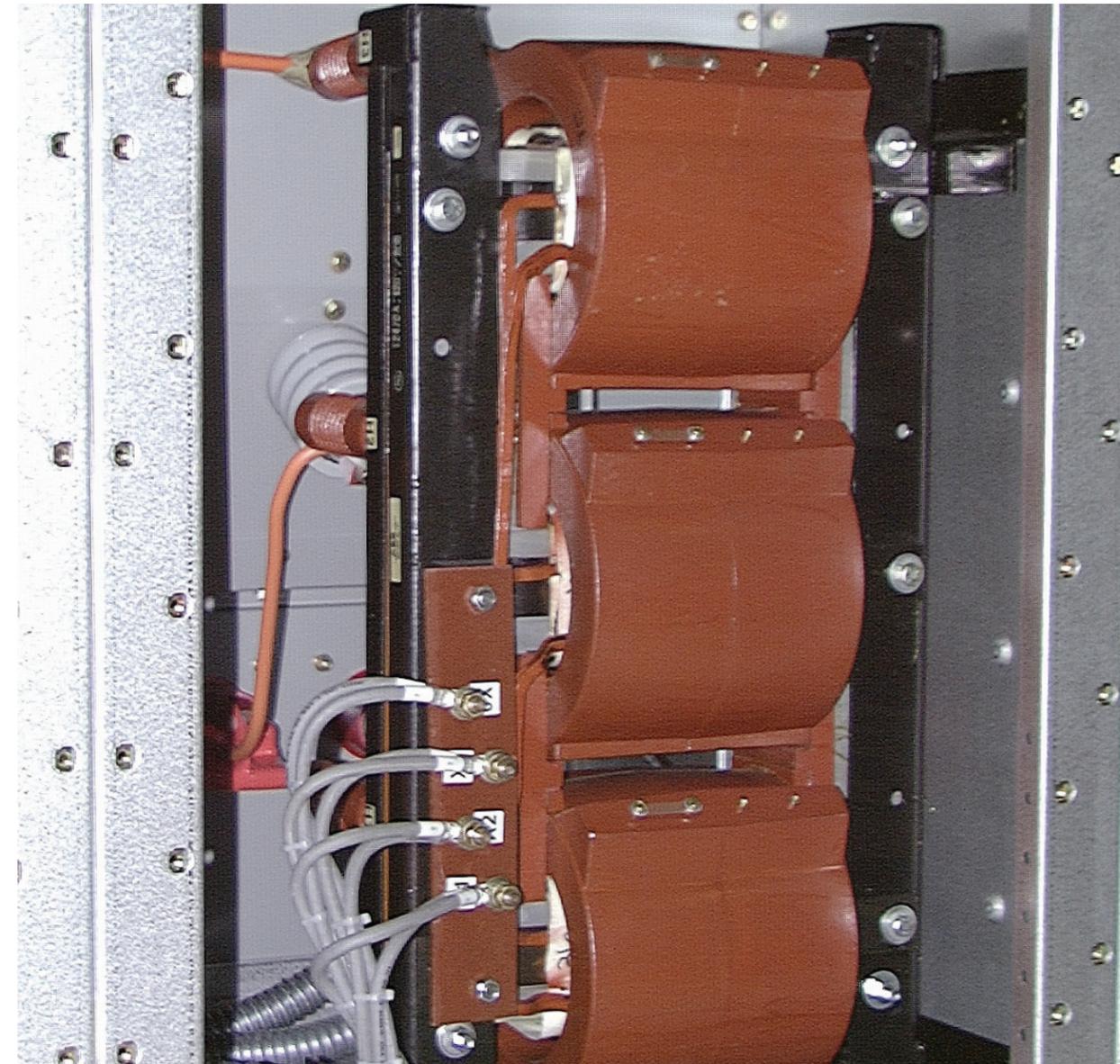
— 02

Cable lug adapters
Riser bus
Reusable boot
Plated joint, boot removed



36" minimum space for cable terminations

— 01 Surge arrestors
— 02 Connection of up to eight cables per phase (three cable lugs shown). Contact factory for more than eight cables per phase requirements.
Larger CPT specs available. Contact factory if larger sizes are needed.
— 03 Large fixed-mount CPT up to 75 kVA 3-phase or 50 kVA single-phase



— 03

Arc chamber and plenum

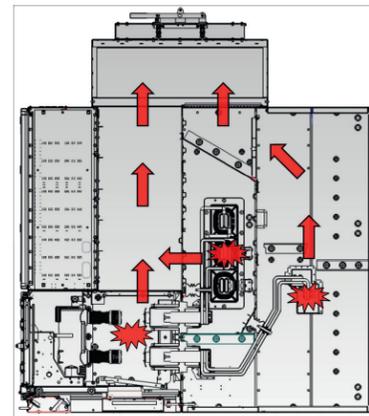
- 01 Arc exhaust flowing through a typical frame of switchgear
- 02 Arc exhaust flow in a typical switchgear lineup

A system of chambers inside the switchgear lineup serves as an exhaust system which vents arc gases away from personnel and the affected cubicle in the case of an arc fault. Vents and flaps are located inside the chamber system which leads to a top-mounted plenum on the enclosure. Once inside the plenum, the gases and pressure are directed to an area outside the building and away from personnel and other equipment. The plenum sections feature external flanges for ease of bolting sections together during installation. ABB developed this venting system which combines the internal chamber and plenum and holds patents on the construction details of this truly innovative design.

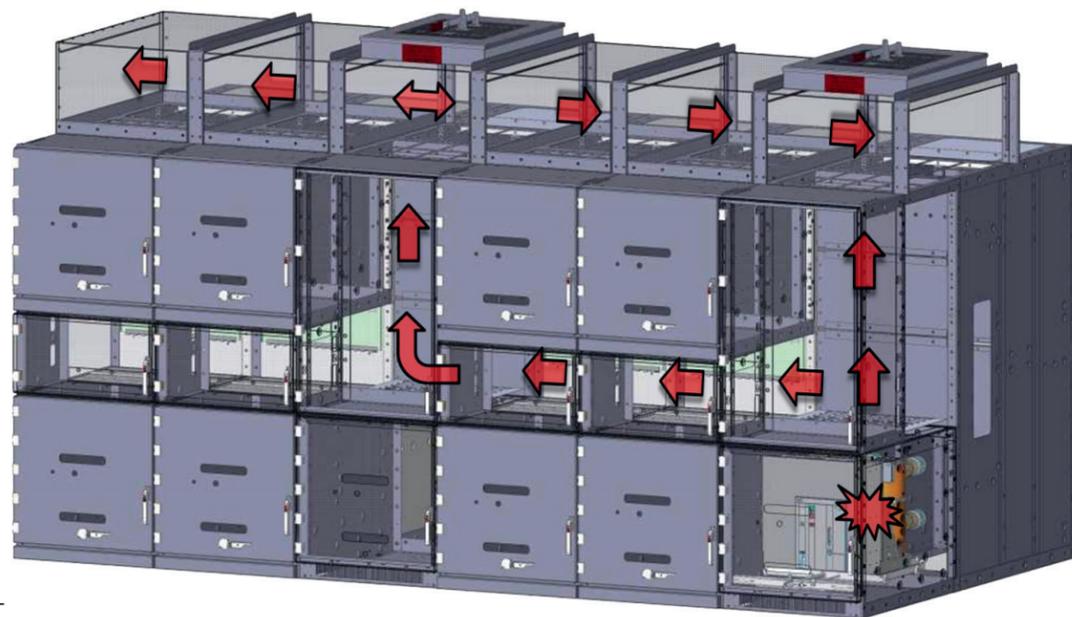
Plenum exhaust clearance requirements

For proper and safe arc fault by-product exhausting, it is recommended that an eight foot cylinder projecting out 15 feet be clear of all objects and personnel at the point where the plenum exits the building. Refer to the Plenum Technical Application Guide, 1VAL1004602-TG, for more details.

Installation expertise is required to properly install and commission arc-resistant metal-clad switchgear. Consult with the factory for assistance. The vent chambers used for channeling arc faults are also used as heat ventilation ducts during normal operating conditions. Ventilation is necessary to ensure equipment will operate within the ANSI standard design temperature limits. These chambers should not be blocked, or otherwise modified to impede the normal flow of air.



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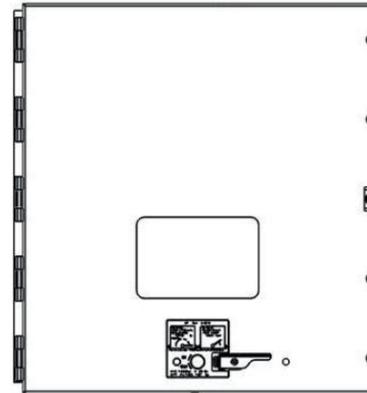
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Front door types

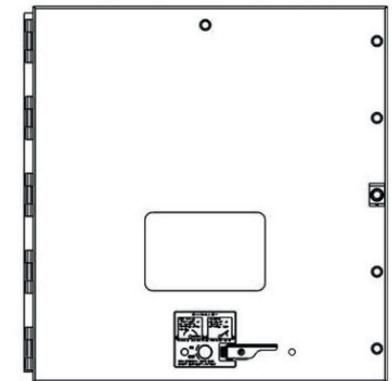
Circuit breaker doors

- 01 For type 2, 2B, 2C and 2BC 10-cycle arc duration only with ratings up to 31.5 kA
- 02 For type 2, 2B, 2C and 2BC 10-cycle arc duration only with ratings of 40 and 50 kA
- 03 For 10-cycle arc duration only with ratings up to 31.5 kA
- 04 Required for 25-50 kA with 0.5s arc duration, type 2/2B only

Bolted breaker door designs

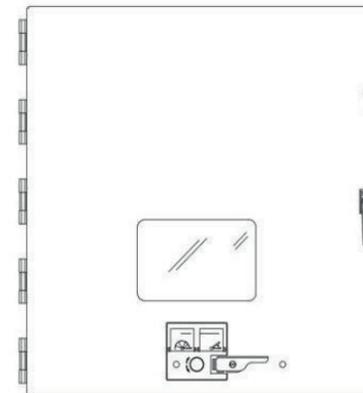


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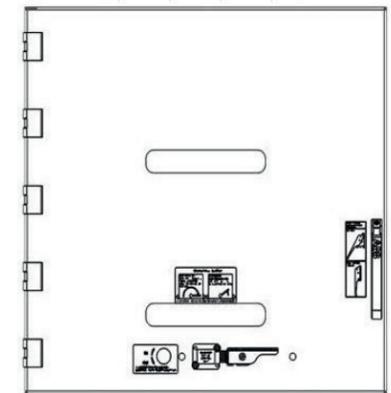


02

Single handle multi-point latch (MPL) breaker door designs



03



04

Notes:

1. Doors in figures 1-3 cannot be used when 0.5s arc duration is required.
2. When MPL breaker doors are supplied (Fig. 3&4), all low voltage instrument compartment doors will be supplied with matching door handles.
3. When bolted breaker doors are supplied (Fig. 1&2), all low voltage instrument compartment doors will be single handle style.
4. PT, CPT and CPT fuse auxiliary unit doors will utilize the same door securing method (bolted vs. MPL) as shown on the breaker doors.
5. When type 2C or 2BC is required, arc duration is limited to 10-cycles and all front doors except low voltage/instrument compartment must be bolted type.

Available frame types

One-high frames

Description

The one-high, bottom mounted device frame consists of a 57-inch instrument compartment stacked over a 38-inch breaker, PT, CPT or draw-out fuse compartment.

Cable termination information

Cable size	# of terms single pad per phase	# of terms bifurcated pad per phase*	GCT option
#2 AWG	4	8	BYZ-S
#4 AWG	4	8	BYZ-S
500 MCM	4	8	BYZ-S
750 MCM	4	8	BYZ-L
1000 MCM (2-hole)	2	4	BYZ-S
1000 MCM (4-hole)	1	2	BYZ-S

* Bifurcated lug pad requires 93.35-inch depth frame

Dimensions

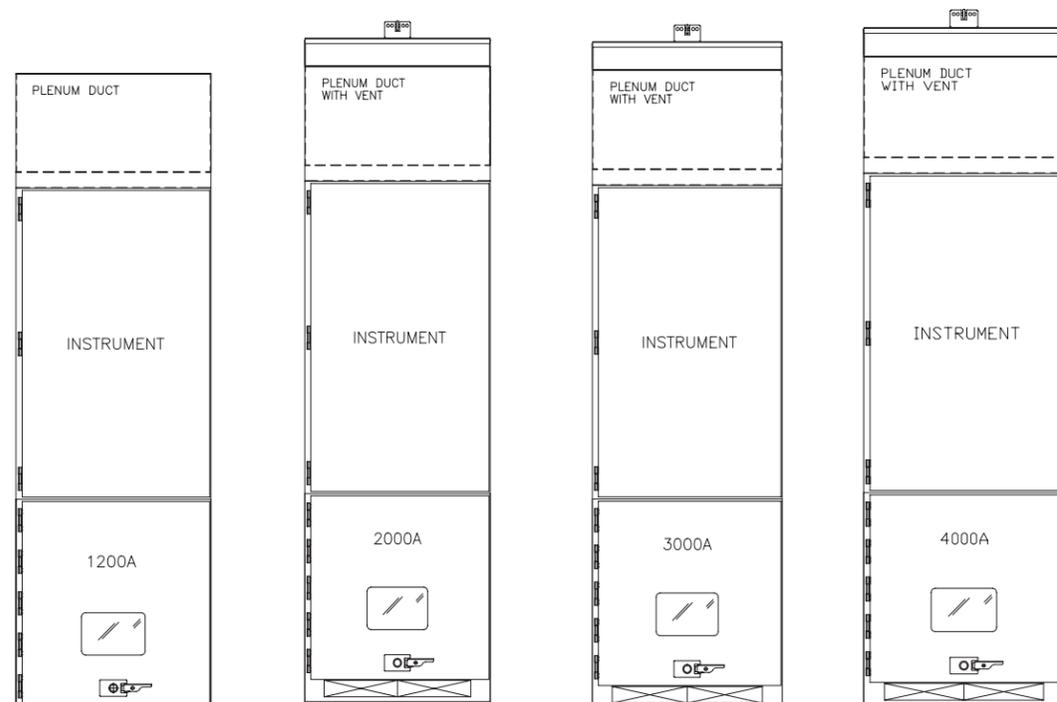
Frame	Width (in)	Height (in)*	Depth (in)
2000/3000/4000 A breaker	36	129.5	86.5 or 93.5
All other frames	36	118	86.5 or 93.5

* Height includes plenum

Options

- Ground CTs
- Surge arrestors
 - Distribution
 - Intermediate
 - Station
- Surge capacitor
- Ground studs
- Space heaters
- Cable supports

All ratings (refer to page 19 for door details and pages 36-43 for floorplans)



Available frame types

Two-high frames

Description

The two-high breaker frame consists of two 38-inch breaker compartments with a 19-inch instrument compartment in between for two breakers in a single frame. See page 20 for information on dimensions and available options.

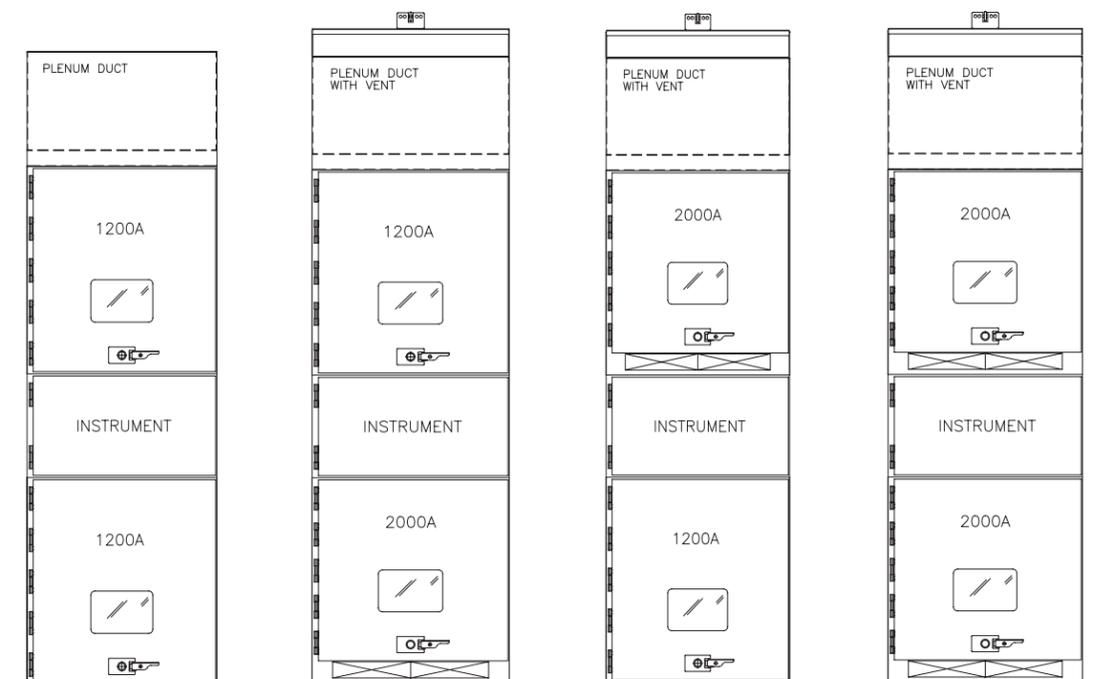
Cable termination information

Cable size	# of terms single pad per phase	GCT option
#2 AWG	4	BYZ-S
#4 AWG	4	BYZ-S
500 MCM	4	BYZ-S
750 MCM	4	BYZ-L
1000 MCM (2-hole)	2	BYZ-S
1000 MCM (4-hole)	1	BYZ-S

Application notes

1. Arrangements shown are available for all ratings except as noted
2. Maximum cumulative load at main bus limited to 2500A. Refer to IEEE C37.20.2, section 8.4.2.3, for further details on determining loading of these frame configurations
3. Maximum cumulative load at main bus limited to 3000 A if main bus rating is 3000A. If 3200 A or higher main bus is used, then maximum cumulative load is 3200 A. Refer to IEEE C37.20.2, section 8.4.2.3, for further details on determining loading of these frame configurations
4. Available for 10-cycle arc duration only
5. Available for 0.5s arc duration only
6. Available for 40-50kA, 10-cycle type 2C/2BC only
7. For Type 2C/2BC applications, all doors are of bolted type

All ratings refer to page 19 for door details and pages 36-43 for floorplans



See notes 2 and 4

See notes 3 and 4

Available frame types

Breaker and auxiliary frames

Description

The two-high breaker and auxiliary frame consists of two 38-inch compartments with a 19-inch instrument compartment in between for one breaker and an auxiliary device in a single frame or one 38-inch compartment with 19-inch low voltage and two 19-inch auxiliary compartments for equipment with short circuit ratings less than 40 kA.

Cable termination information

Cable size	# of terms single pad per phase	# of terms bifurcated pad per phase*	GCT option
#2 AWG	4	8	BYZ-S
#4 AWG	4	8	BYZ-S
500 MCM	4	8	BYZ-S
750 MCM	4	8	BYZ-L
1000 MCM (2-hole)	2	4	BYZ-S
1000 MCM (4-hole)	1	2	BYZ-S

* Bifurcated lug pad requires 93.35-inch depth frame

Dimensions

Frame	Width (in)	Height (in)*	Depth (in)
2000/3000 A breaker	36	129.5	86.5 or 93.5
All other frames	36	118	86.5 or 93.5

* Height includes plenum

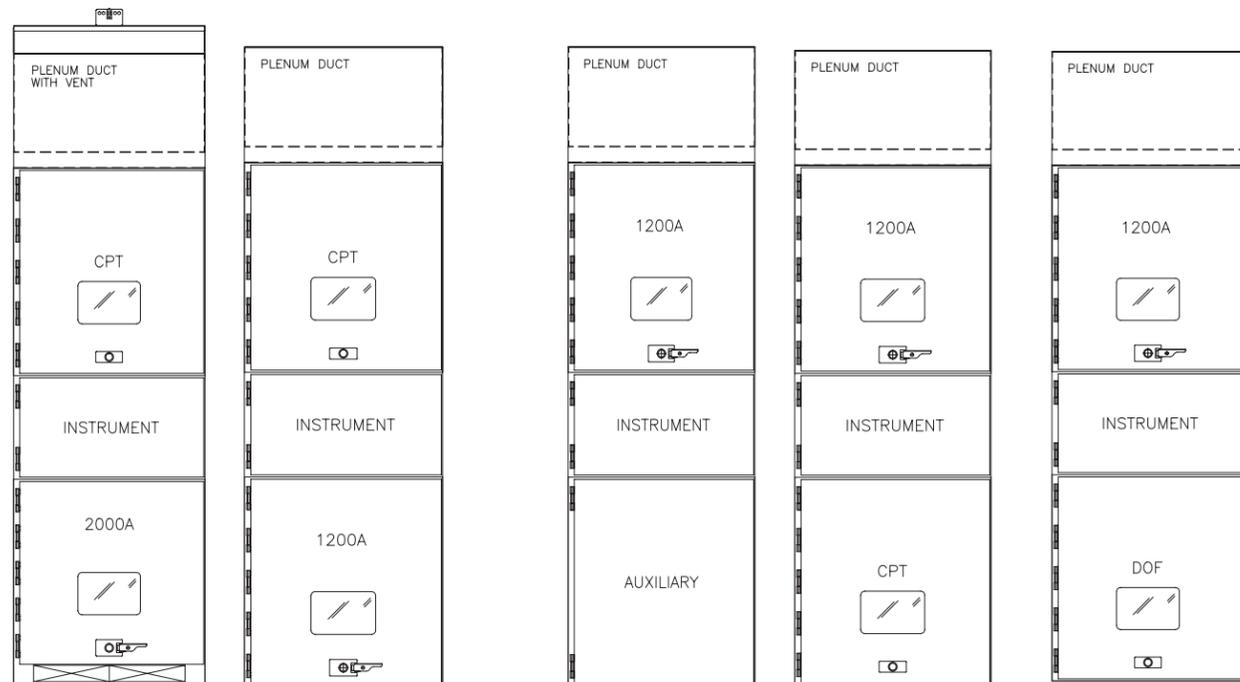
Options

- Ground CTs
- Surge arrestors
 - Distribution
 - Intermediate
 - Station
- Surge capacitor
- Ground studs
- Space heaters
- Cable supports
- SmartRack® remote racking system
- SwitchgearMD™ 24x7 monitoring system

01 Breaker below

02 Breaker above

All ratings refer to page 19 for door details, 21 for application notes and pages 36-43 for floorplans



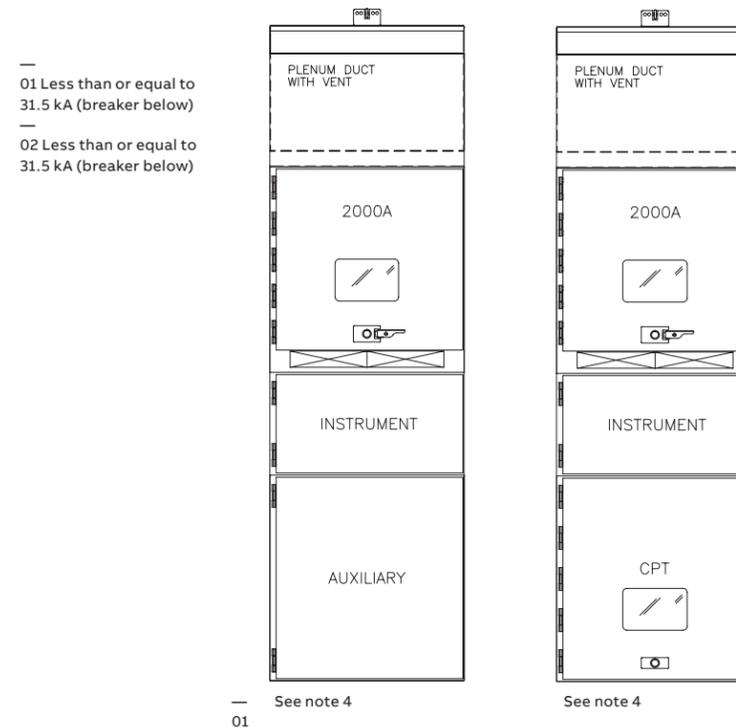
01

02

Available frame types

Breaker and auxiliary frames

All ratings refer to page 19 for door details, page 21 for application notes and pages 36-43 for floorplans

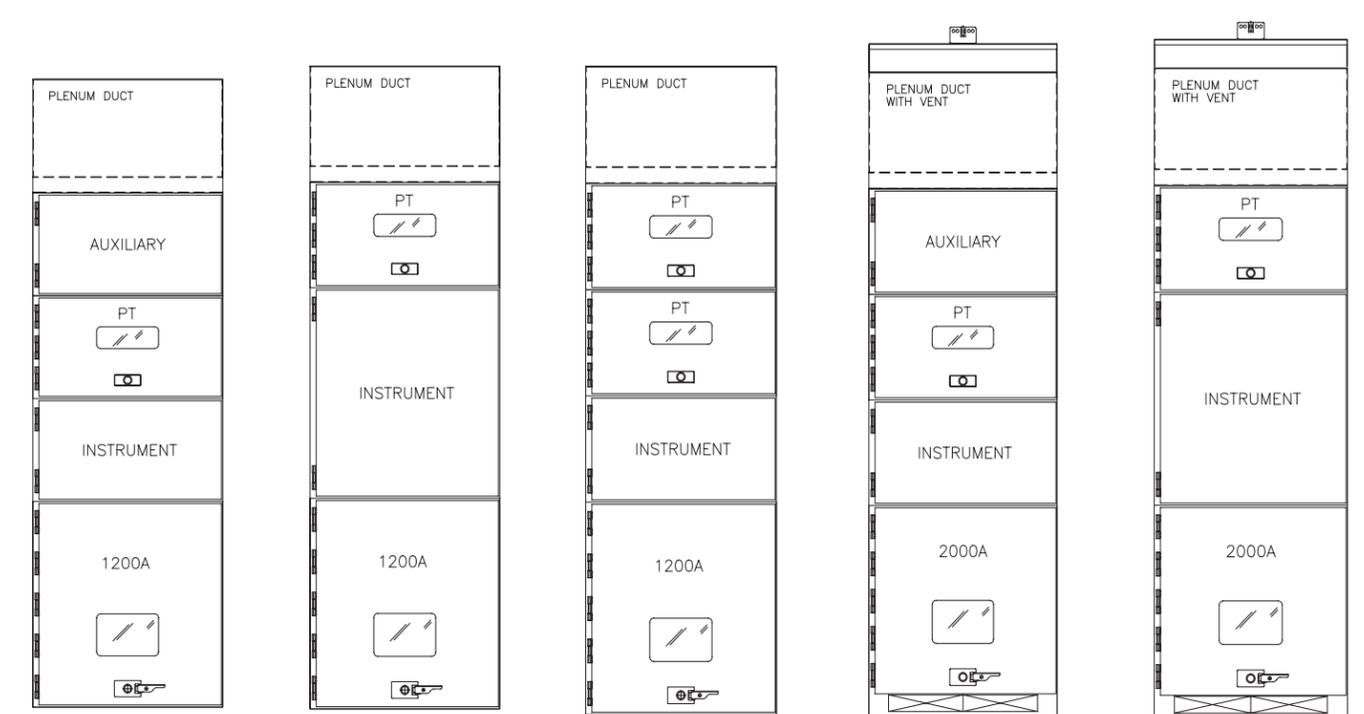


01 Less than or equal to 31.5 kA (breaker below)

02 Less than or equal to 31.5 kA (breaker below)

01 See note 4

See note 4



02 See note 4

See note 4

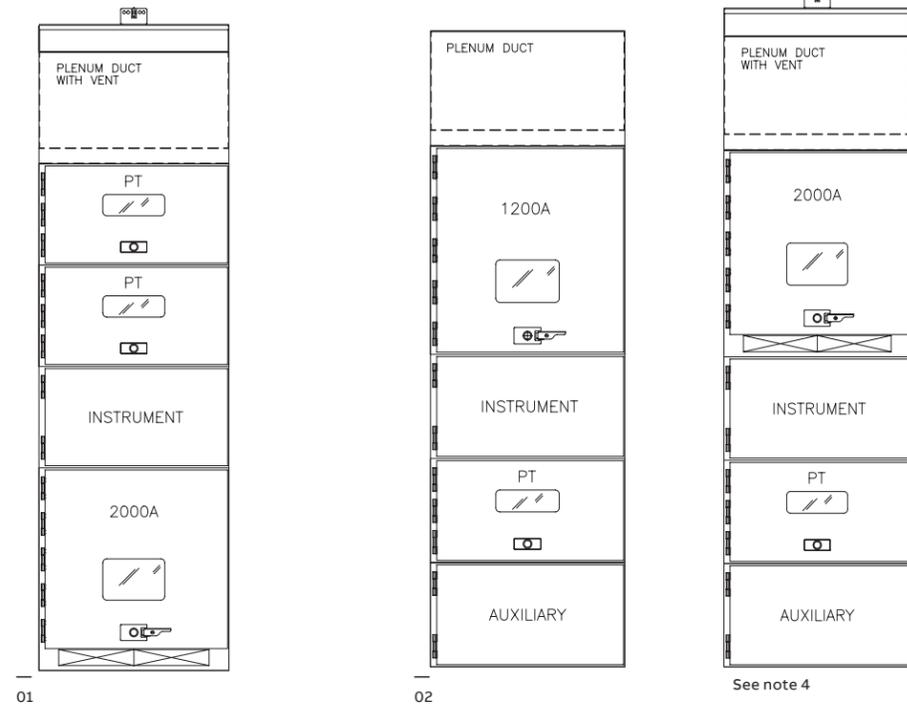
See note 4

Available frame types

Breaker and auxiliary frames

Refer to page 21 for application notes and pages 36-43 for floorplans

- 01 Less than or equal to 31.5 kA (breaker below)
- 02 Less than or equal to 31.5 kA (breaker above)
- 03 Greater than or equal to 40 kA (breaker below)

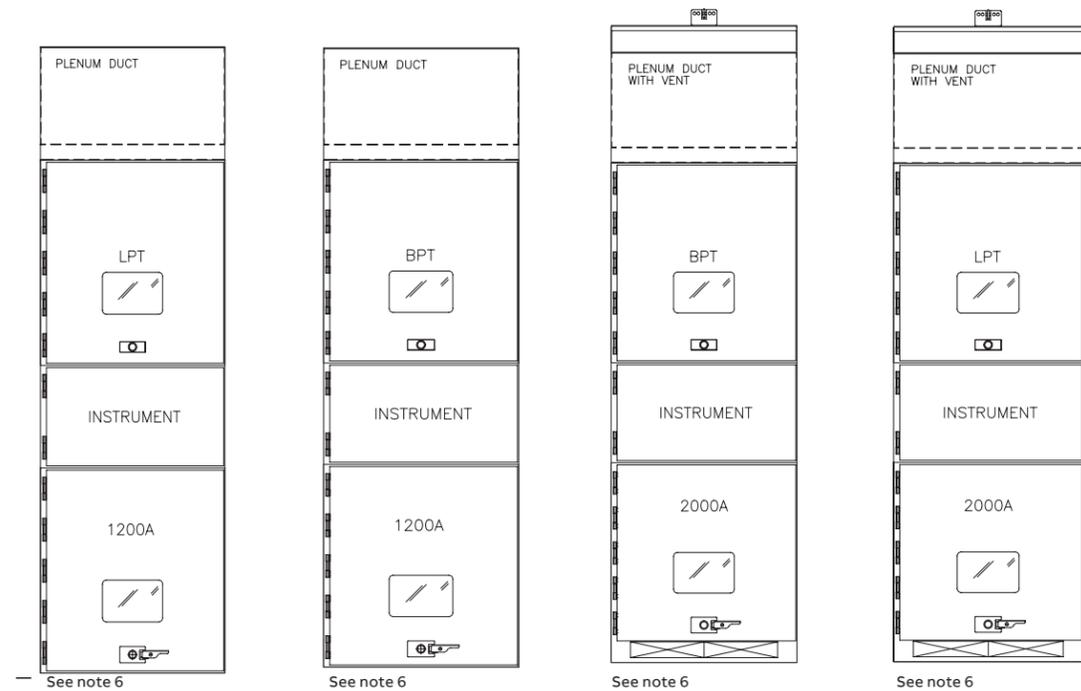
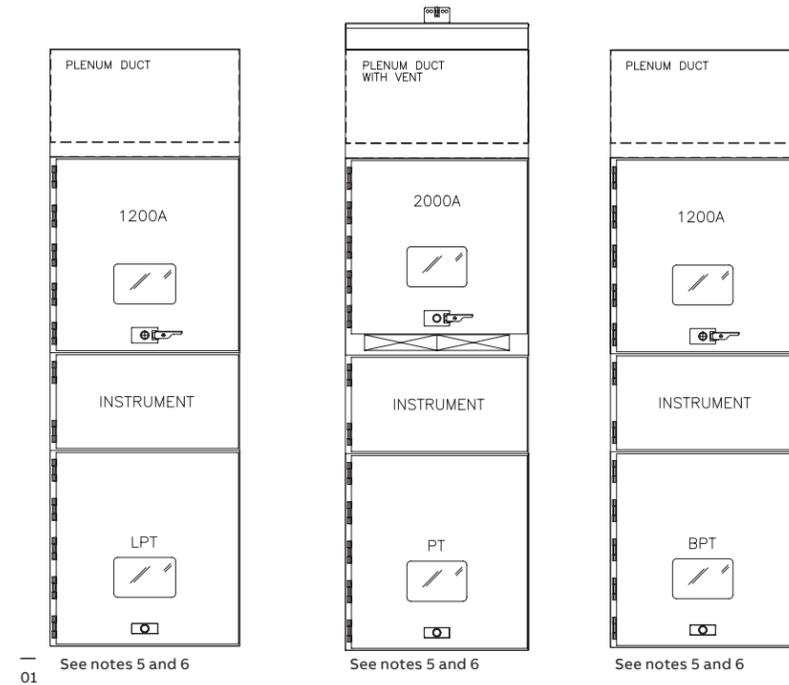


Available frame types

Breaker and auxiliary frames

Refer to page 21 for application notes and pages 36-43 for floorplans

- 01 Greater than or equal to 40 kA (breaker above)



03

Available frame types

Auxiliary frames

Description

The two-high auxiliary frame consists of compartments with a 19-inch instrument compartment in between multiple auxiliary devices per frame.

Dimensions

Frame	Width (in)	Height (in)*	Depth (in)
All frames	36	118	86.5 or 93.5

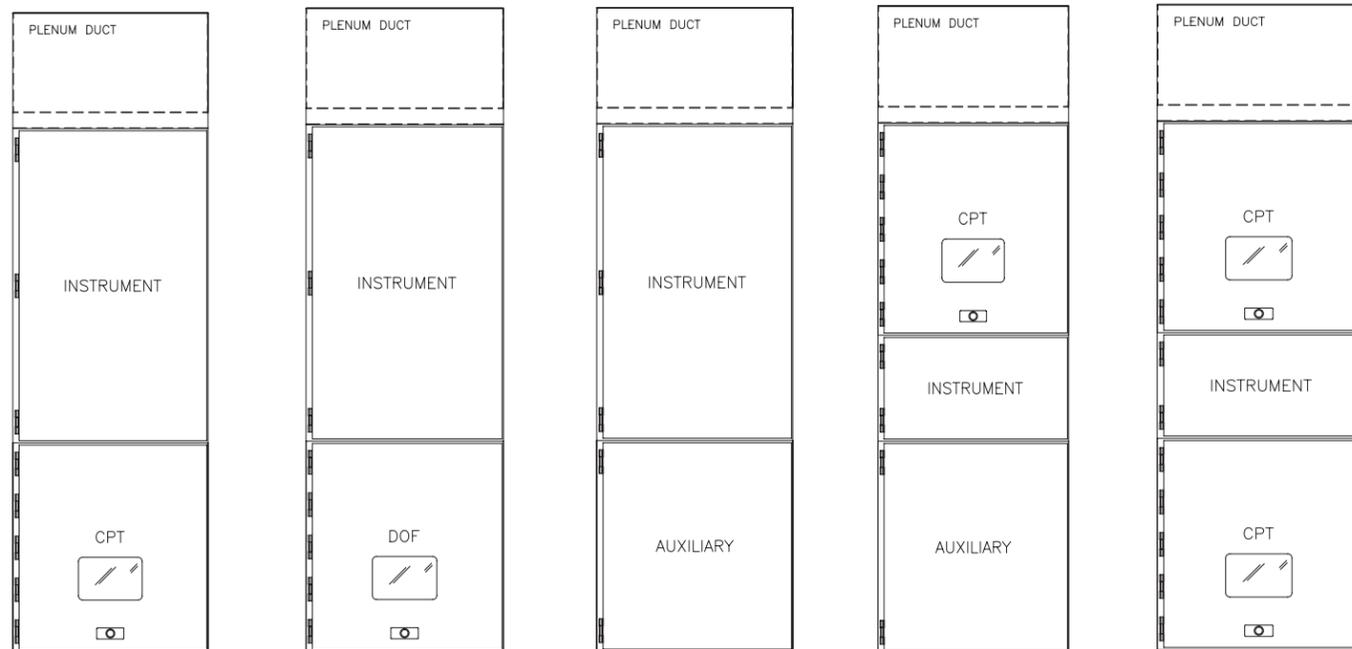
* Height includes plenum

Options

- Space heaters
- Incoming/outgoing cables
- Surge arrestors
 - Distribution
 - Intermediate
 - Station
- Ground studs
- Cable supports
- IR windows
- SmartRack® remote racking system
- SwitchgearMD™ 24x7 monitoring system

— CPT=control power transformer
 — LVC=low voltage compartment/instrument compartment
 — PT=potential transformer
 — DOF=drawout fuse

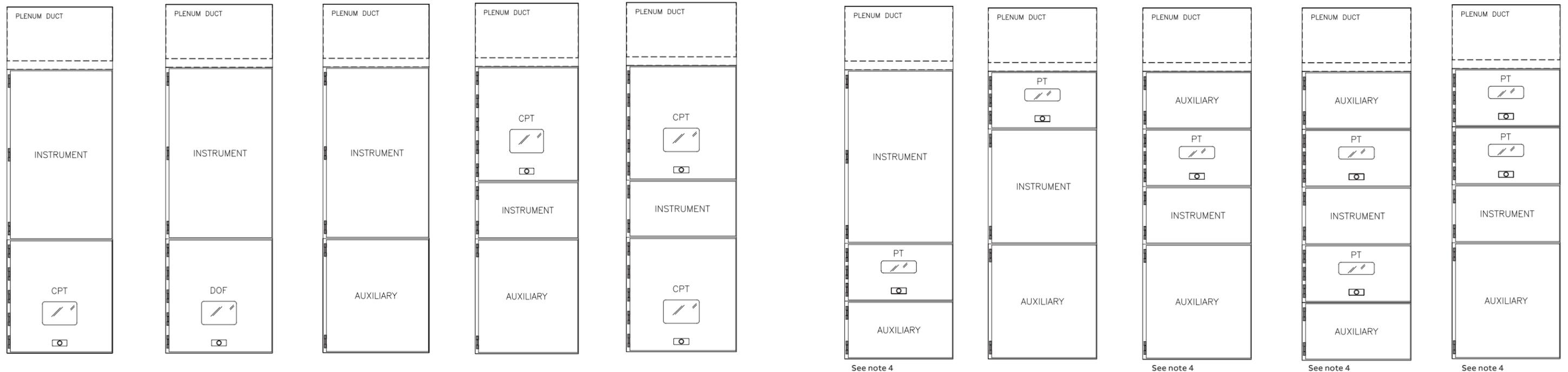
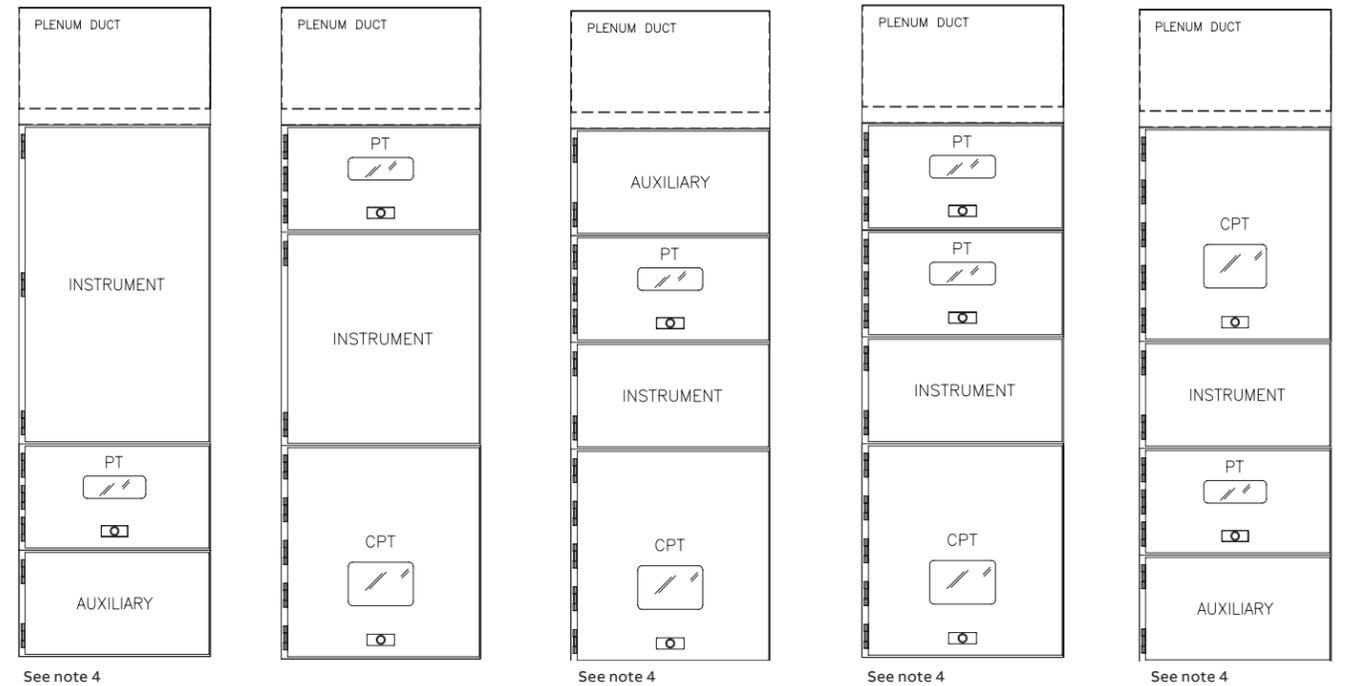
All ratings refer to page 19 for door details and page 21 for application notes and pages 36-43 for floorplans



Available frame types

Auxiliary frames

Less than or equal to 31.5 k A

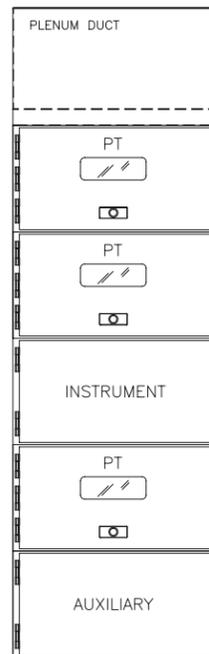


Available frame types

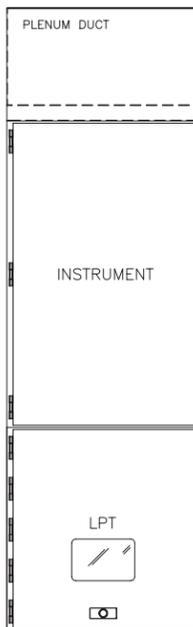
Auxiliary frames

Refer to page 19 for door details and page 21 for application notes and pages 36-43 for floorplans

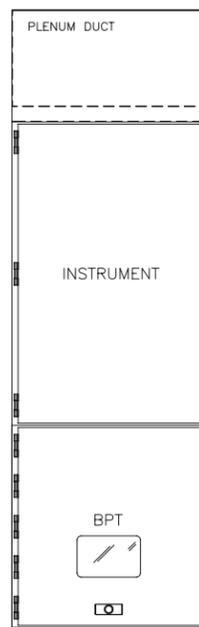
- 01 Less than or equal to 31.5 kA
- 02 Greater than or equal to 40 kA, Type 2C/2BC, 10-cycle and all 0.5s ratings



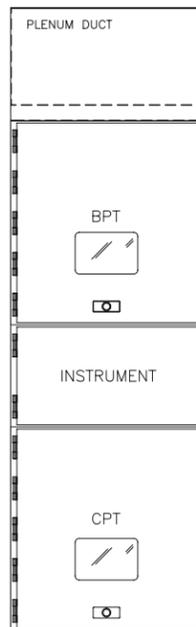
See note 4



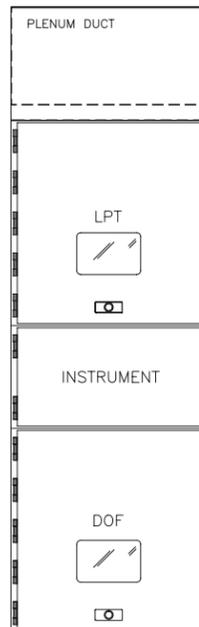
See notes 5 and 6



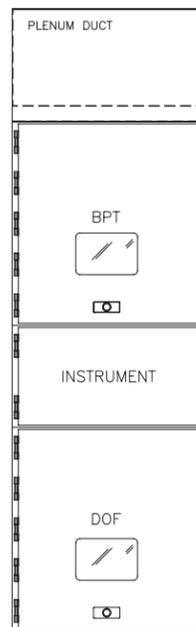
See notes 5 and 6



See notes 5 and 6



See notes 5 and 6

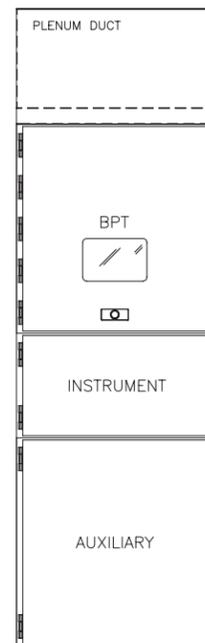


See notes 5 and 6

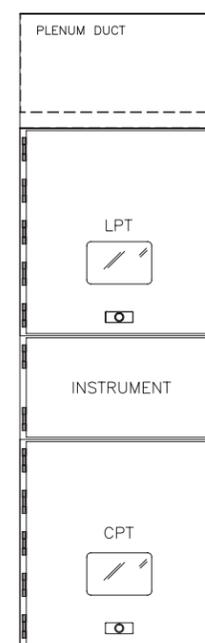
Available frame types

Auxiliary frames

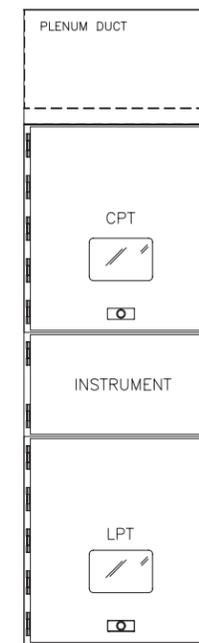
Greater than or equal to 40 kA (refer to page 19 for door details, page 21 for application notes and pages 36-43 for floorplans)



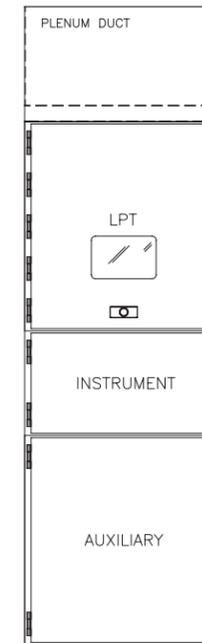
See notes 5 and 6



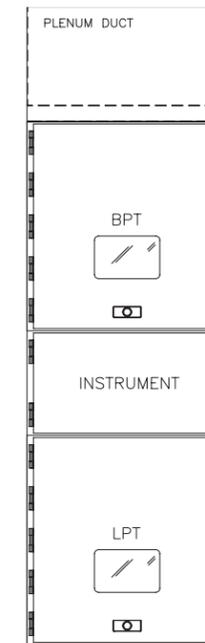
See notes 5 and 6



See notes 5 and 6



See notes 5 and 6



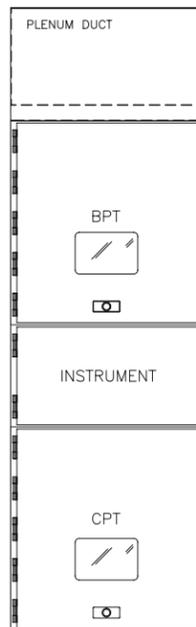
See notes 5 and 6



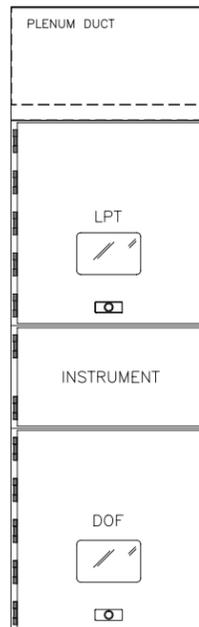
See notes 5 and 6



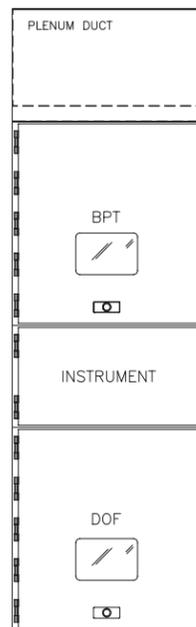
See notes 5 and 6



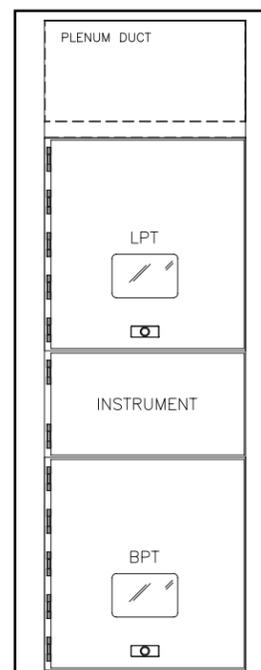
See notes 5 and 6



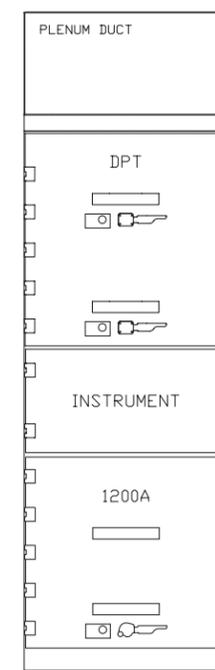
See notes 5 and 6



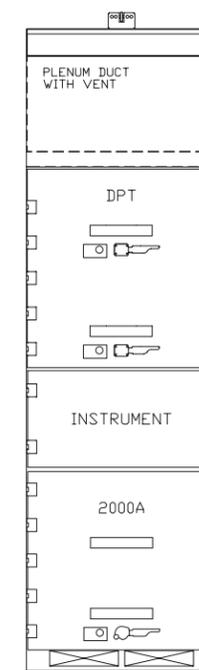
See notes 5 and 6



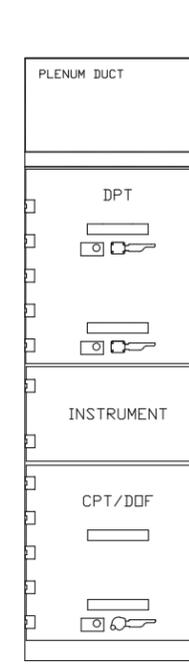
See notes 5 and 6



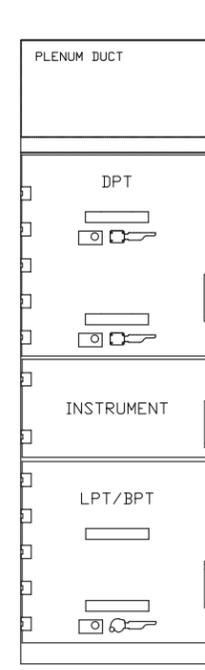
See notes 5 and 6



See notes 5 and 6



See notes 5 and 6

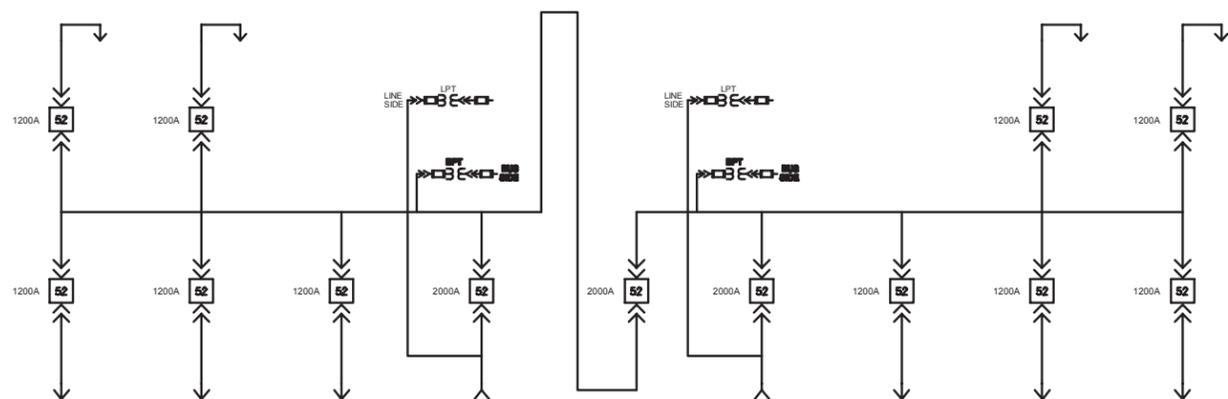
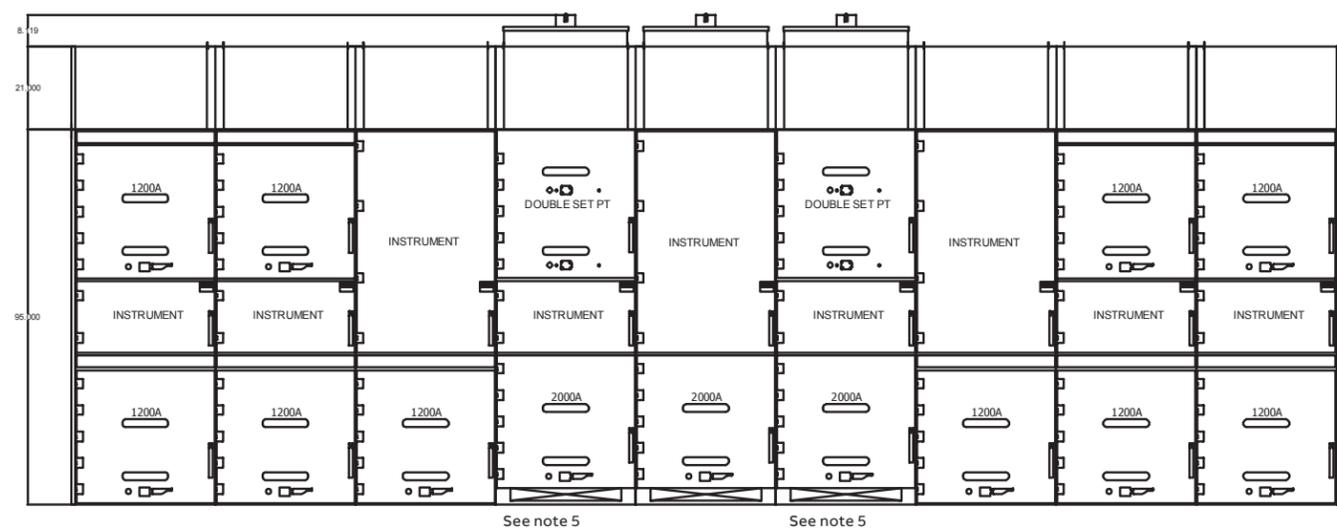


See notes 5 and 6

Typical arrangements

Main-Tie-Main: 1200 A/2000 A, up to and including 50 kA

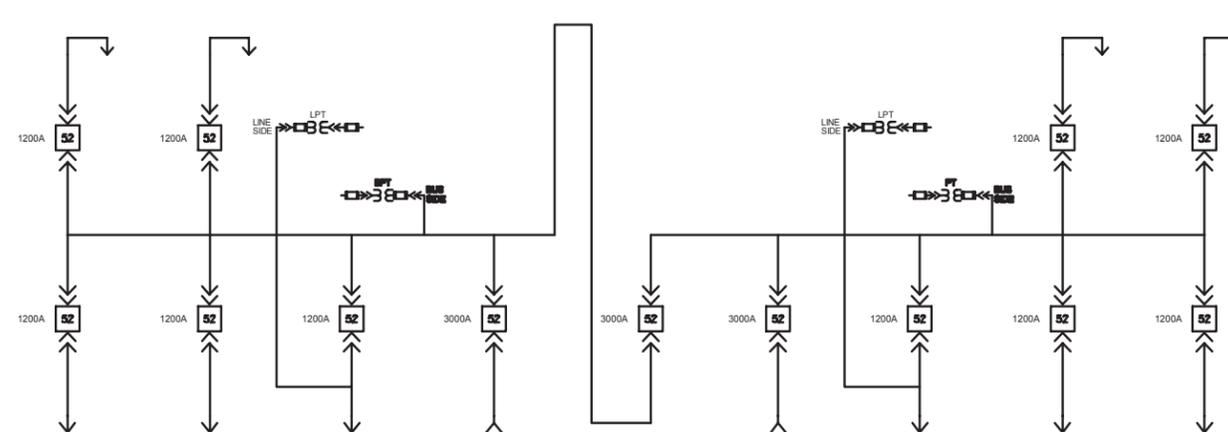
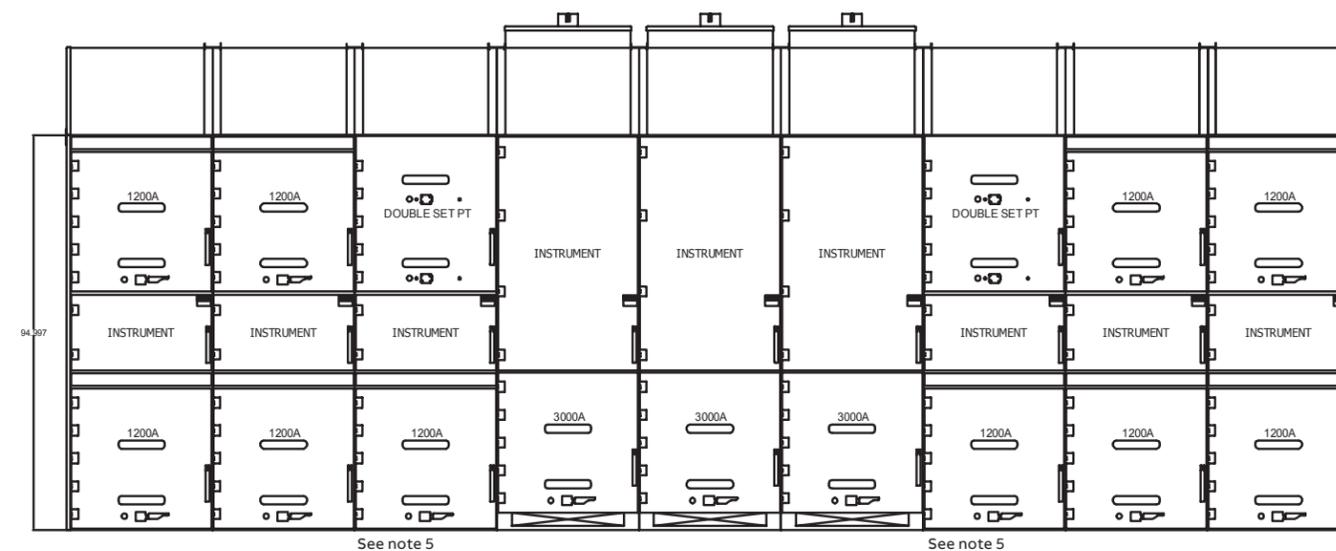
Arrangements are the same for 5, 8.25 and 15 kV (refer to page 19 for door details and page 21 for application notes)



Typical arrangements

Main-Tie-Main: 3000 A and 4000 A, up to and including 50 kA

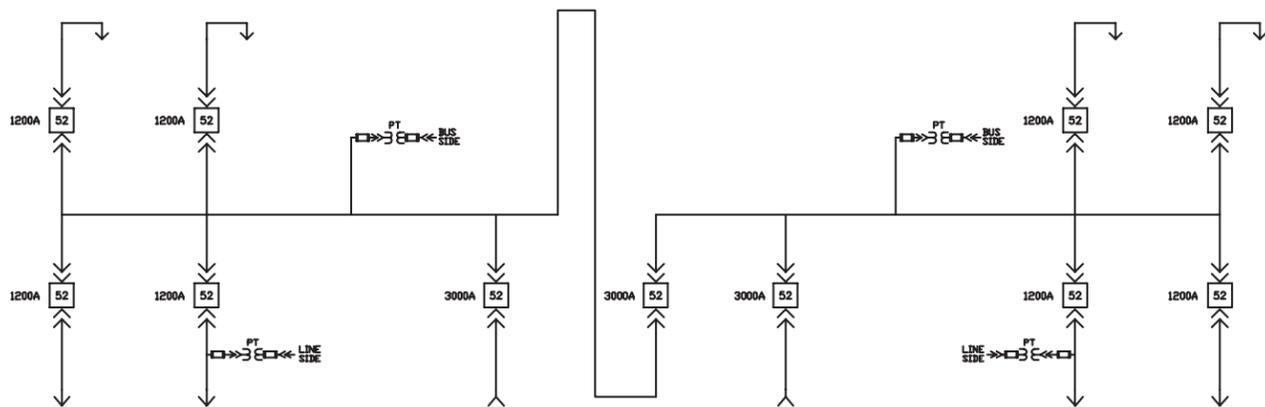
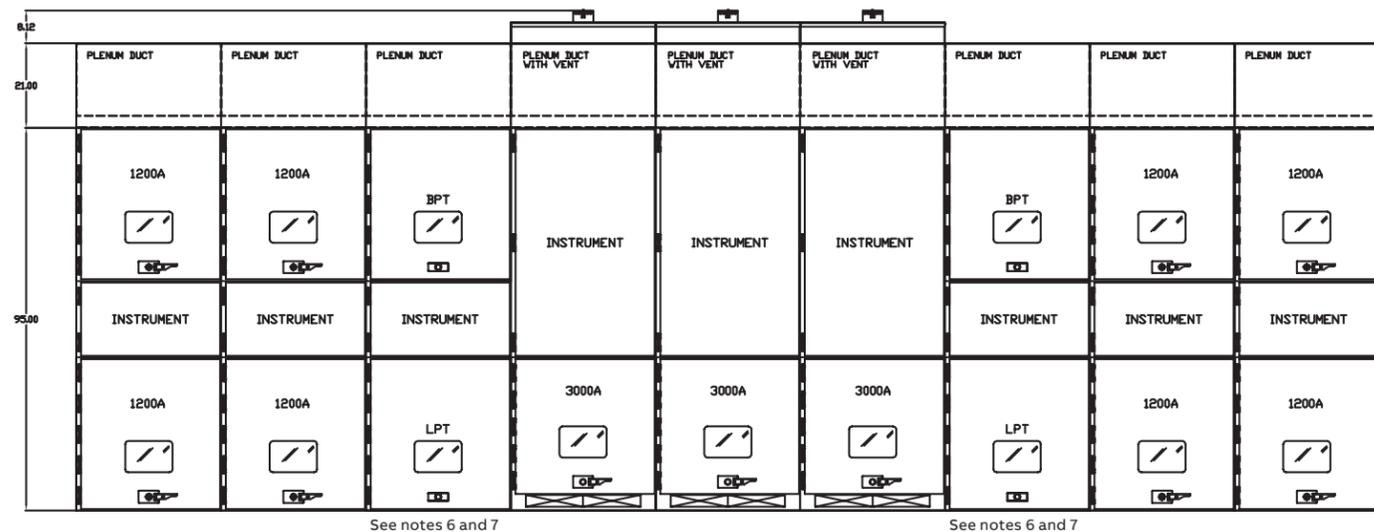
Arrangements are the same for 5, 8.25 and 15 kV (refer to page 19 for door details and page 21 for application notes)



Typical arrangements

Main-Tie-Main: 3000 A and 4000 A, 40 kA and 50 kA

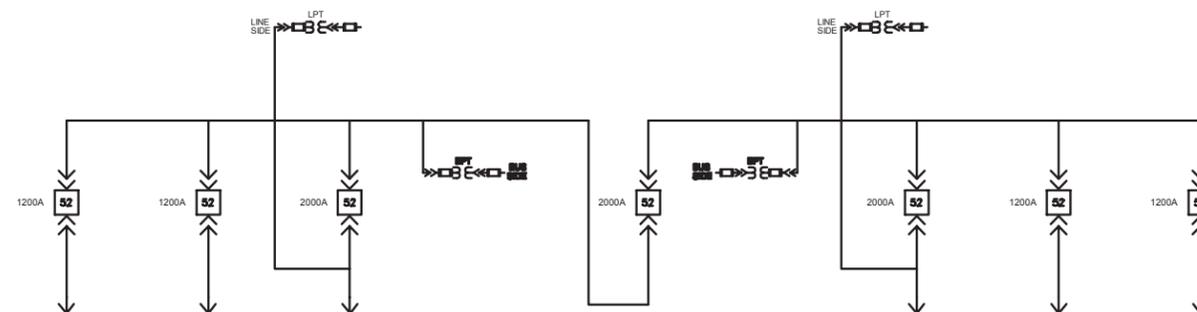
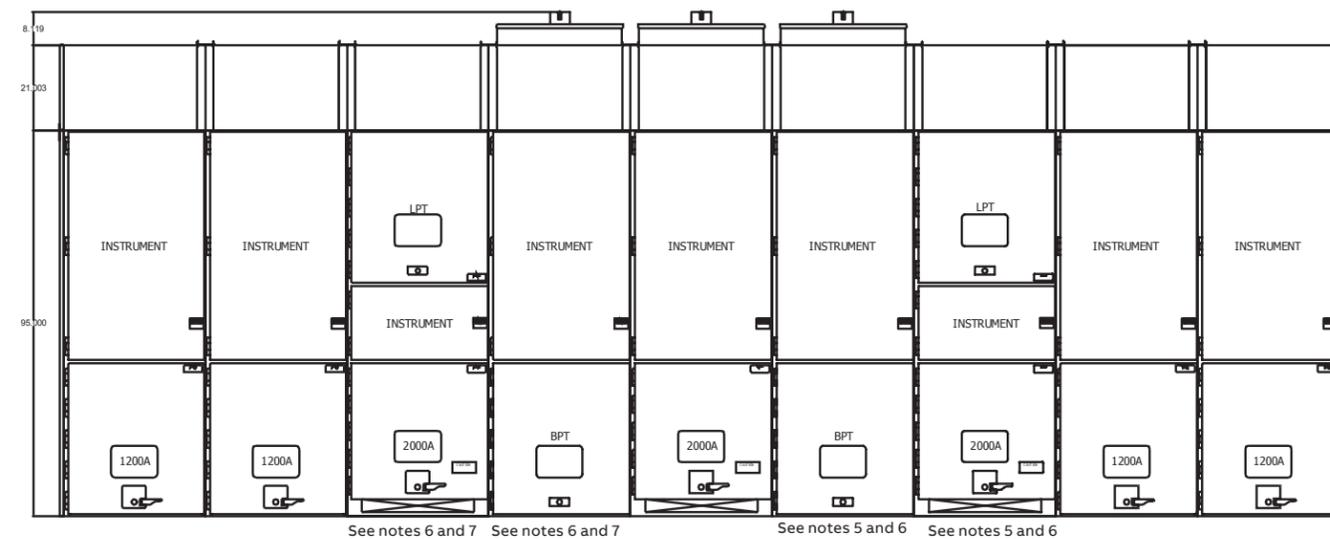
Arrangements are the same for 5, 8.25 and 15 kV (refer to page 19 for door details and page 21 for application notes)



Typical arrangements

Main-Tie-Main: 1200 A/2000 A, 40 kA and 50 kA

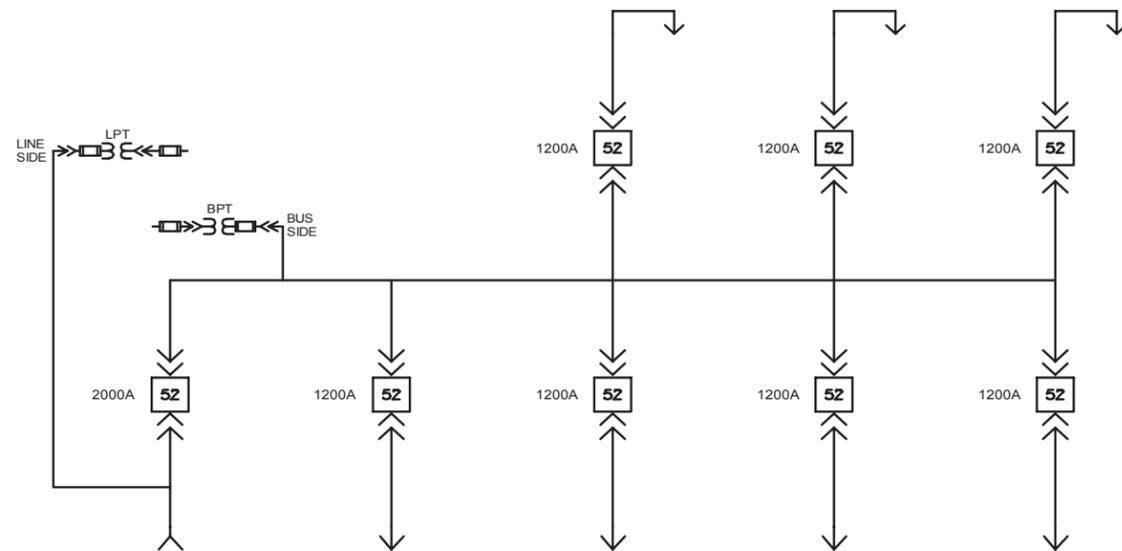
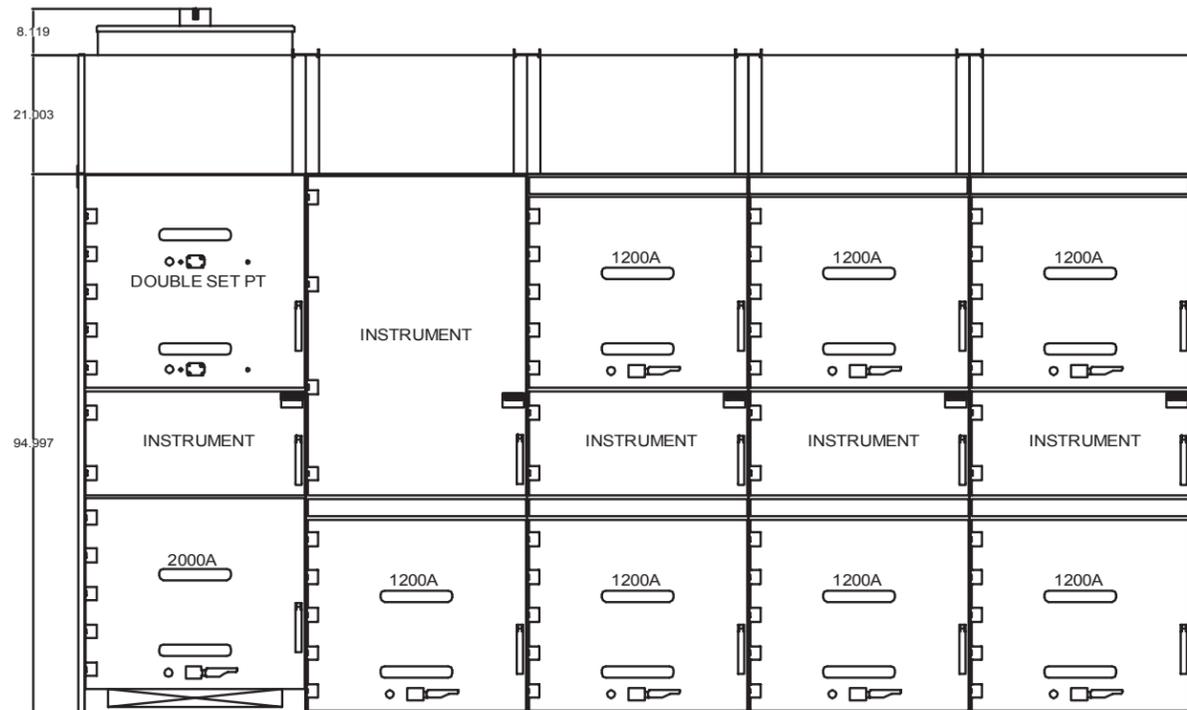
Arrangements are the same for 5, 8.25 and 15 kV (refer to page 19 for door details and page 21 for application notes)



Typical arrangements

Main with Feeders: 1200 A/2000 A, 40 kA and 50 kA

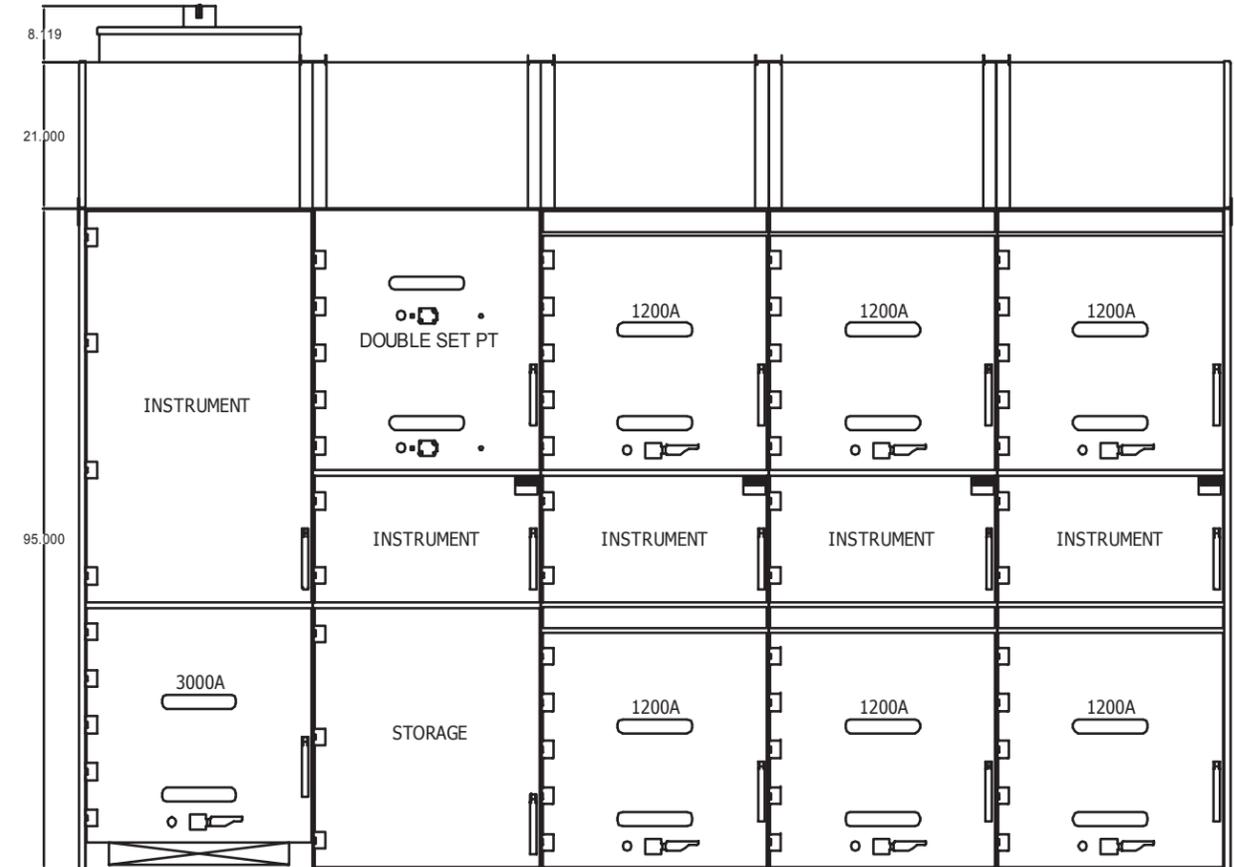
Arrangements are the same for 5, 8.25 and 15 kV (refer to page 19 for door details and page 21 for application notes)



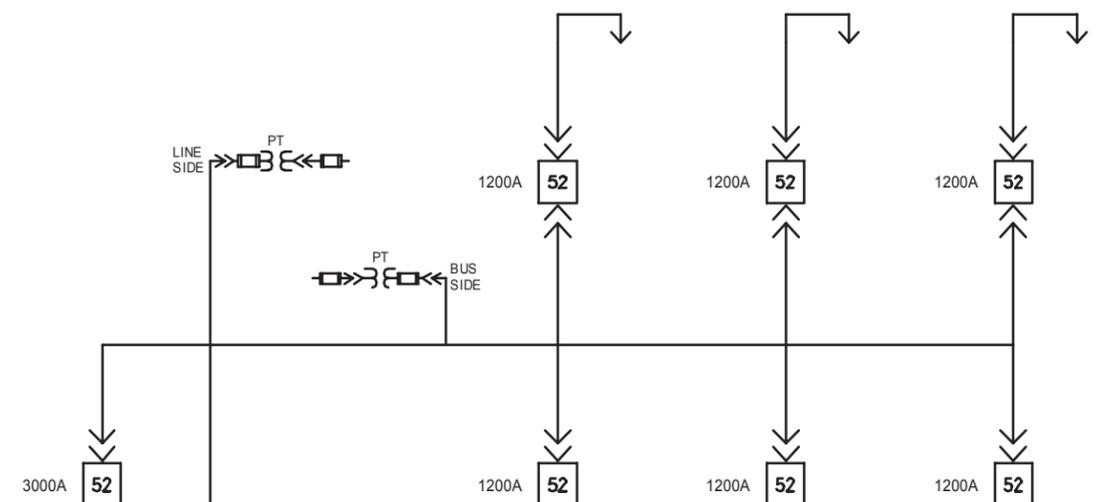
Typical arrangements

Main with Feeders: 3000 A and 4000 A, up to and including 50 kA

Arrangements are the same for 5, 8.25 and 15 kV (refer to page 19 for door details and page 21 for application notes)



See note 4



Civil engineering details

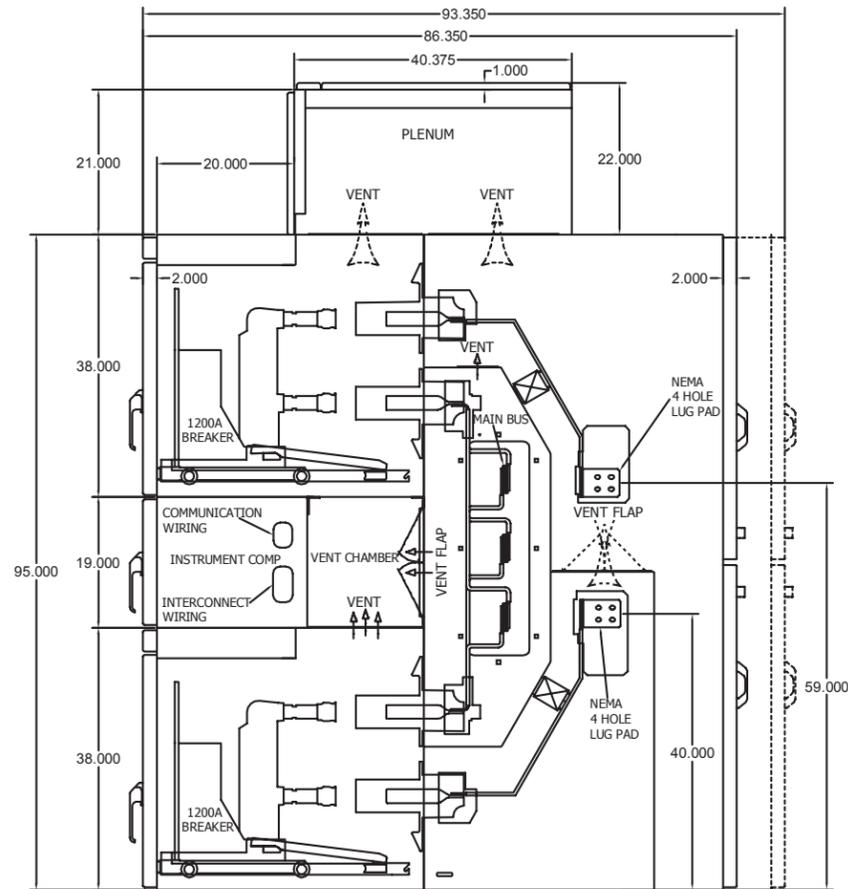
Typical side views, floor plans, and clearances

SafeGear switchgear two-high frames

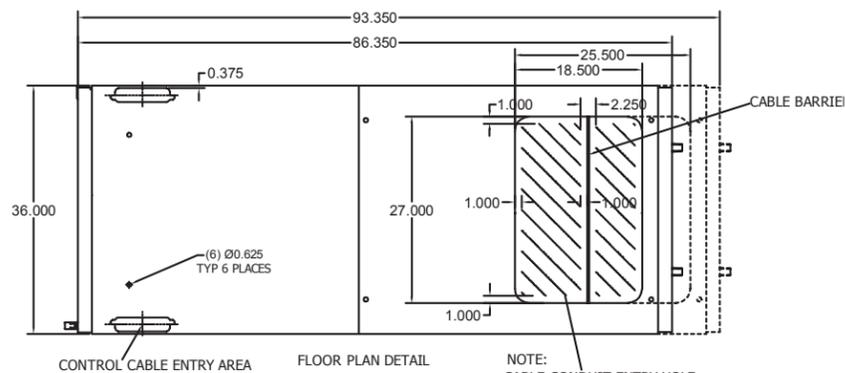
Circuit breaker: 1200 A/1200 A

Refer to page 19 for door details

Refer to page 45 for frame weights



SECTION VIEW DETAIL



FLOOR PLAN DETAIL

NOTE:
CABLE CONDUIT ENTRY HOLE
MUST BE WITHIN AREA
OUTLINED WITH A 1.00
CLEARANCE BETWEEN THE
SWITCHGEAR BARRIER
FOR CONDUIT CAP AND GLAND

Civil engineering details

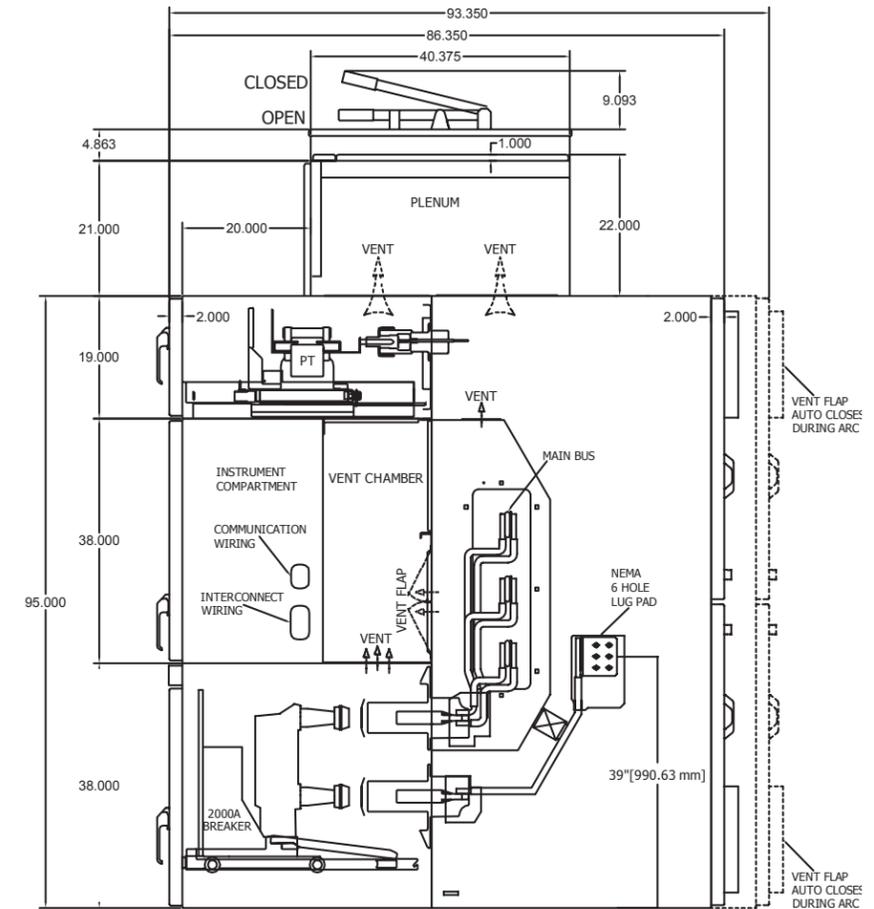
Typical side views, floor plans, and clearances

SafeGear switchgear breaker and auxiliary

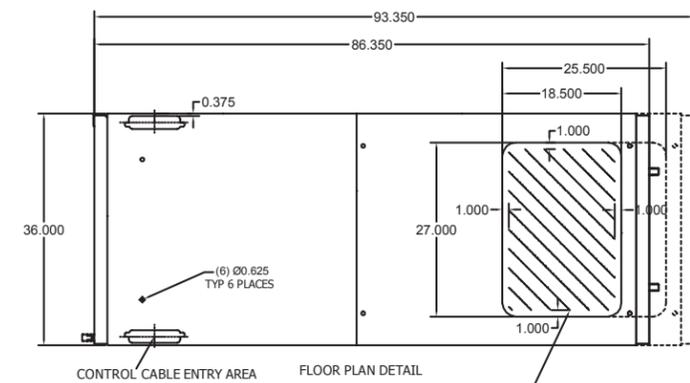
Circuit breaker: 2000 A

Refer to page 19 for door details

Refer to page 45 for frame weights



SECTION VIEW DETAIL



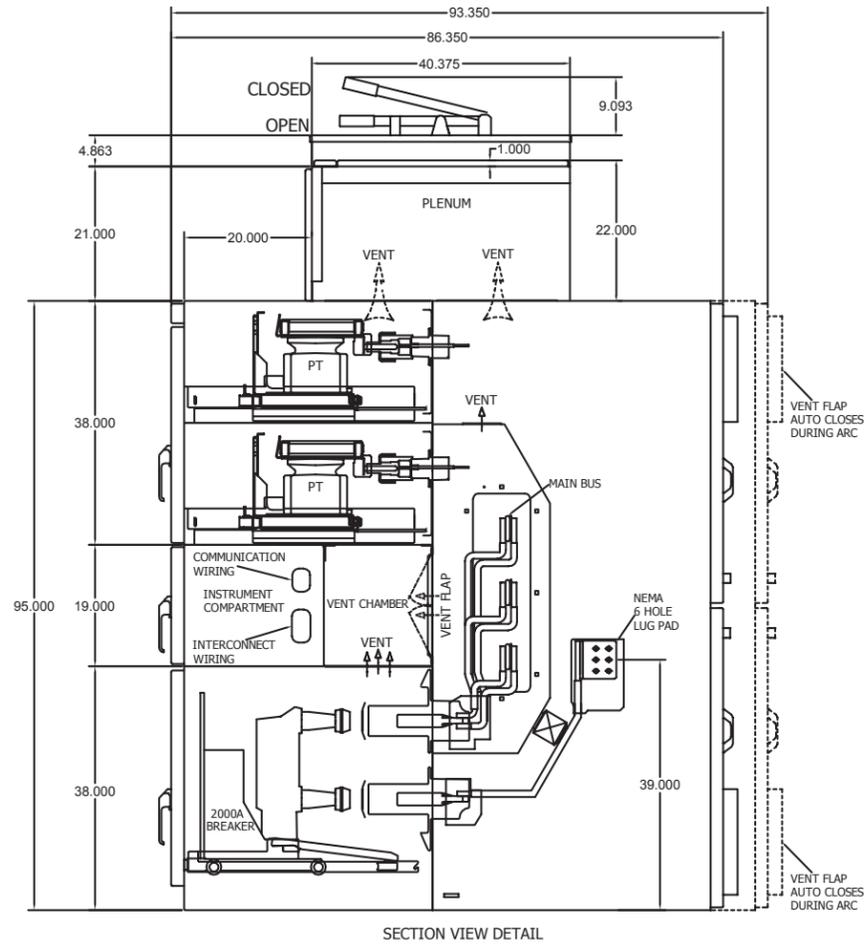
FLOOR PLAN DETAIL

NOTE:
CABLE CONDUIT ENTRY HOLE
MUST BE WITHIN AREA
OUTLINED WITH A 1.00
CLEARANCE AROUND THE
CABLE CUTOUT
FOR CONDUIT CAP AND GLAND

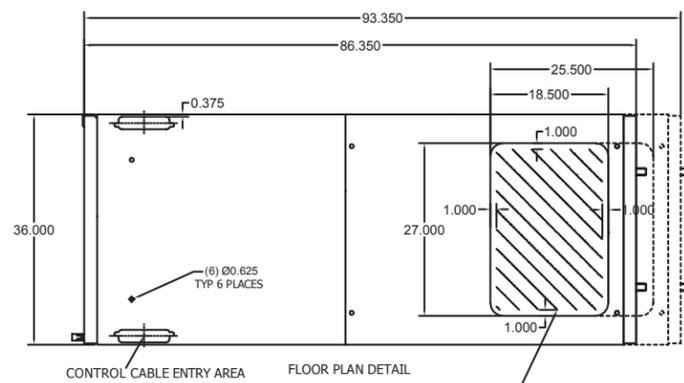
Civil engineering details

Typical side views, floor plans, and clearances

SafeGear switchgear breaker and auxiliary
 Circuit breaker: 2000 A, with double set of PTs
 Refer to page 19 for door details
 Refer to page 45 for frame weights



SECTION VIEW DETAIL



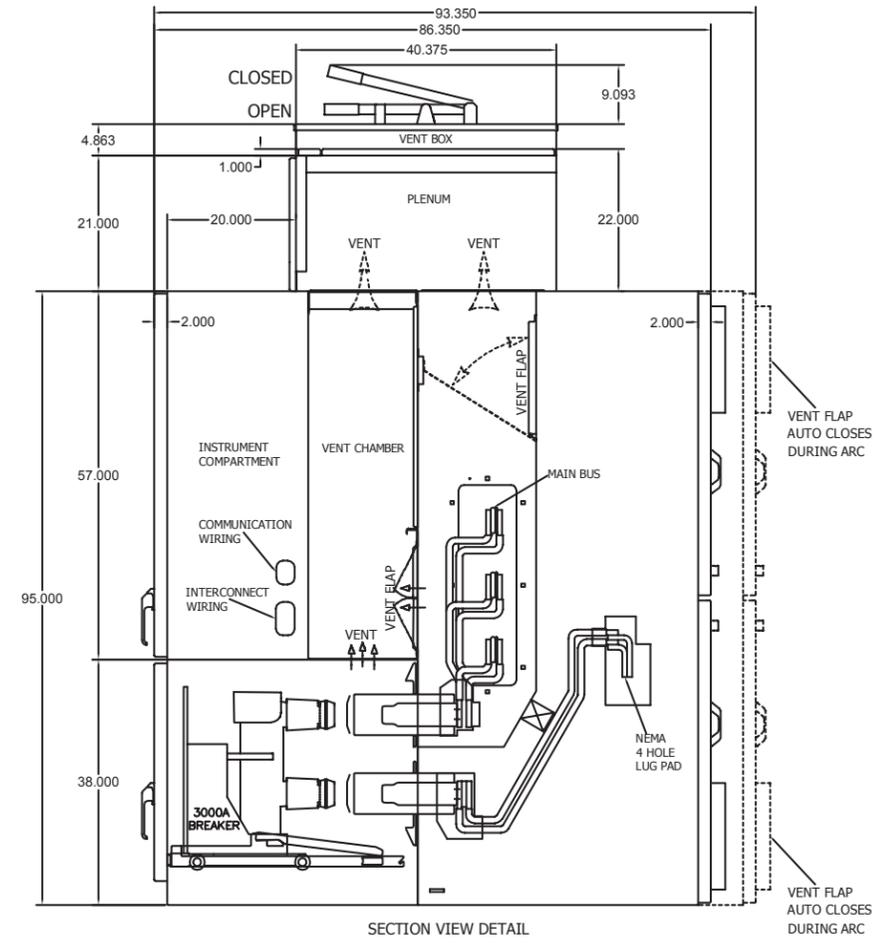
CONTROL CABLE ENTRY AREA FLOOR PLAN DETAIL

NOTE:
 CABLE CONDUIT ENTRY HOLE
 MUST BE WITHIN AREA
 OUTLINED WITH A 1.00
 CLEARANCE AROUND THE
 CABLE CUTOUT
 FOR CONDUIT CAP AND GLAND

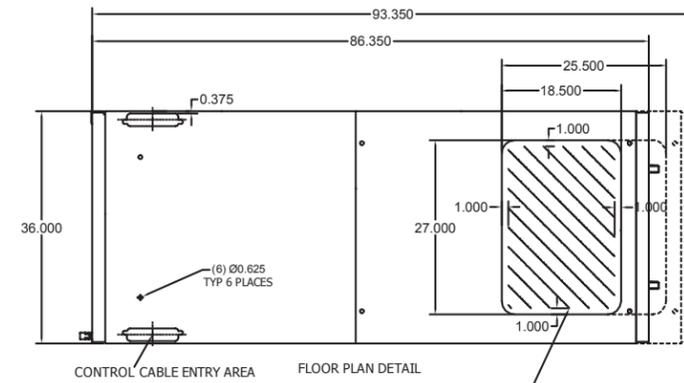
Civil engineering details

Typical side views, floor plans, and clearances

SafeGear switchgear one-high frames
 Circuit breaker: 3000 A or 4000 A
 Refer to page 19 for door details
 Refer to page 45 for frame weights



SECTION VIEW DETAIL

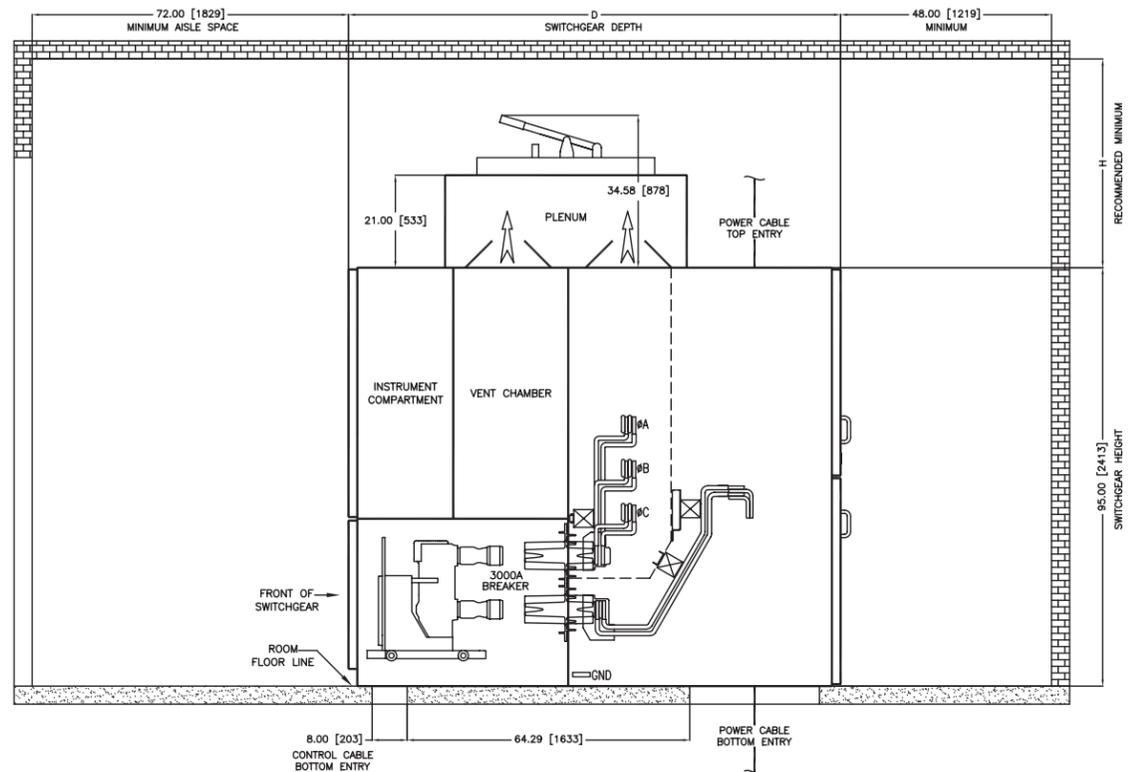


CONTROL CABLE ENTRY AREA FLOOR PLAN DETAIL

NOTE:
 CABLE CONDUIT ENTRY HOLE
 MUST BE WITHIN AREA
 OUTLINED WITH A 1.00
 CLEARANCE AROUND THE
 CABLE CUTOUT
 FOR CONDUIT CAP AND GLAND

Civil engineering details

Typical side views, floor plans, and clearances



Note: Vent box assembly used only for 2000 - 4000 A ratings

Typical civil engineering dimensions - inches (mm)

	Depth (D)
SafeGear	86.5 or 93.5" for 0.5s or if 0.5s MPL doors are used
SafeGear	85 or 92" for 10-cycles with bolted door design

Dimension H:

- 24 inches for 1200 A lineups
- 40 inches for 2000 A/3000 A lineups

Additional clearance may be needed during assembly of the plenum.

Indoor and outdoor applications

SafeGear is available in indoor construction. For outdoor applications, SafeGear is installed in a sheltered aisle or PDC building. Both applications offer the flexibility of one-high or two-high construction. Standard indoor construction meets the requirements of ANSI/IEEE standards.

Civil engineering details

Seismic applications

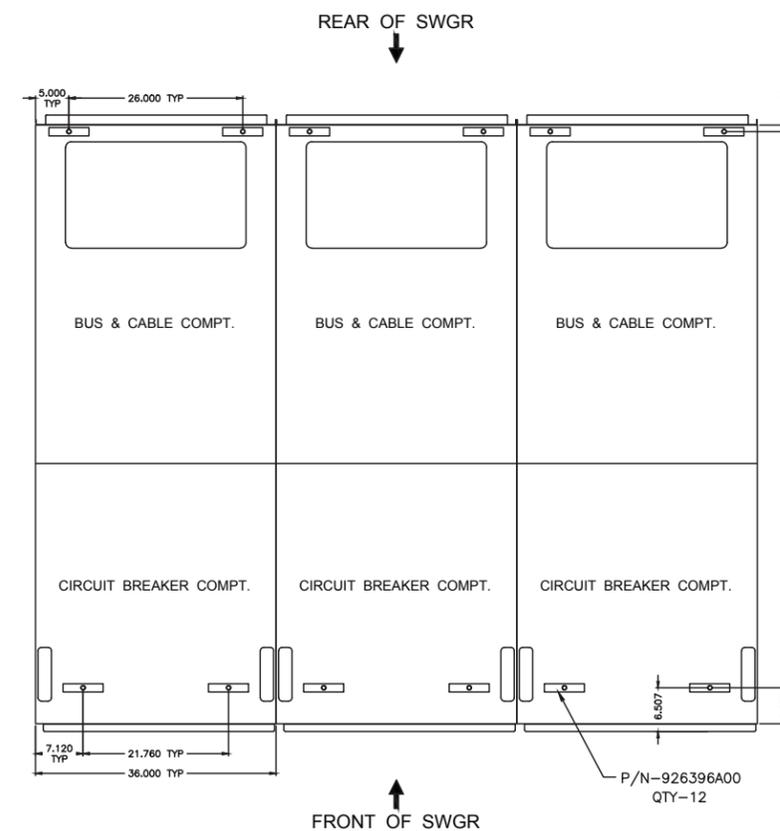
Seismic applications for SafeGear in indoor, sheltered aisle or PDC applications require special anchoring in order to assure proper installation in seismic regions. SafeGear is qualified to the following seismic standards:

- IBC 2012 with $I_p=1.5$
- CBC 2013
- ASCE 7-10
- NEHRP 2009
- IEEE STD 693-2005
- UBC 1997 Zone 4

Anchor Bolt Installation

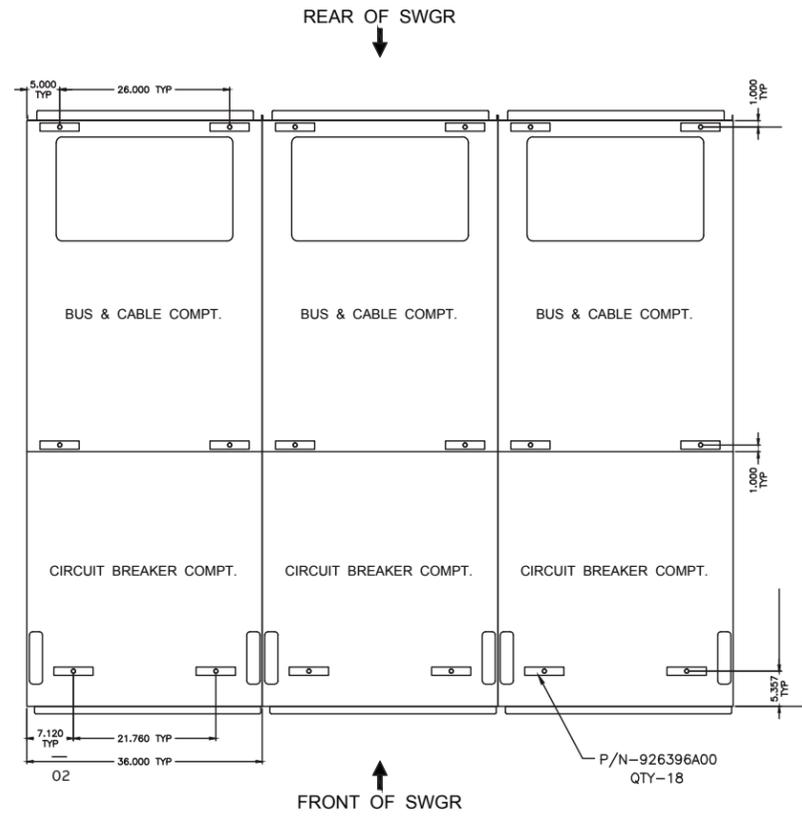
- Anchor Type and Diameter : HIT-RE 500 V3 + HAS B7 ½ Post Installed Anchor Bolt or Equivalent
- Effective embedment depth : 6.00"
- Bolt Material : ASTM A 193 Grade B7
- Base Material: Cracked concrete, 4000; $f_c' = 4000$ psi; $h = 8"$ at 32° F
- Installation : Hammer drilled hole
- Installation condition : Dry
- Seismic Washer : ABB Part No. 926396A00

01
Bolt Location for $I_p = 1.0$
2X- Front on each frame
2X- Rear on each frame



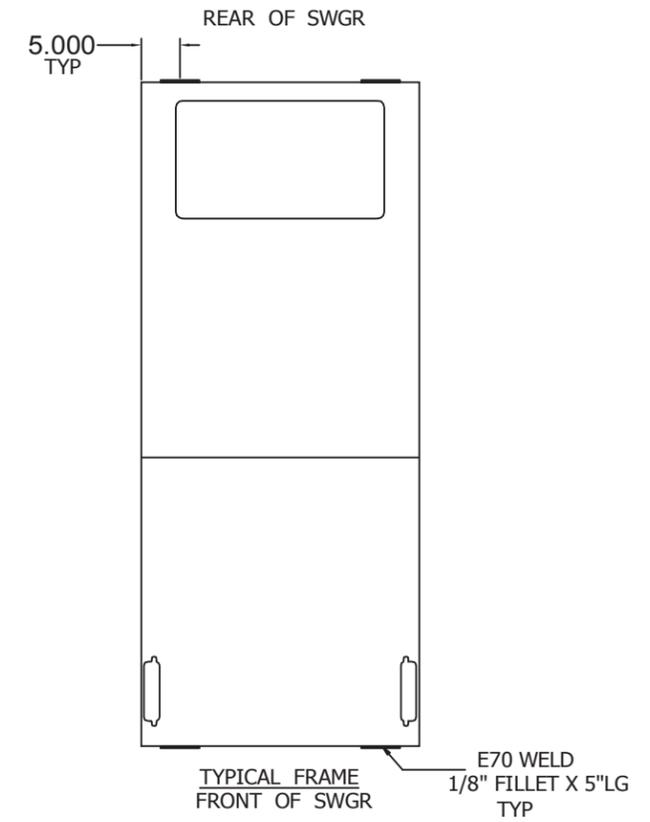
01

Civil engineering details
Seismic applications



— 02 Bolt Location
for Ip = 1.5
2X- Front on each frame
2X- Middle on each frame
2X- Rear on each frame

Civil engineering details
Seismic applications



— 03 Weld Location
for Ip = 1.0
2X- Front on each frame
2X- Rear on each frame

Civil engineering details

Seismic applications

04 Weld Location
for Ip = 1.5

Left End Shipping Split

2X- Front on each frame

3X- Left and Right

side of shipping split

2X- Rear on each frame

Intermediate Ship-

ping Split

2X- Front on each frame

3X- Right side of

shipping split

2X- Rear on each frame

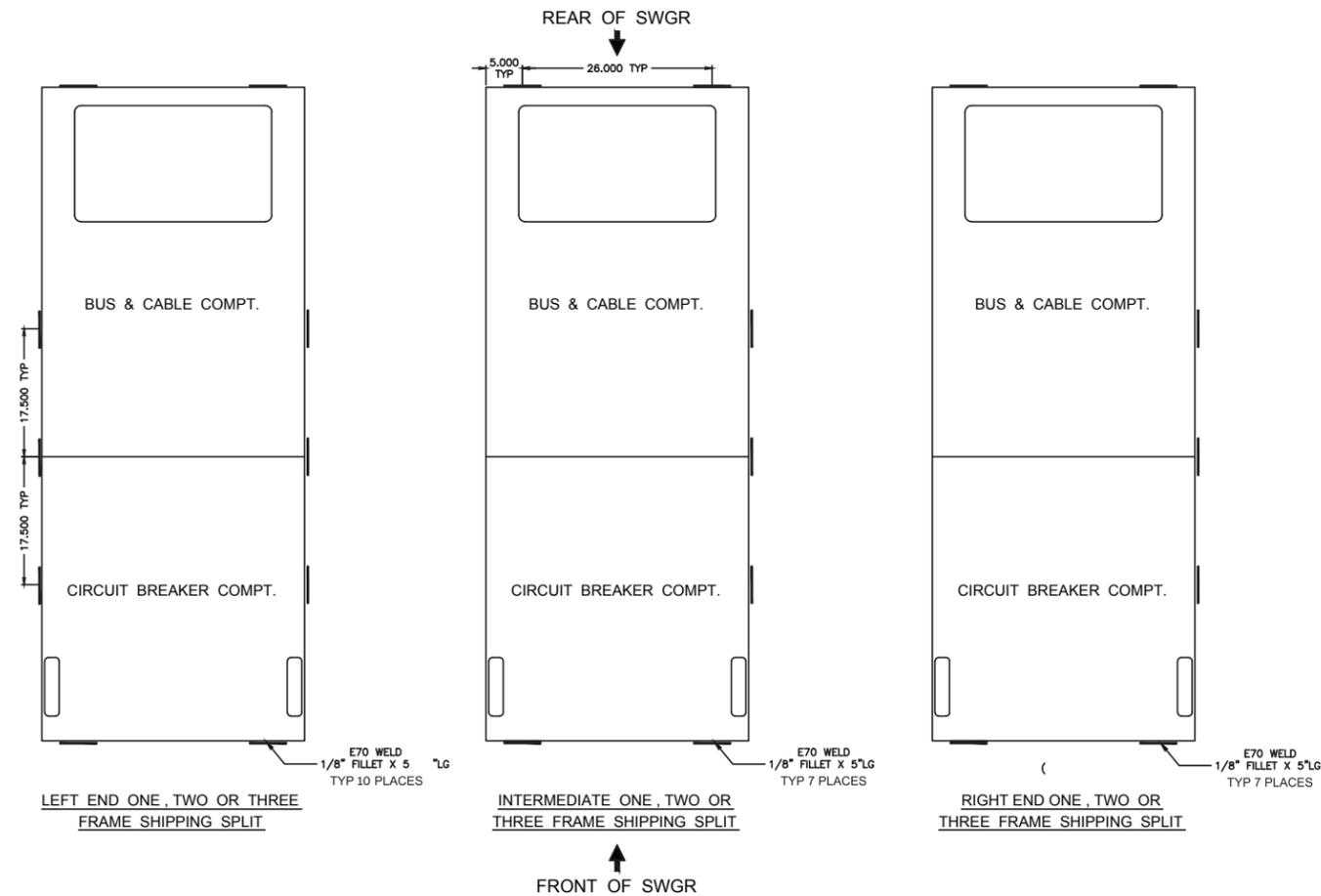
Right End Shipping Split

2X- Front on each frame

3X- Right side of

shipping split

2X- Rear on each frame



LEFT END ONE, TWO OR THREE FRAME SHIPPING SPLIT
 INTERMEDIATE ONE, TWO OR THREE FRAME SHIPPING SPLIT
 RIGHT END ONE, TWO OR THREE FRAME SHIPPING SPLIT

04

Frame weights calculation

All frame styles

To calculate the weight of a frame, identify the current rating for each module. Select the weights from the appropriate column in the adjoining table for SafeGear components.

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.

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.

Typical frame weights are listed in the adjoining table. Weights include all modules and components previously listed.

Basic frame configuration	Circuit breaker (rating)	Weight	
		lbs	kg
One circuit breaker	1200	2023	918
	2000	2441	1107
	3000	3331	1511
	4000	3461	1570
Two circuits breakers	1200/1200	3013	1367
	1200/2000	3302	1498
One circuit breaker, one VT	1200	2440	1107
	2000	2858	1296
	3000	3748	1700
One circuit breaker, two VTs	1200	2859	1297
	2000	3277	1486
One circuit breaker, one VT	1200	3210	1456
	2000	3628	1646
One circuit breaker, one CPT fuse	1200	2590	1175
	2000	3008	1364

Note: These weights do not include the circuit breakers. Please reference the AMVAC or ADVAC breaker technical guides for more information

Heat dissipation

All frame styles

To calculate the total heat dissipation, in watts by frame, select the proper element from the adjoining table for SafeGear components.

Breakers can be either ADVAC or AMVAC and are assumed to operate at full rated current.

5-15 kV ADVAC and AMVAC CBs	Device or CB	Bussing and enclosure	Total
1200 A CB	413	713	1426
2000 A CB	845	1145	2290
3000 A CB	845	1520	3040
4000 A CB	1502	2702	5404
CTs (sets of 3)			
600:5	23		45
1200:5	45		90
2000:5	75		150
3000:5	113		225
4000:5	150		300
Auxiliary frames	150		300
Main bus per frame			
1200 A	108		216
2000 A	180		360
3000 A	115		230
4000 A	204		409
CPTs			
CPT - 5 KVA, 1 Phase	60		120
CPT - 10 KVA, 1 Phase	115		230
CPT - 15 KVA, 1 Phase	175		350
CPT - 25 KVA, 1 Phase	295		590
CPT - 50 KVA, 1 Phase	450		900
CPT - 45 KVA, 3 Phase	520		1040
CPT - 75 KVA, 3 Phase	885		1770
Heaters - 300 WATT heater at 75 WATTS (each)	75		75

Note: All values are in watts



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