

Technical and application guide

# Medium voltage ANSI air-insulated switchgear

Power and productivity  
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# Portfolio at a glance

Product name	Voltage class (kV)			Maximum main bus (A)	Short circuit (kA)	Arc-resistant	Dimensions (in) W x H x D
	5	15	27				
Advance	x	x		4000*	25, 31.5, 40, 50	N/A	36 x 95 x (85 or 92)
Advance 27			x	2000	16, 25	N/A	36 x 95 x 92
ReliaGear ND	x	x		2000	25, 31.5	N/A	26 x 104 x 77 for 1-H 26 x 104 x 85 for 2-H
SafeGear	x	x		3000	25, 31.5, 40, 50	2, 2B, 2BC	36 x 129.5 x (85 or 92)**
SafeGear HD	x	x		4000*	50, 63	2, 2B	36 x 129.5 x 112**

\*4000 A rating is forced-air cooled

\*\*Heights include plenum and vent box with handle in open position

Feature	Advance	Advance 27	ReliaGear ND	SafeGear	SafeGear HD
Maximum voltage – 15kV	X		X	X	X
Maximum voltage – 27kV		X			
Maximum short circuit – 50kA	X			X	
Maximum short circuit – 63kA					X
UL Labeled	X	X	X	X	X
CSA Certified	X			X	X
Arc-resistant Type 2, 2B				X	X
Arc-resistant Type 2C, 2BC				X	
Reduced width			X		
AMVAC Breaker	X	X		X	
ADVAC Breaker	X			X	X
Vmax/A breaker			X		
Outdoor non-walk-in	X	X			
Outdoor sheltered aisle	X	X	X	X	
PDC (Power Distribution Center)	X	X	X	X	X



Technical and application guide

# Advance<sup>®</sup>

## 5, 15 and 27 kV ANSI, metal-clad switchgear

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# General Overview

## Advance® 5, 15 and 27 kV ANSI, metal-clad switchgear

### Introduction

Advance is ABB's ANSI non-arc-resistant, metal-clad switchgear line for short circuit currents at 50 kA and below and rated maximum voltages of 5 and 15 kV. Advance 27 is ABB's ANSI non-arc-resistant, metal-clad switchgear line for 27 kV applications.

### Certifications

The Advance line of metal-clad switchgear is seismic certified IBC region D with importance factor of 1.5. The manufacturing locations for the Advance line are both ISO 9001 and 140001 certified. Advance switchgear is available with UL label or as a CSA certified lineup. Advance 27 is available with a UL label only.

### Applicable standards

ABB Advance is designed, built, and tested per the IEEE C37.20.2-1999 metal-clad switchgear standard.

### Construction

The Advance line is manufactured of hem bent, 14-gauge galvanized steel for superior rust and scratch protection. All parts of the frame that are not galvanized steel are treated and painted ANSI 61 gray.

The Advance product utilizes many of the same structural designs used in ABB's arc-resistant Safegear product, which provides an extremely robust design.

Using a modular and bolted frame design with 19, 38, 57 or 95-inch compartment sizes, Advance provides highly flexible design configurations and field changes are made easier and faster to reduce downtime.

### Outdoor enclosures

The Advance product line can be supplied in outdoor non-walk-in, outdoor sheltered-aisle enclosures or PDC (power distribution center) enclosures for outdoor applications.

### Breakers used in the Advance platform

The 5-15 kV Advance platform uses ABB AMVAC and ADVAC breakers. Advance 27 is available with AMVAC breakers only. More details, including ratings tables, can be found in the ADVAC Breaker Technical Guide (1VAL050501-TG ) and AMVAC Breaker Technical Guide (1VAL050601-TG).

### Instrument transformers

ABB Advance 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 3000A breakers and exclusively in the Advance 27 platform.

For ground CT requirements, the Advance line can be supplied with 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 5kV applications, Advance switchgear utilizes ABB VIY-60 potential transformers (PTs). For 15 kV applications, Advance uses ABB VIZ-11 and VIZ-75 PTs. For 27kV applications, ABB VIZ-12 and VIZ-12G potential transformers are used. All PTs are available in wye-wye, open delta, line to line, and line to ground configurations.

For more information on CTs, GCTs and PTs, please see the Switchgear Components and Accessories Technical Guide (1VAL104601-TG).

Characteristic	Unit	Rated Maximum Voltage Level			
		5 kV	8.25 kV	15 kV	27 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	20.78, 21.6, 20.86, 23.0, 23.9, 24.94, 28.5***
Main bus continuous current	A	1200, 2000, 3000, 4000**			
Short circuit current (rms)	kA	25, 31.5, 40, 50			
Rated frequency	Hz	50, 60			
Low frequency withstand (rms)	kV	19	36	36	60
Impulse level (BIL, crest)	kV	60	95	95	125

\* Ratings given are for service conditions within temperature and altitude limitations as defined by the IEEE C37.20.2-1999 metal-clad standard.

\*\*4000 A Ratings are achieved through forced air cooling

\*\*\* Contact factory if this rating is required.

# General Overview

## Advance® 5, 15 and 27 kV ANSI, metal-clad switchgear

### Available Accessories

The Advance line is available with the following accessories:

- Breaker accessory kit including breaker, PT and CPT racking handle, breaker lifting yoke
- Lift truck
- Test cabinet
- Test jumper
- SmartRack™ remote racking device
- Electrically operated ground and test device (not available for 27kV)
- Manually operated ground and test device
- Breaker ramps

### Testing

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

- One second dielectric test of 1800 VAC on 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

- Installation, operation and maintenance manual by CD or printed
- Mechanical options
  - Tin plated bus
  - Mimic bus
  - Cable supports
  - Mechanical trip on breaker doors
  - IR windows (IRISS or Fluke)
  - Channel sills
  - Surge arrestors and capacitors
  - Ground studs
  - Lexan shutters in breaker compartments (Lexan shutters are standard for 27 kV applications)
  - Mechanical breaker position indicator on front of breaker door
- Electrical options
  - Separate or common pull-out fuse block or molded case circuit breaker trip and close coil protection
  - 10%, 15%, 20% spare terminal blocks

- Phase bus marking labels
- Instrument door ground strap

### Configuration software

Medium Voltage Pro (MVP) has been developed to be a switchgear configuration 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
Advance 27 Descriptive Bulletin	1VAL107001-DB
Advance 27 Flyer	1VAL107001-FL
Installation, Operation and Maintenance Manual for Advance	1VAL108001-MB
ADVAC Breaker Technical Guide	1VAL050501-TG
AMVAC Breaker Technical Guide	1VAL050601-TG
Instrument Transformers Technical Guide	1VAL066701-TG
Switchgear Components and Accessories Technical Guide	1VAL104601-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

- 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 for heat ventilation
- CPTs greater than 15 kVA single-phase require a draw-out fuse unit with stationary mounted CPT
- PTs may not be mounted above a 3000 A breaker, but a 3000 A breaker may be placed in the top position with PTs below
- 4000 A breakers must be in their own frame in the bottom breaker position with a 57-inch instrument compartment above

# Construction

## Doors

Advance front doors consist of the breaker compartment, auxiliary unit compartments and LV compartments. These doors are provided with a single handle, multi-point latch (MPL) as standard. Bolted doors are available as an option. All doors are hinged on the left as standard (when facing the front door). Right-hand hinged doors are available as an option.

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

- Full height hinged and bolted
- Split doors (top compartment/bottom compartment) hinged and bolted
- Full height hinged with multi-point latch (MPL) is optional
- Bolted, non-hinged full height or split doors are also available as an option

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

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

Breaker and auxiliary compartment unit doors include a viewing window 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 without adding the optional 10-inch front extension to the front of the frame. With the 10-inch front extension, protection and control relaying can be installed on these doors.



# Compartment types

## Circuit breaker compartment

### Circuit breaker compartments

Advance circuit breaker compartments are designed for operator safety by providing one large viewing window 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 racking operation.

### 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 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 the primary or secondary contacts and is continuous during the racking operation.

The three racking positions are defined as follows:

- Disconnect: 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.

**Note:** Terminal blocks normally covered by grounded metal barrier have been removed in this photo

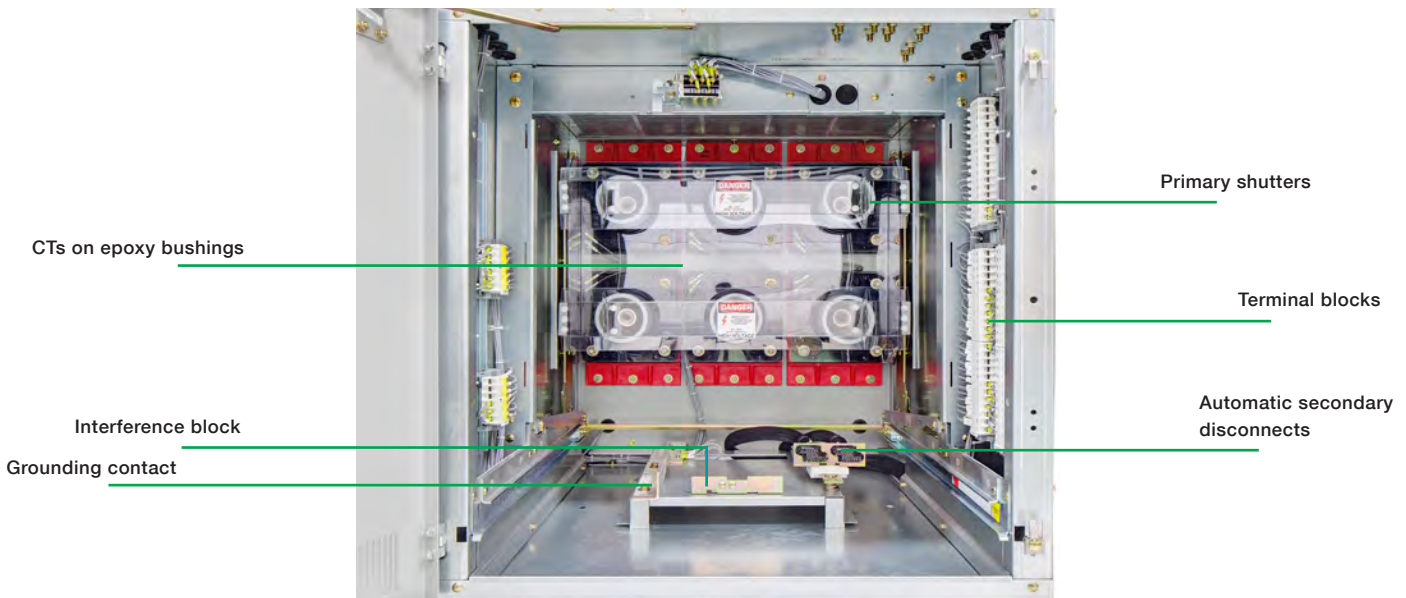


### Secondary disconnect system

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. Potentially energized contacts are recessed and are touch safe. No manual connection of secondary contacts required.

### 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 Lexan material. Lexan is standard for 27 kv applications. Primary shutter opening and closing is forced by circuit breaker movement, rather than relying on springs or gravity. A locking mechanism prevents opening of the shutter when the circuit breaker is removed.





# Compartment types

## Auxiliary modules

### PT/CPT/Draw-out fuse compartments

Similar to breaker compartments, potential transformer, control power transformer and draw-out fuse compartments are inserted via a racking mechanism which allows for closed door racking 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.

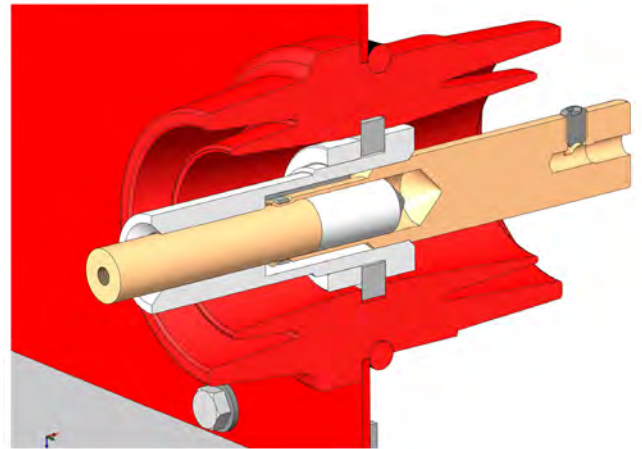
All primary auxiliary compartments, including potential transformers, control power transformers and draw-out fuse compartments, use arc-quenching Delrin® technology for primary contact assemblies (Delrin® is a registered trademark of DuPont). A Delrin® tipped conductor probe is inserted into a Delrin® 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 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 15 kVA, minimizing the possibility of inadvertent interruption of

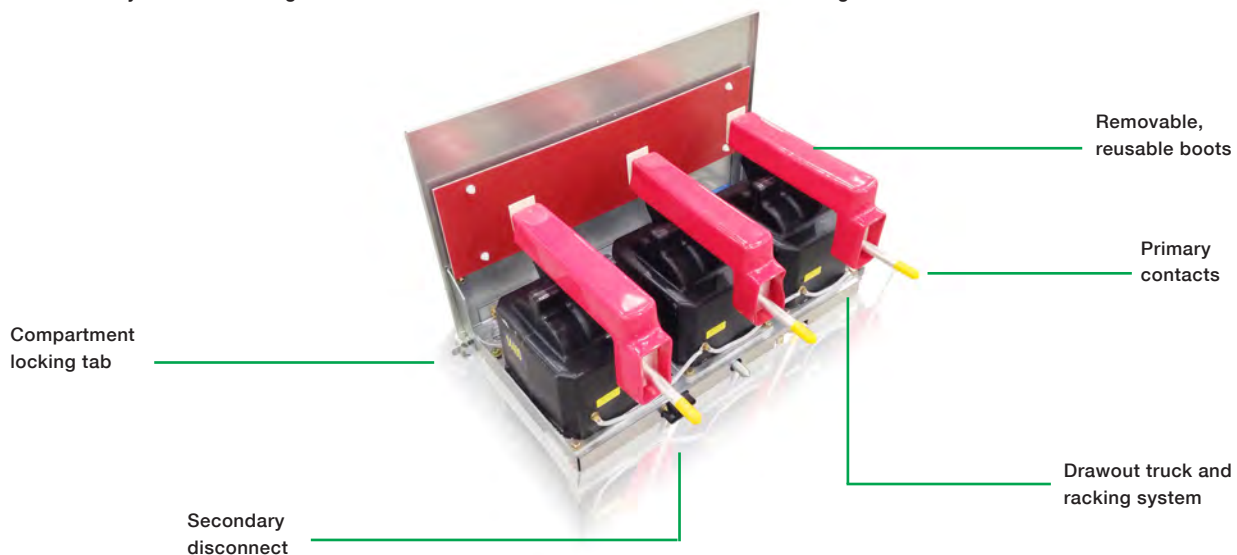
PT drawout assembly with three voltage transformers - the fuses can be removed without removing the PT truck from the rails



Delrin primary probe and recessed contact assembly

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 45 kVA three-phase or 50 kVA single phase. Fixed mounted CPTs can be mounted in the rear cable compartment or at a remote location.



# Compartment types

## Instrument compartment

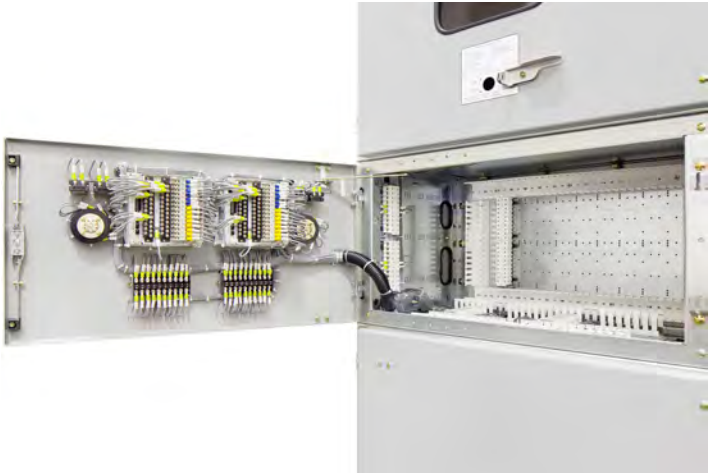
### Instrument compartment

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 operations and maintenance personnel while they work on control and auxiliary circuits. The LV wiring pans are designed to be removeable and customizable.

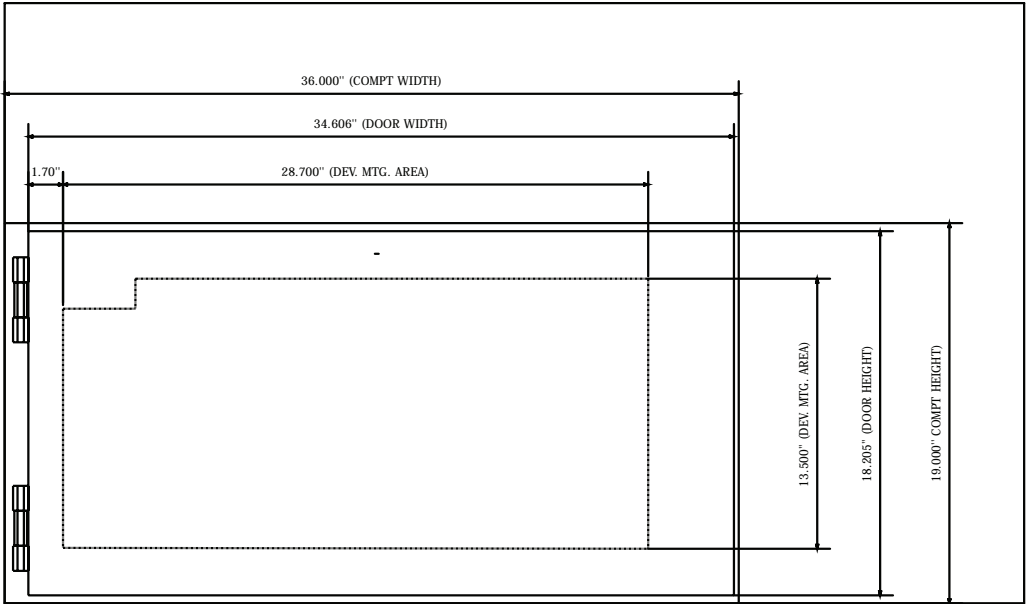
Plastic enclosed wireways are used to provide protection for the wiring, as well as a neat and organized appearance. This allows for easy addition of wiring, should it be needed.

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.



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

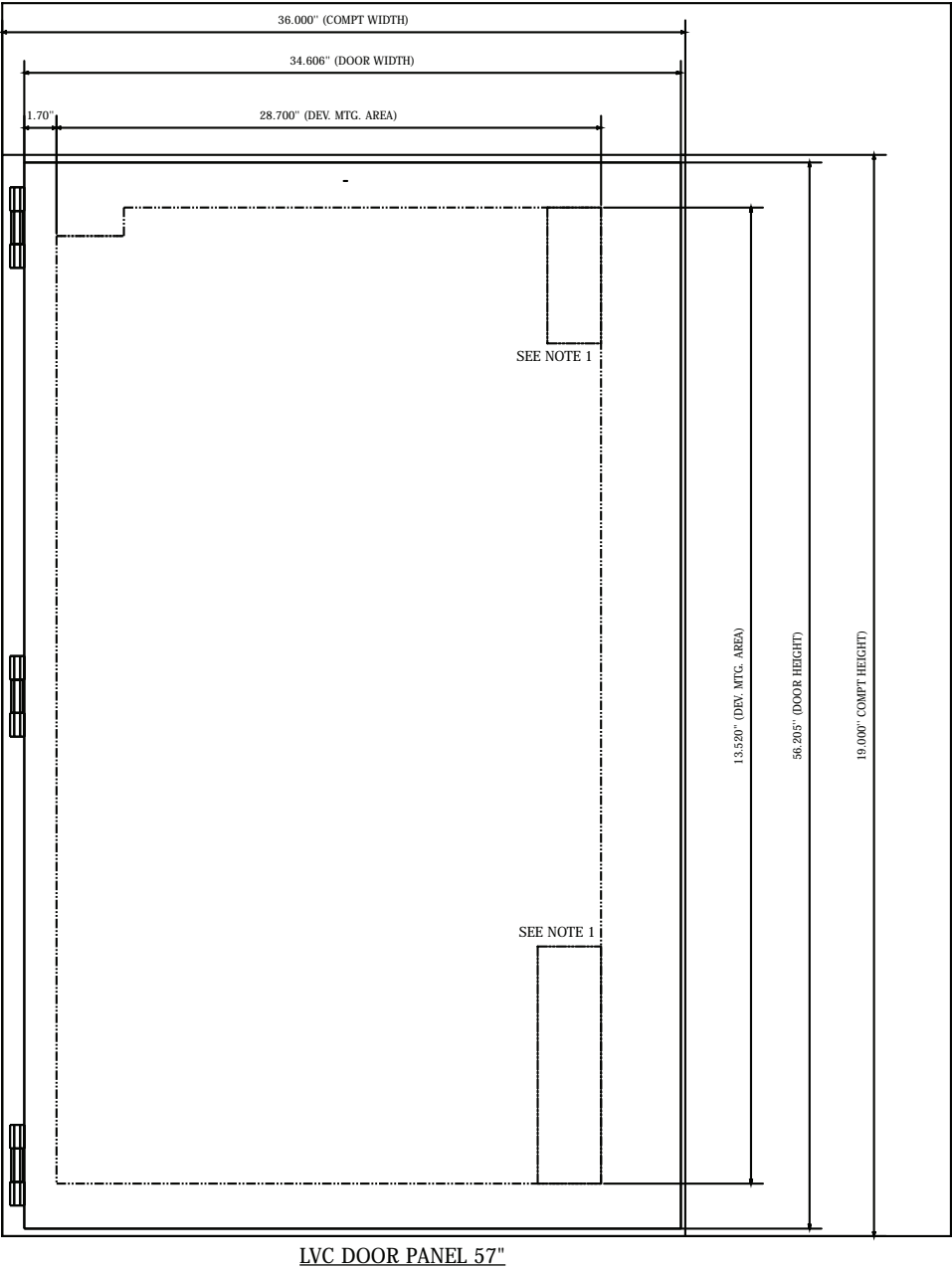


LVC DOOR PANEL 19"



# Compartment types

## Instrument compartment



# Compartment types

## Bus compartment

### Bus compartment

All primary buses are copper with a corona-free design, and are available in 1200, 2000, 3000 and 4000 A ratings. 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 expansion.

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.

### Bus design details-Advance

Continuous current	Short-circuit rating	Quantity	Size
1200 A	up to 50 kA	1	.375" x 4"
2000 A	up to 50 kA	1	.75" x 4"
3000 A	up to 50 kA	2	.75" x 4"
4000 A	up to 50 kA	2	.75" x 4"

Advance non-arc-resistant, metal-clad switchgear design certifications are based on glass polyester or porcelain primary bus supports. Epoxy is standard for standoff bus insulator supports. Primary breaker bushings and interframe main bus supports are glass polyester at 1200/2000 A and porcelain at 3000/4000 A breaker bushings and interframe main bus supports. Separate drawings are available to indicate the position and dimensions of the epoxy compartment-mounted primary contact supports, epoxy inter-frame horizontal bus supports, and standoff insulators. If porcelain bus supports and insulators are needed, contact factory.

Characteristic	Epoxy specification
Flexural Strength, MPA	120 - 150
Tensile Strength, MPA	70 – 90
Impact Strength, KJ/m2	10 – 15
Thermal Class	F
Dielectric Strength (Short Time), kV/mm	> 23

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

Insulating standoffs rigidly support the bus. This includes jumps, the connections from stationary primary contacts to the main bus and risers, and connections from the stationary primary contacts to line or bus terminations. Internal standoffs and inter-frame supports are epoxy for all ratings. For applications requiring porcelain, contact the factory.

### Bus design details-Advance 27

Continuous current	Short-circuit rating	Quantity	Size
1200 A	25 kA	1	.375" x 4"
2000 A	25 kA	1	.75" x 4"

Advance 27 utilizes a special bus boot design consisting of black Plastisol joint covers encapsulating all bus joints and a special bus skirt applied to each of the bus bars. A silicone sealant is used to assure complete sealing of the skirts and the boot. All boots installations are completed by nylon hardware to seal the flanges

Advance 27 metal-clad switchgear design certifications are based on porcelain primary bus supports. Porcelain is standard for standoff bus insulator supports, primary breaker bushings and inter-frame main bus supports. Separate drawings are available to indicate the position and dimensions of the porcelain compartment-mounted primary contact supports, porcelain inter-frame horizontal bus supports, and standoff insulators. Physical characteristics of the porcelain material are provided in the following table

Characteristic	Porcelain specification
Flexural Strength, ksi	25
Tensile Strength, ksi	6
Izod Impact Strength, ft-lb/inch of notch	1.5
Thermal Shock – cycles	1
Dielectric Strength (Short Time), V/m	300

# Compartment types

## Cable compartment

The design of the cable compartments for Advance 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 or bottom connections can also be made to bus duct.

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

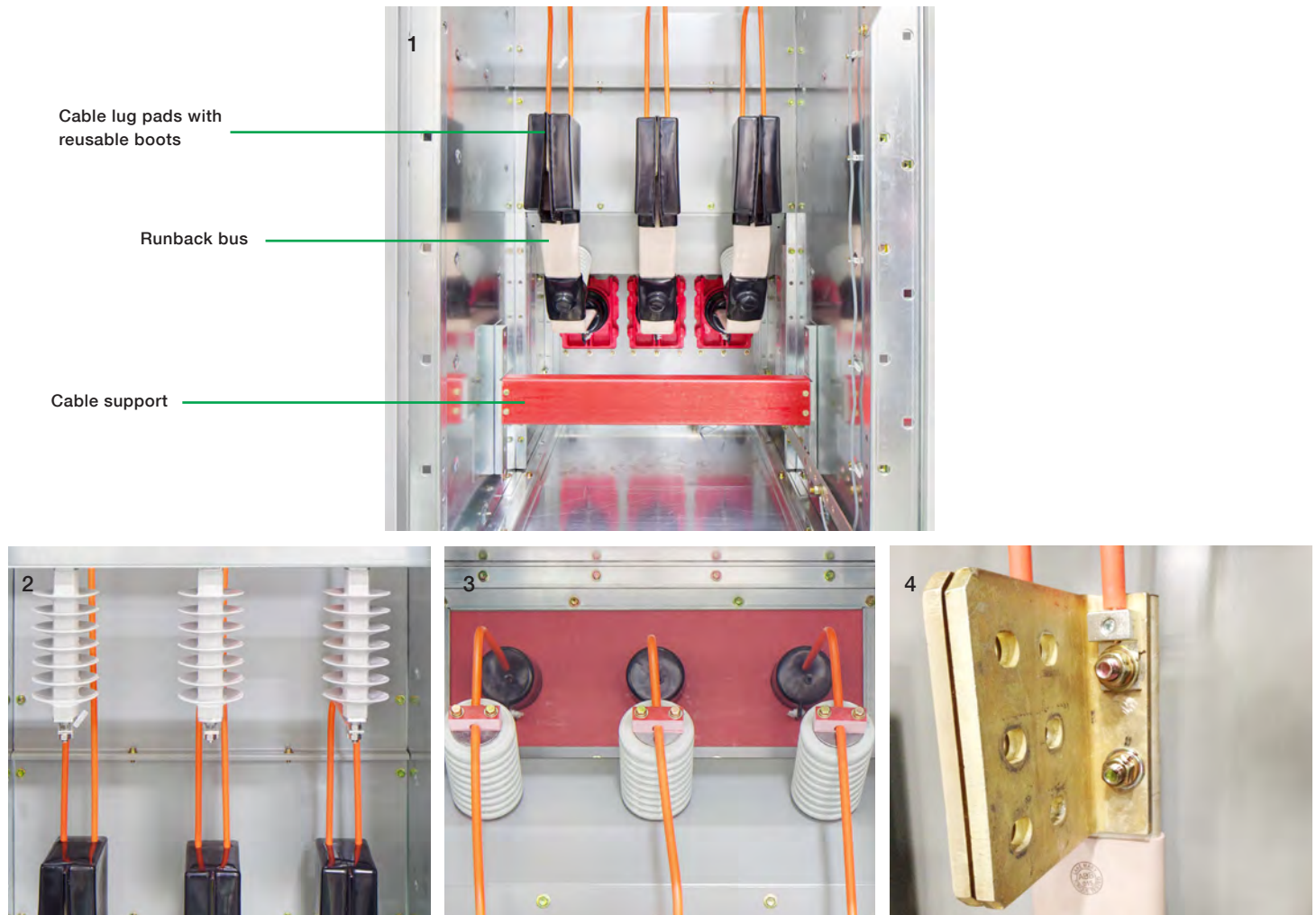
Cable compartments are available with optional readily accessible zero sequence current transformers, surge arrestors and capacitor and ground studs on the bus risers. When a draw-out fuse compartment is installed in the front of the switchgear, the

rear cable compartment offers room for a large three-phase, floor-mounted control power transformer up to 75 kVA for 5/15 kV applications and up to 30 kVA for 27 kV applications.

The photos below show Advance 27 frames. Advance differs only in that the boots are red and lug pads follow a standard 4-hole design.

Primary cable compartments are provided with removable cover plates used to install conduit or cable sealing glands. Non-sealing conduit snub-ups are acceptable for installation in the non-arc-resistant Advance & Advance 27 products. Conduits should be sized to accommodate the cabling intended to be used for the specific application. Non-painted 5052 aluminum 1/8" thick covers are provided as standard. 14-gauge type 304 Stainless steel is available as an option.

1 Cable compartment (main bus - cover installed) | 2 Surge arrestors | 3 PT line connection via Natvar | 4 Standard 2000 A lug pad (boot removed)



# 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, CPT or draw-out fuse compartment or two 19-inch compartments.

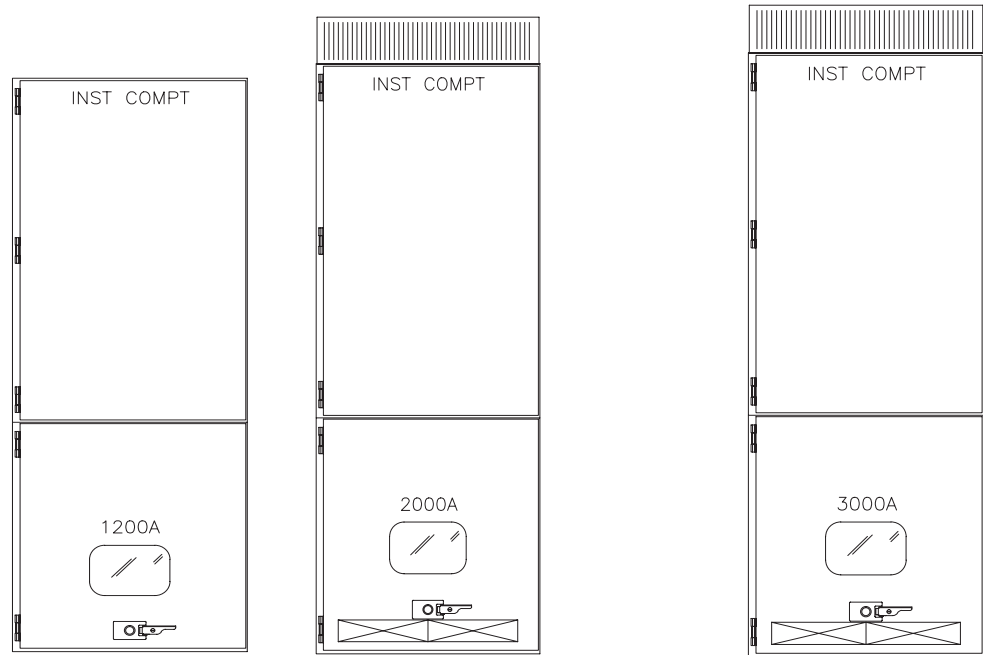
### Cable termination information

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 92" depth.

Note: Refer to page 28 for 5/15 kV floorplan and page 25 for 27 kV floorplan

### All ratings



### Dimensions

Frame	Width (in)	Height with vent box (in)	Depth (in)
2000/3000 A breaker	36	103	85 or 92*
All other frames	36	95 (no vent)	85 or 92*

\* 27 kV available in 92-inch depth only

### Options

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

# 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.

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

Dimensions			
Frame	Width (in)	Height with vent box (in)	Depth (in)
2000/3000 A breaker	36	103	85 or 92*
All other frames	36	95 (no vent)	85 or 92*

\* 27 kV available in 92-inch depth only

### Options

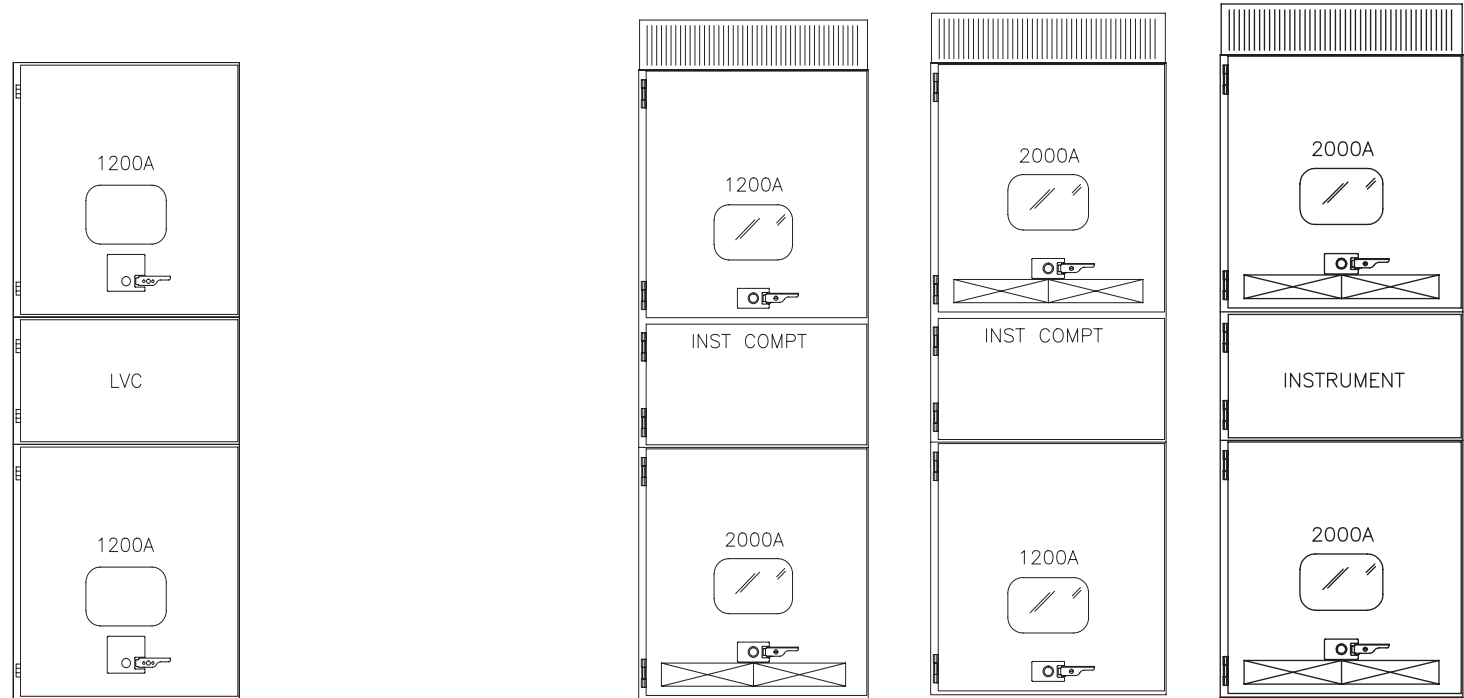
- Ground CTs
- Surge arrestors
  - Distribution
  - Intermediate
  - Station
- Surge capacitor
- Ground studs
- Space heaters
- Cable supports

#### Notes:

1. Refer to page 29 for 5/15 kV floorplan and page 26 for 27 kV floorplan
2. LVC=low voltage compartment/instrument compartment

### All ratings

### 5-15 kV ratings only



# Available frame types

## Breaker and auxiliary frames

### Description

The two-high breaker and auxiliary frame consists of one 38-inch compartment, two 19-inch compartments (that can be combined for another 38-inch compartment) with a 19-inch instrument compartment in between for one breaker and an auxiliary device in a single frame.

### 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

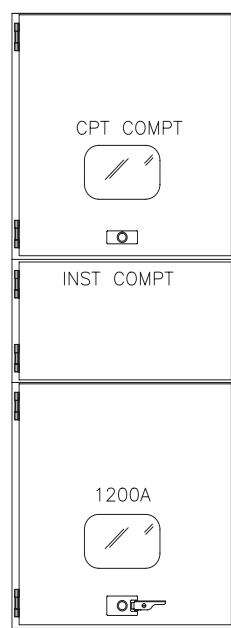
\* Bifurcated lug pad requires 92-inch depth.

### Notes:

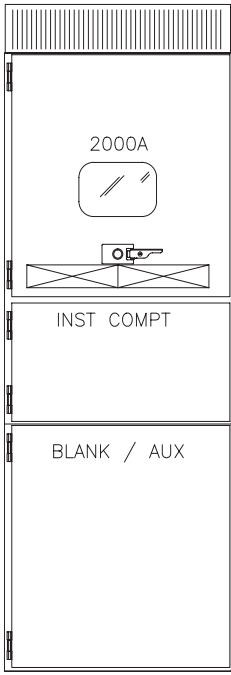
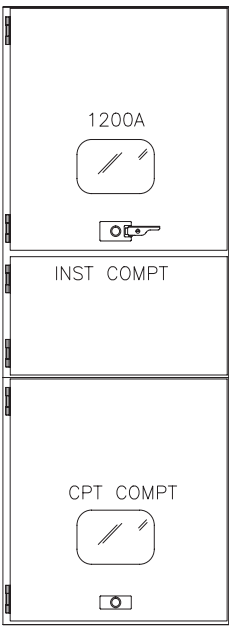
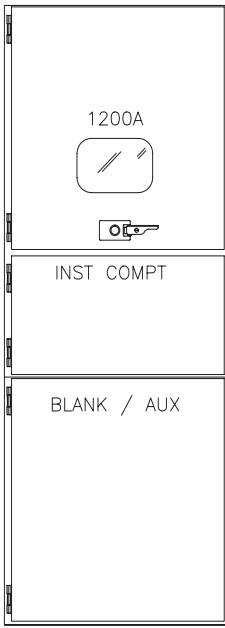
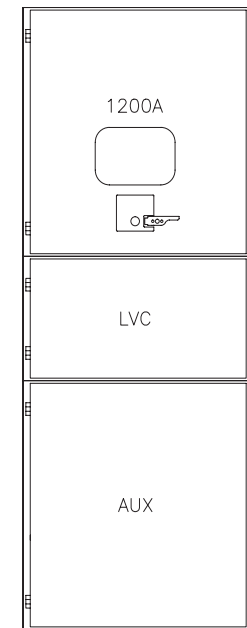
1. Refer to page 30 for 5/15 kV floorplan and page 27 for 27 kV floorplan
2. CPT=control power transformer
3. LVC=low voltage compartment/instrument compartment

### All ratings

Breaker below



Breaker above



Dimensions			
Frame	Width (in)	Height with vent box (in)	Depth (in)
2000/3000 A breaker	36	103	85 or 92*
All other frames	36	95 (no vent)	85 or 92*

\* 27 kV available in 92-inch depth only

### Options

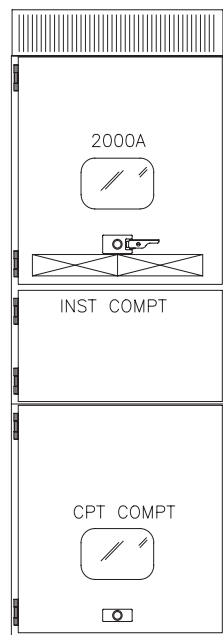
- Ground CTs
- Surge arrestors
  - Distribution
  - Intermediate
  - Station
- Surge capacitor
- Ground studs
- Space heaters
- Cable supports

# Available frame types

## Breaker and auxiliary frames

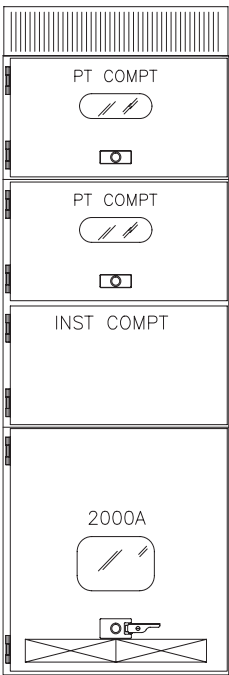
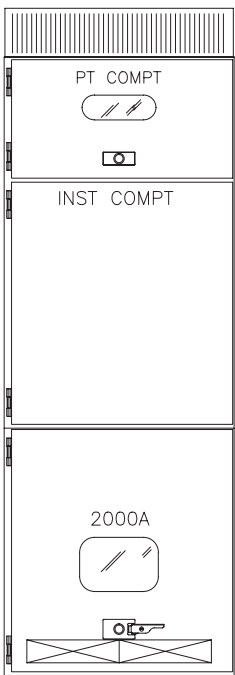
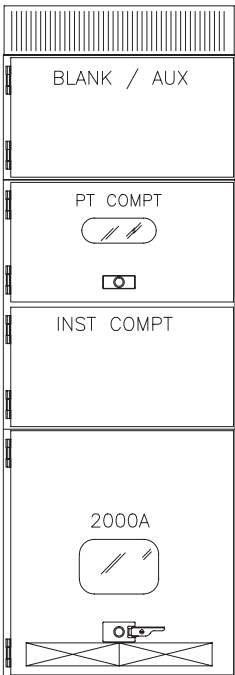
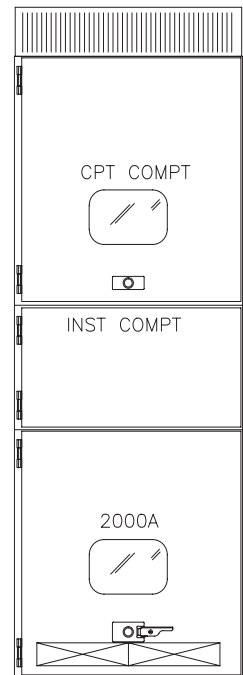
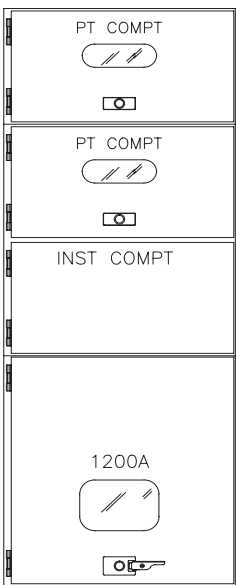
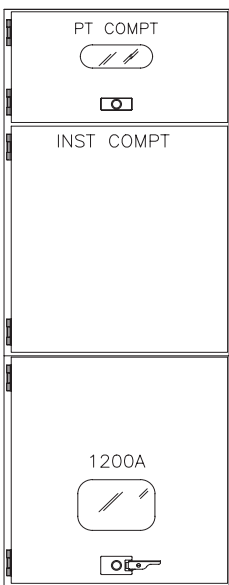
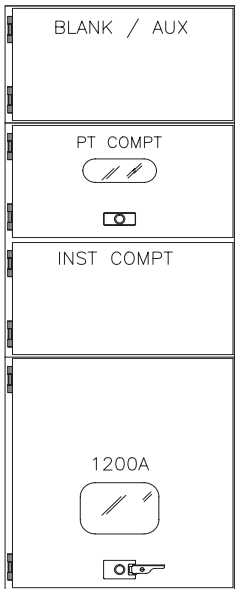
### All ratings

Breaker below



### 5-15 kV ratings

Breaker below



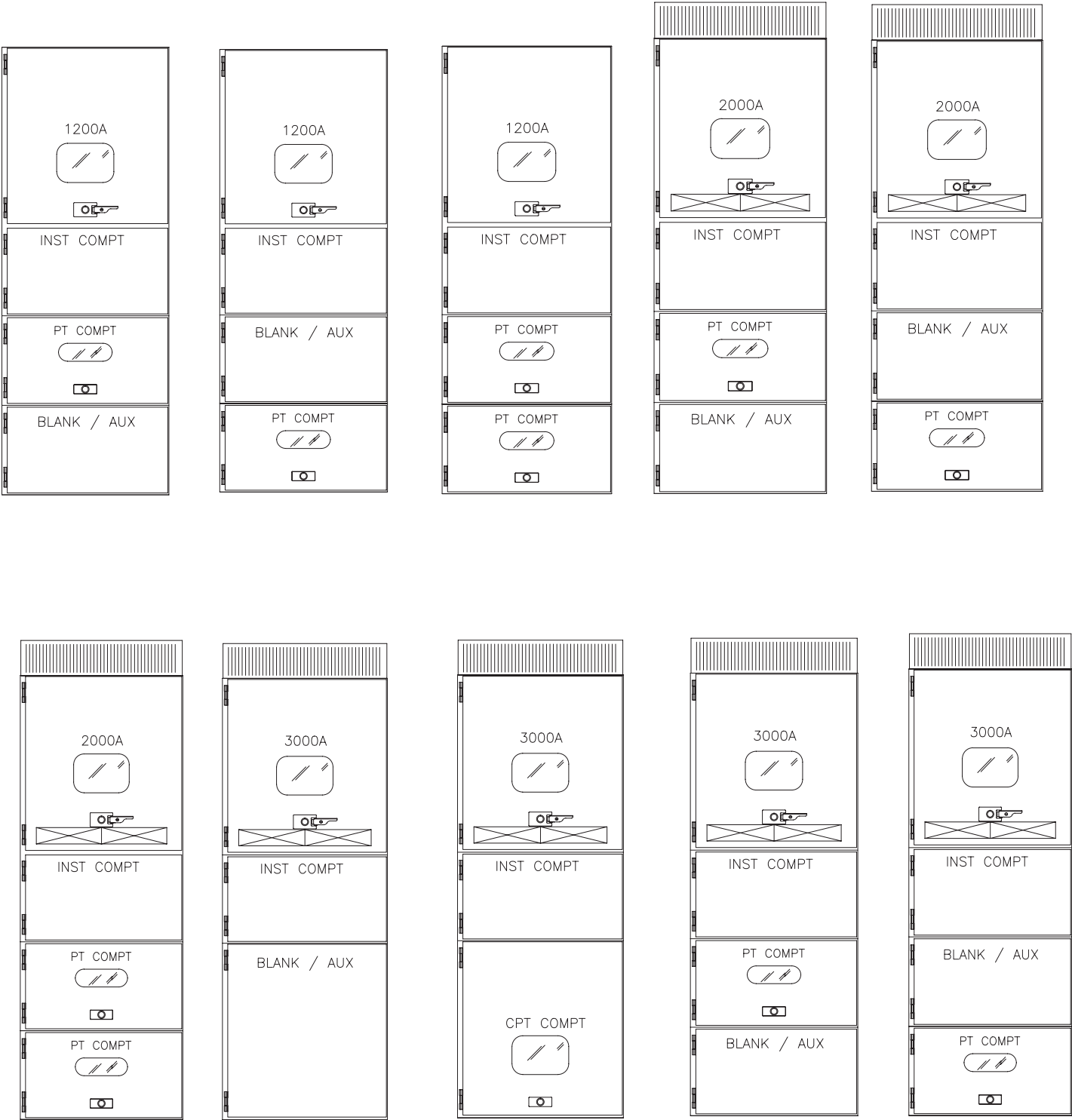


# Available frame types

## Breaker and auxiliary frames

5-15 kV ratings

Breaker above

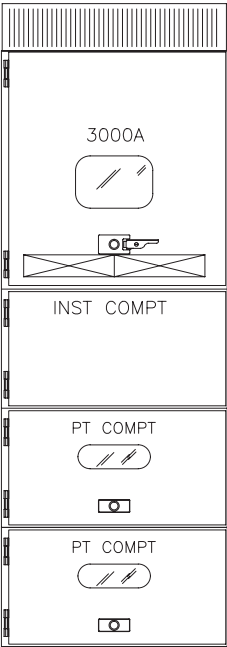


# Available frame types

## Breaker and auxiliary frames

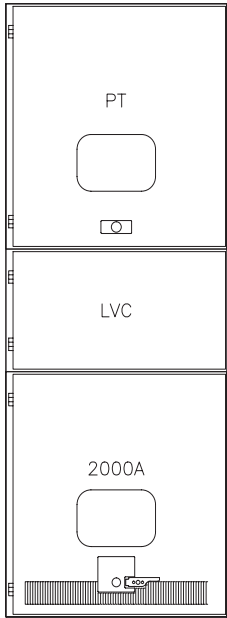
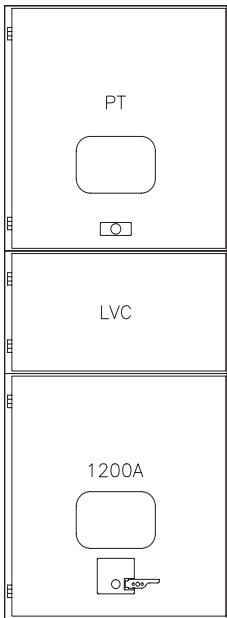
### 5-15 kV ratings

Breaker above

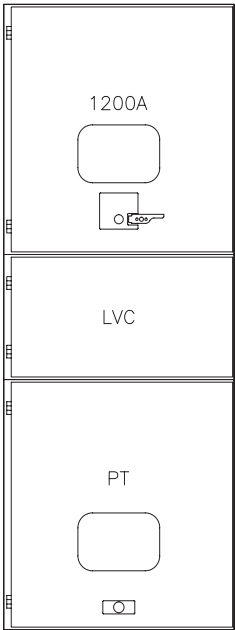


### 27 kV rating

Breaker below



Breaker above



# Available frame types

## Auxiliary frames

### Description

The Advance frame is designed around a 19-inch compartment concept, offering the ability to provide two 38-inch or four 19-inch compartments with a 19-inch instrument compartment in a single frame.

Dimensions			
Frame	Width (in)	Height with vent box (in)	Depth (in)
2000/3000 A breaker	36	103	85 or 92*
All other frames	36	95 (no vent)	85 or 92*

\* 27 kV available in 92-inch depth only

### Options

- Space heaters

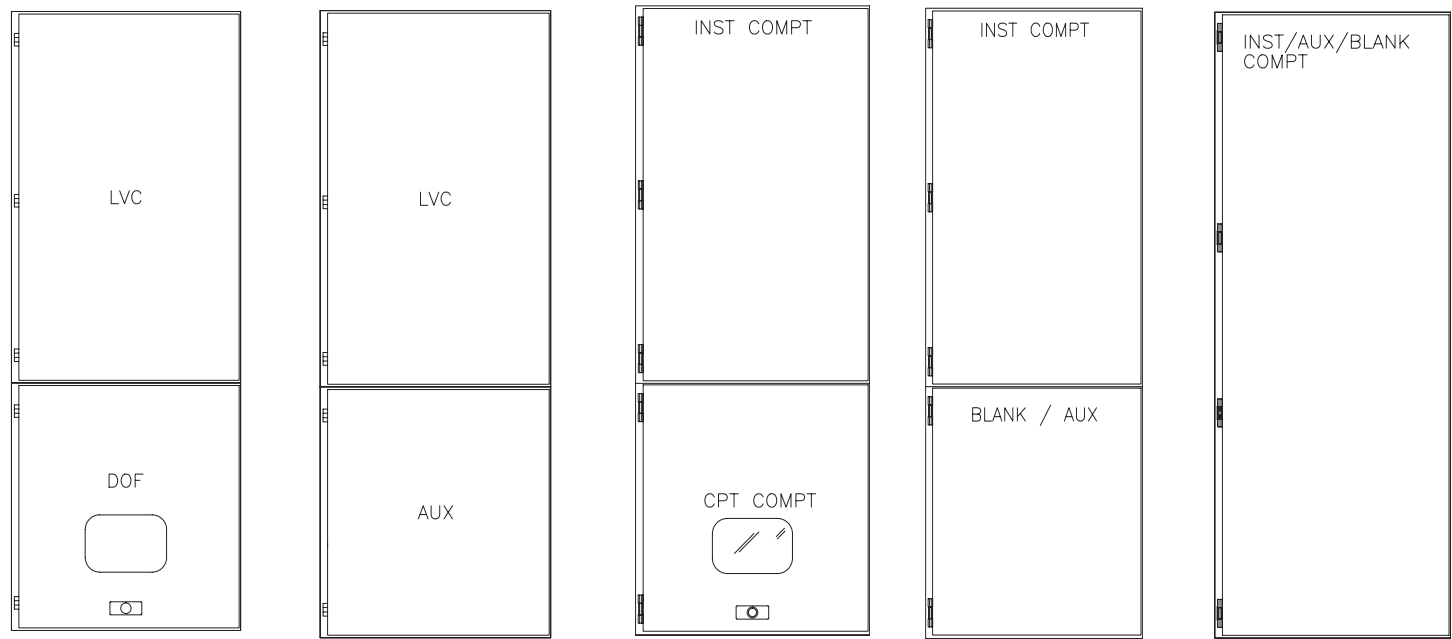
### Notes:

1. CPT=control power transformer

2. LVC=low voltage compartment/instrument compartment
3. PT=potential transformer

4. DOF=drawout fuse

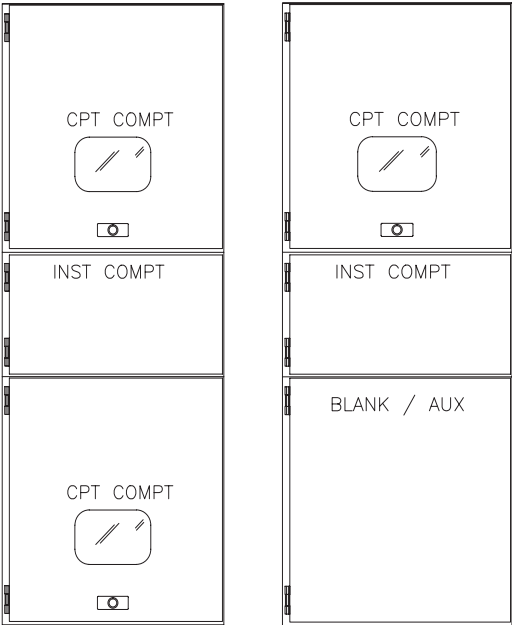
### All ratings



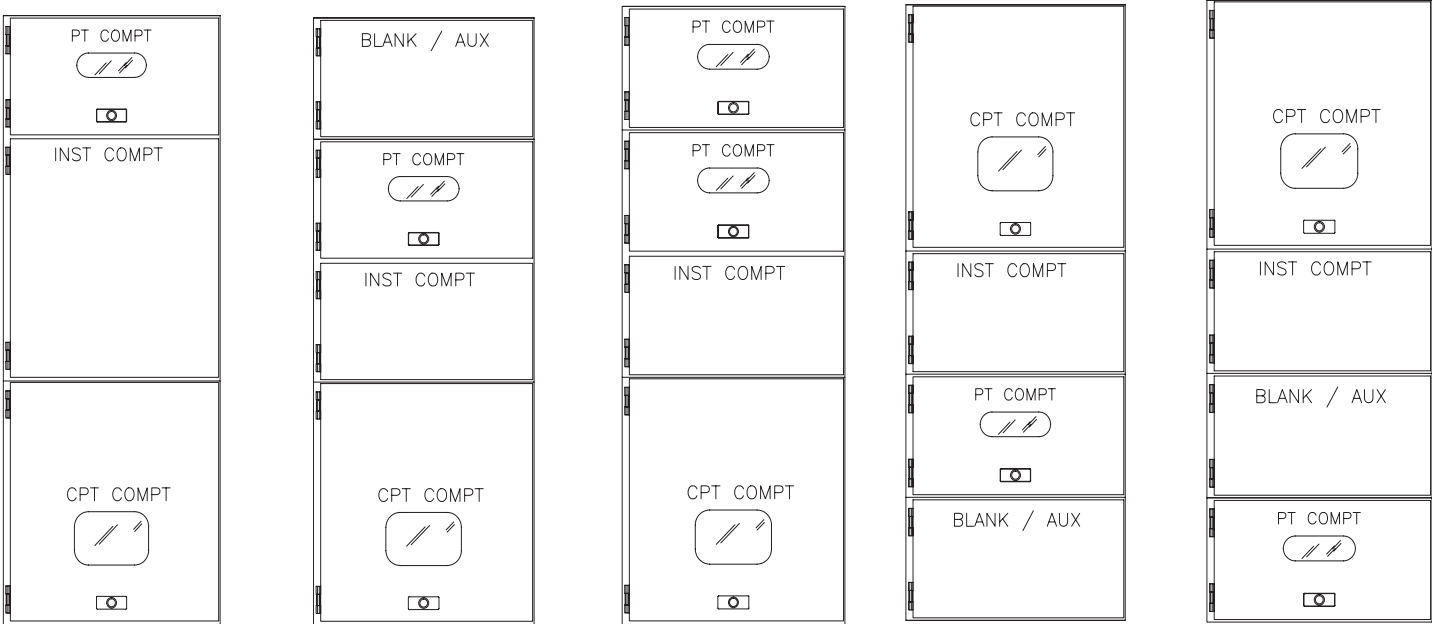
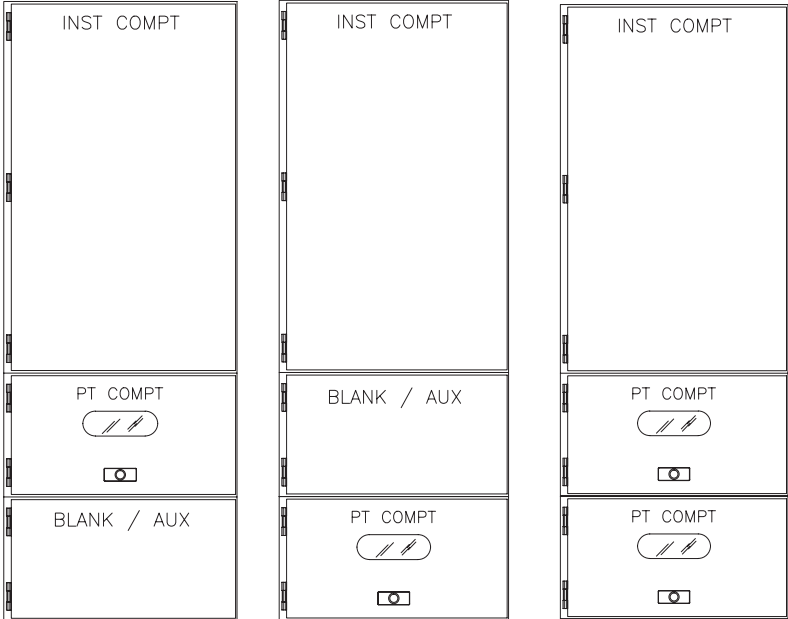
# Available frame types

## Auxiliary frames

All ratings



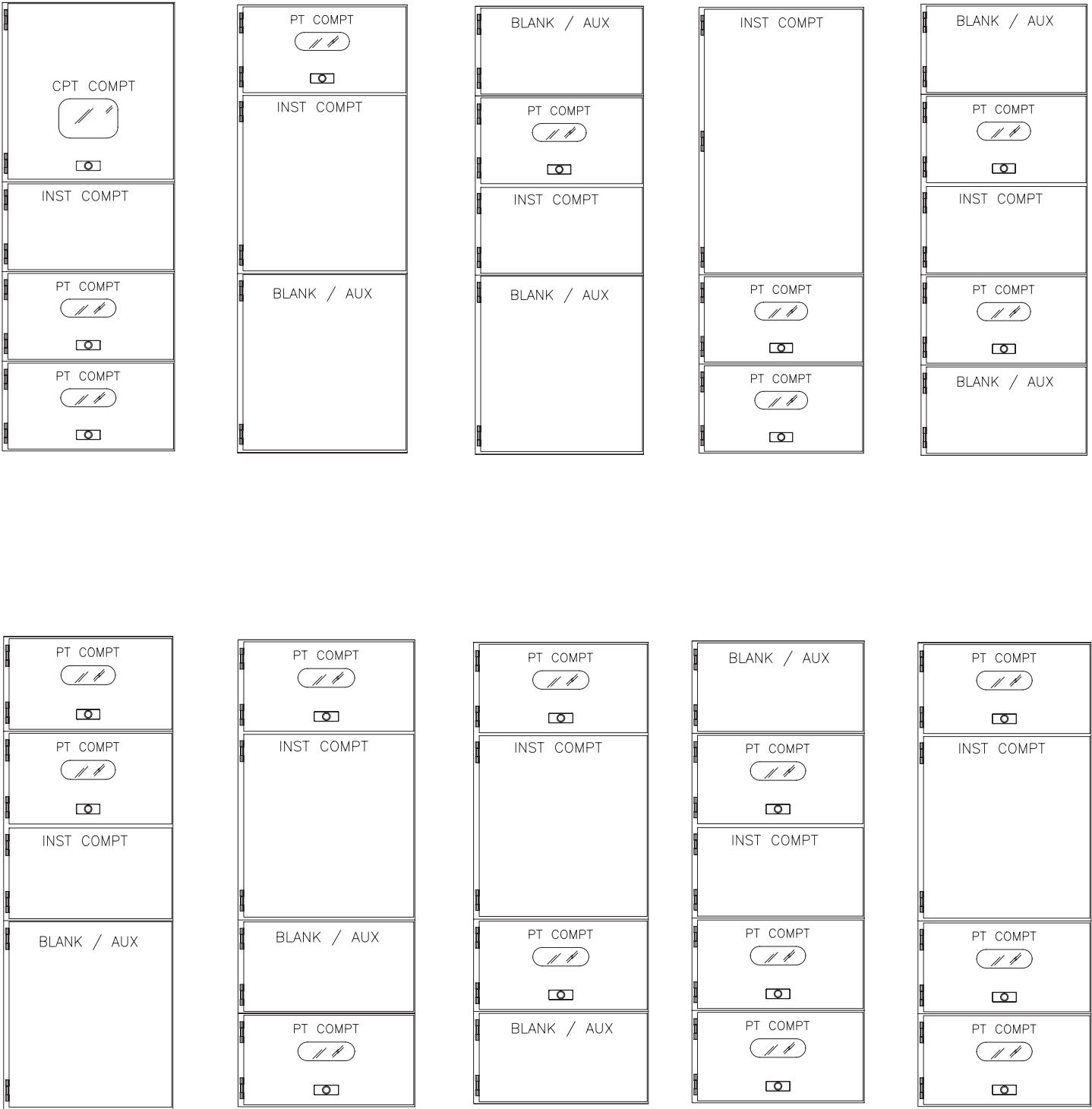
5-15 kV ratings



# Available frame types

## Auxiliary frames

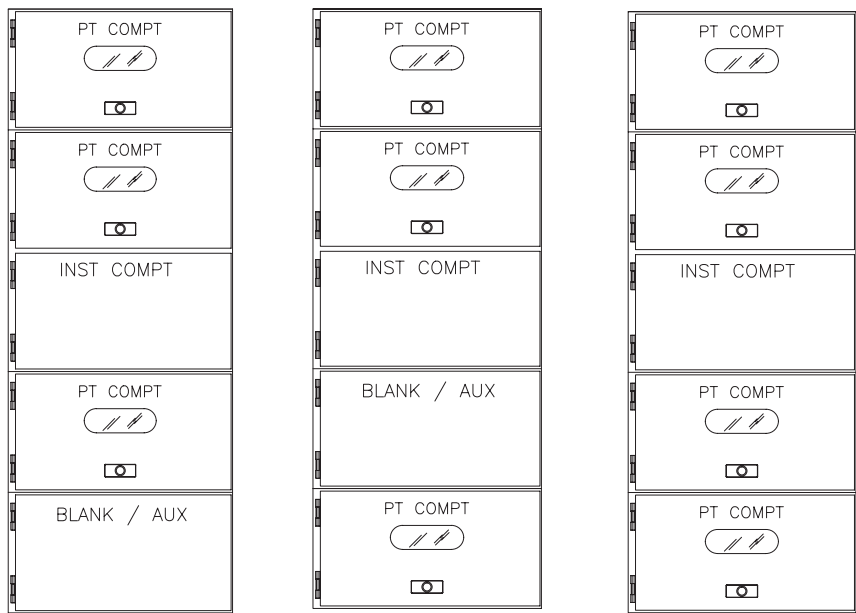
5-15 kV ratings



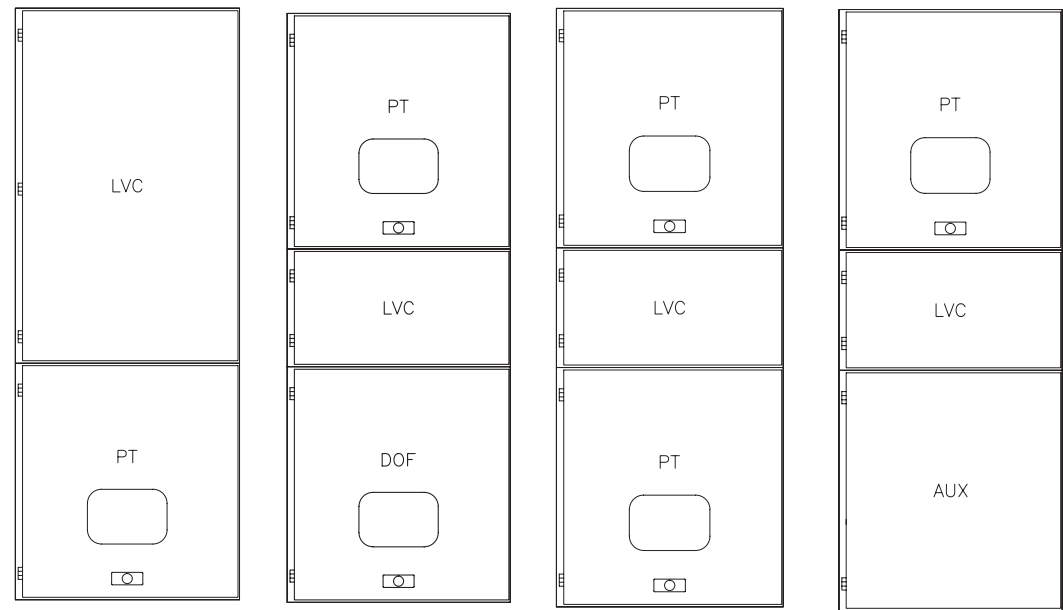
# Available frame types

## Auxiliary frames

### 5-15 kV ratings



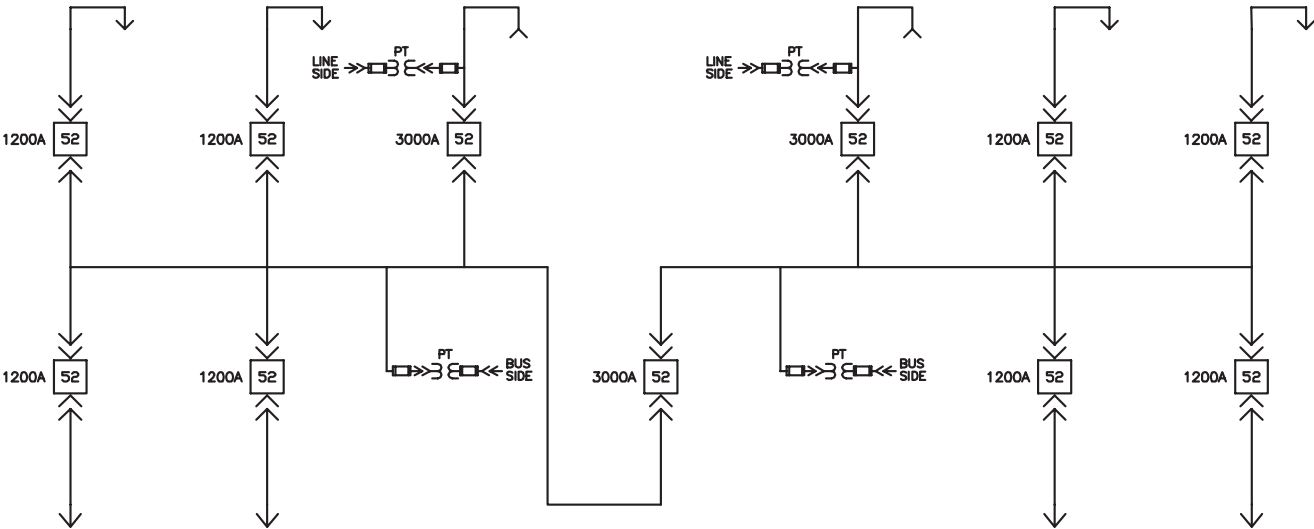
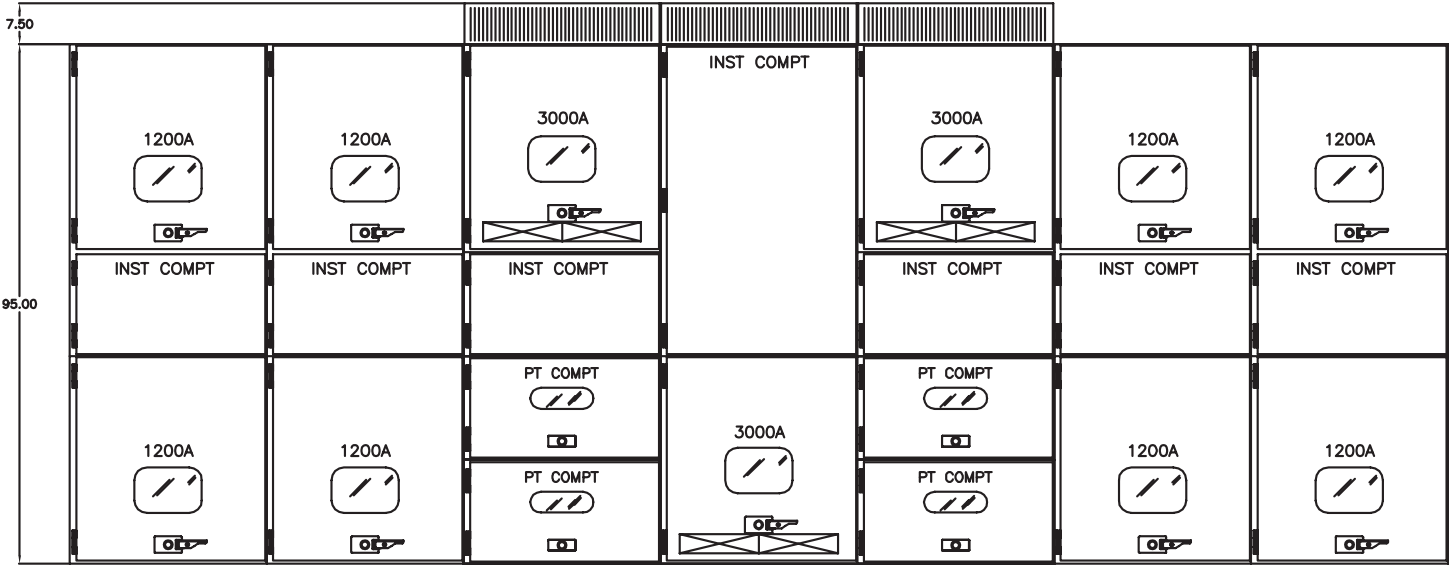
### 27 kV rating



# Typical arrangements

## 5-15 kV, 3000 A Main-Tie-Main

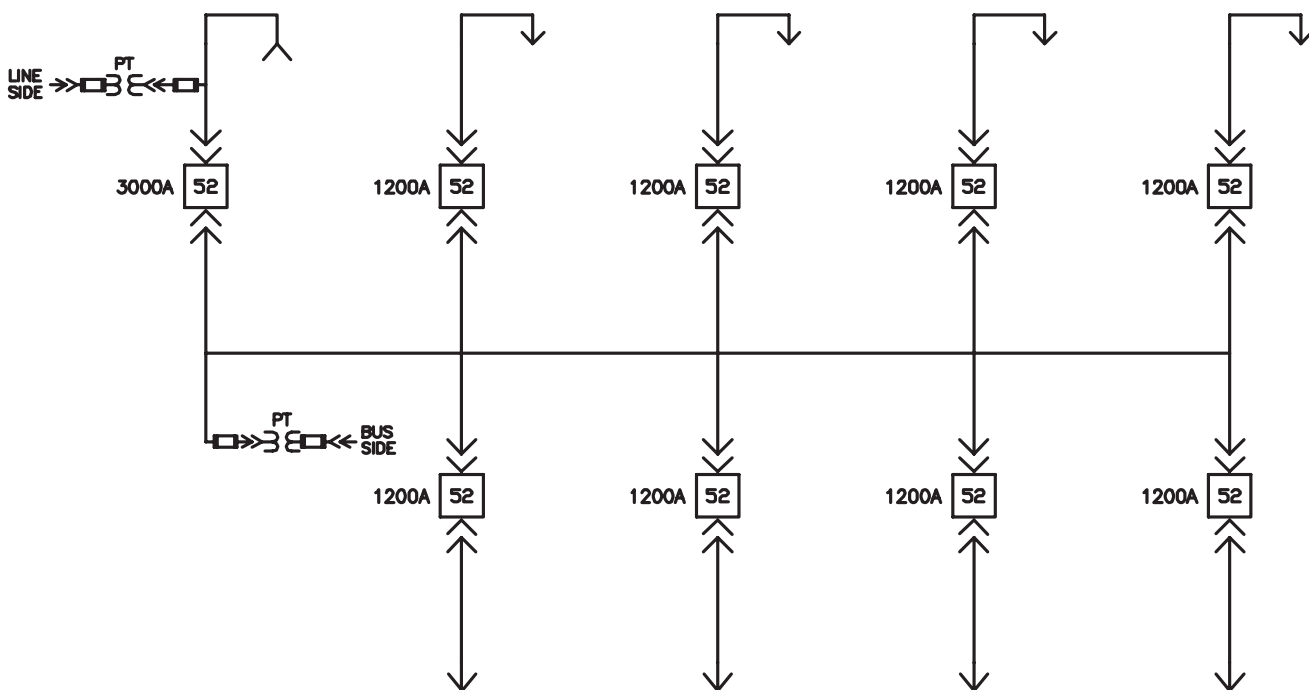
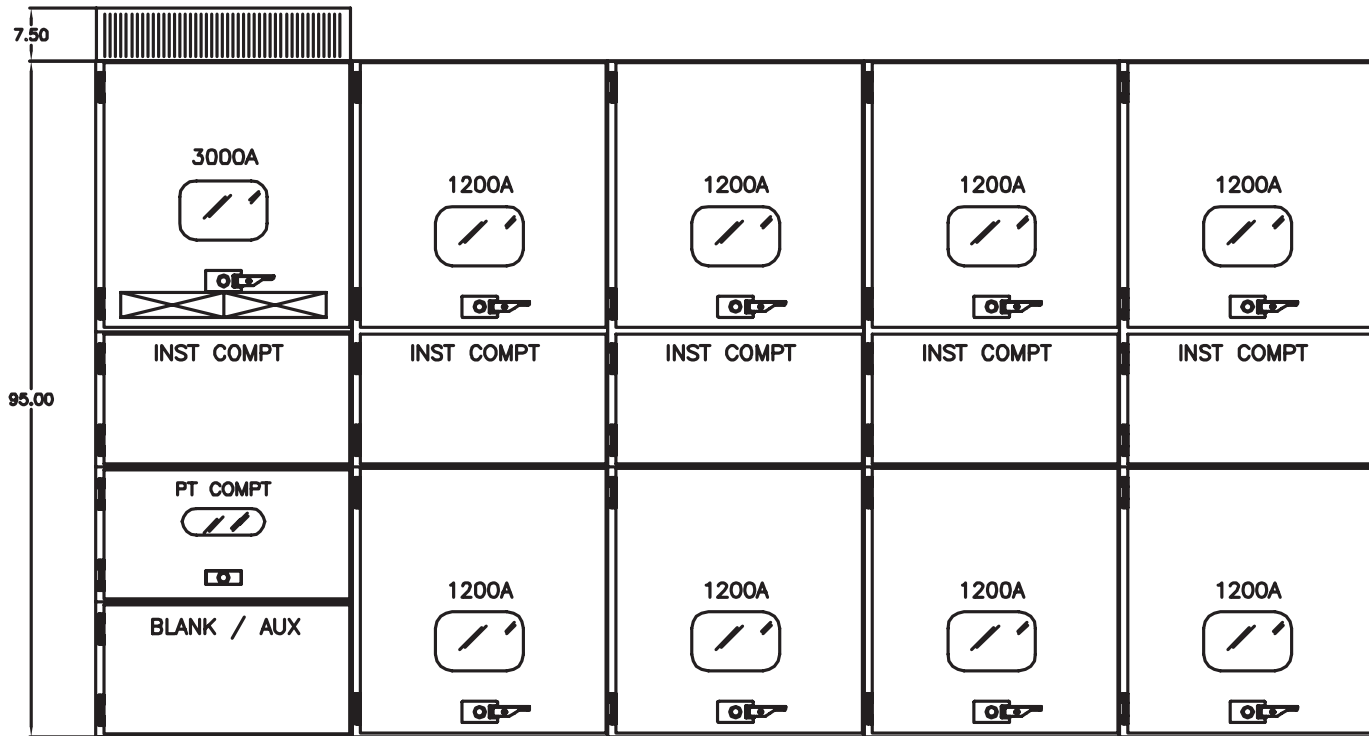
Arrangements are the same for 5, 8.25 and 15 kV





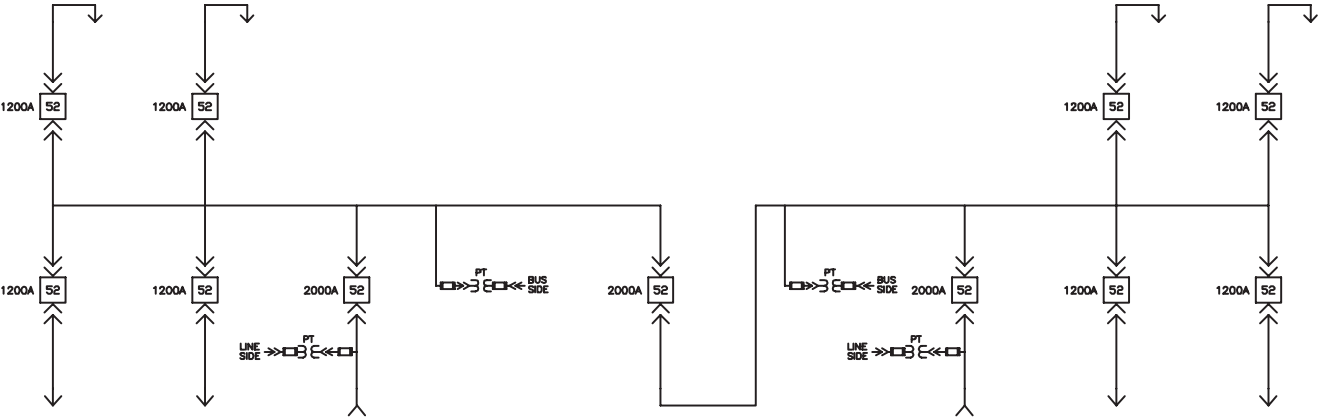
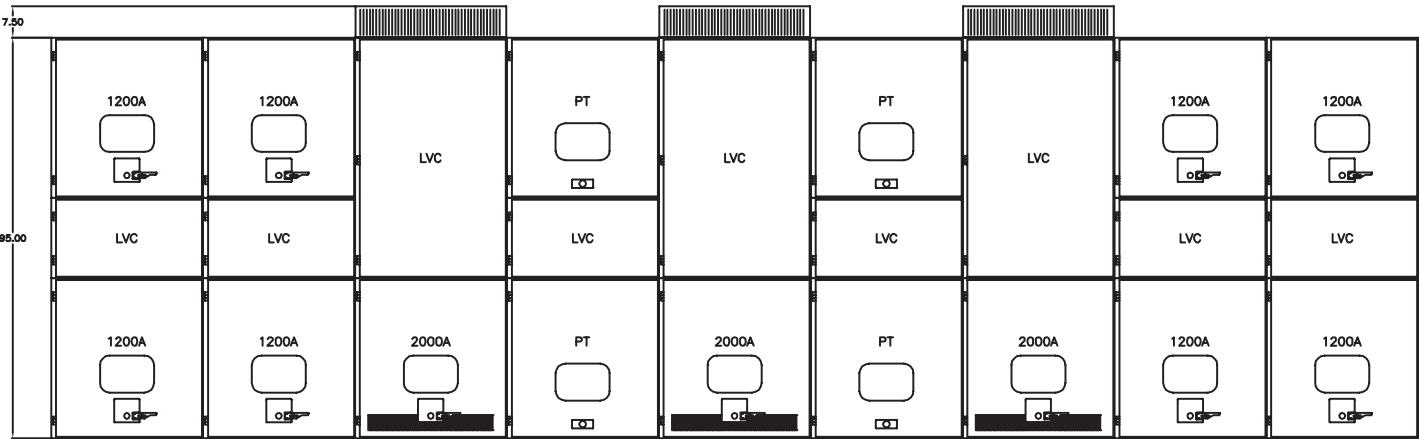
## 5-15 kV, 3000 A Main with feeders

Arrangements are the same for 5, 8.25 and 15 kV

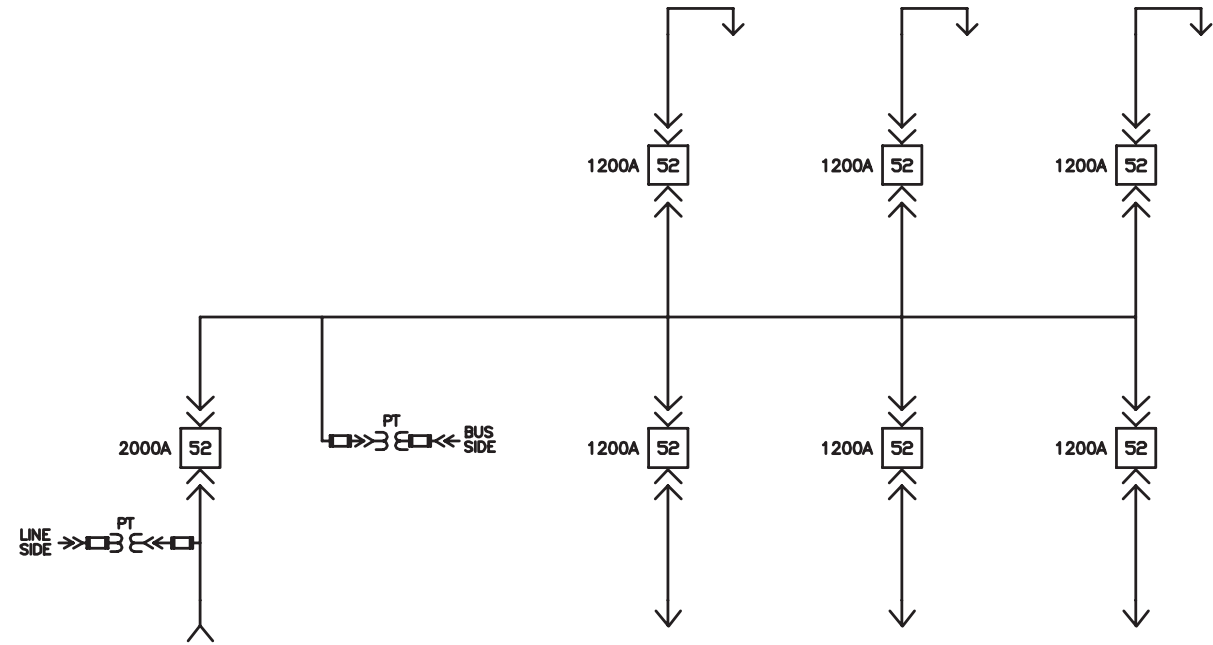
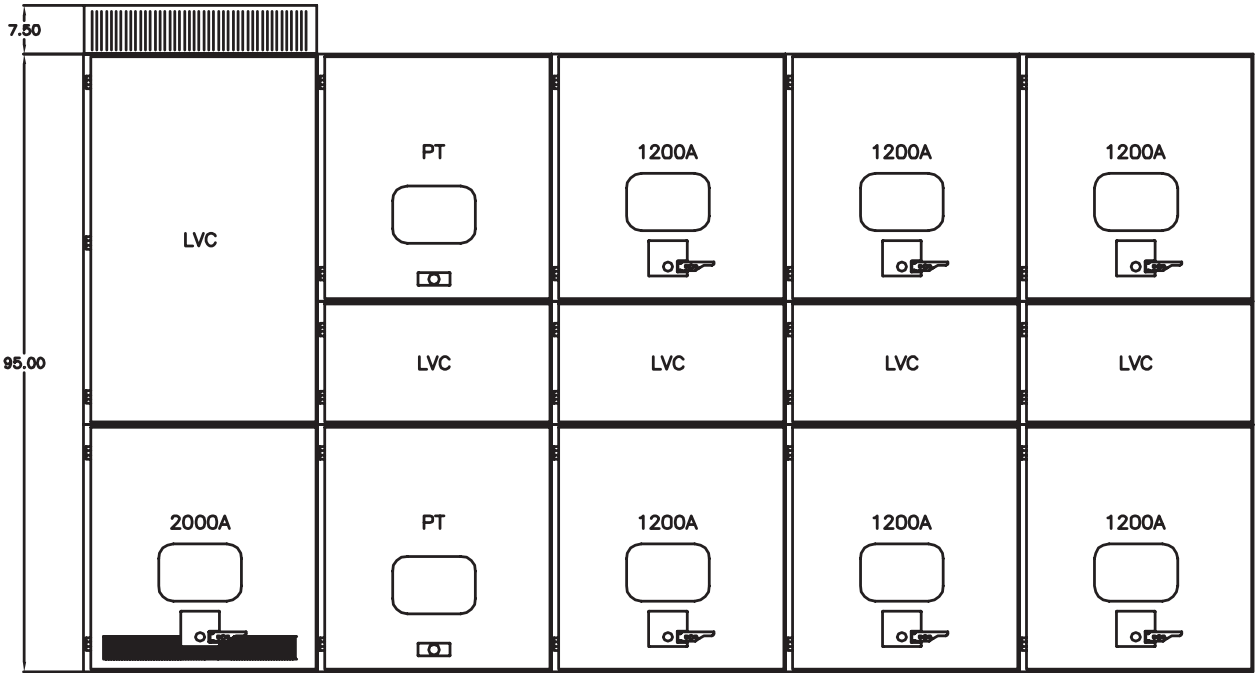


# Typical arrangements

## 27 kV, 2000 A Main-Tie-Main



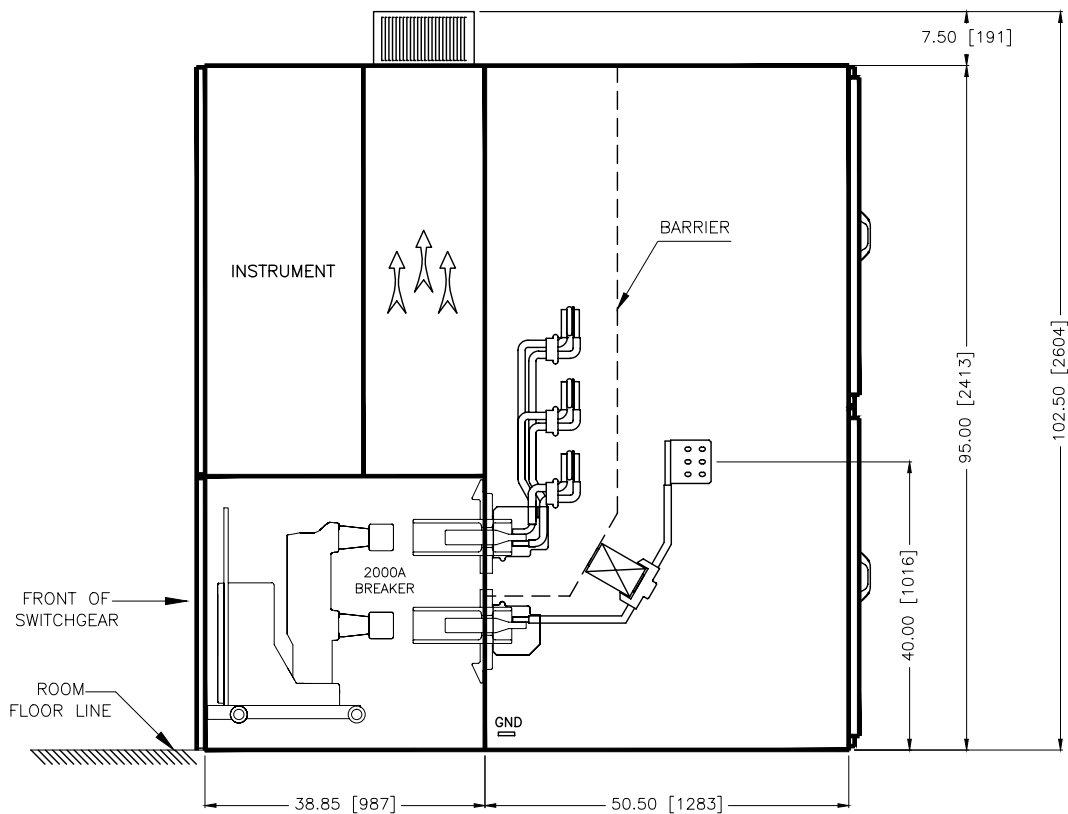
# Typical arrangements 27 kV, 2000 A Main with feeders



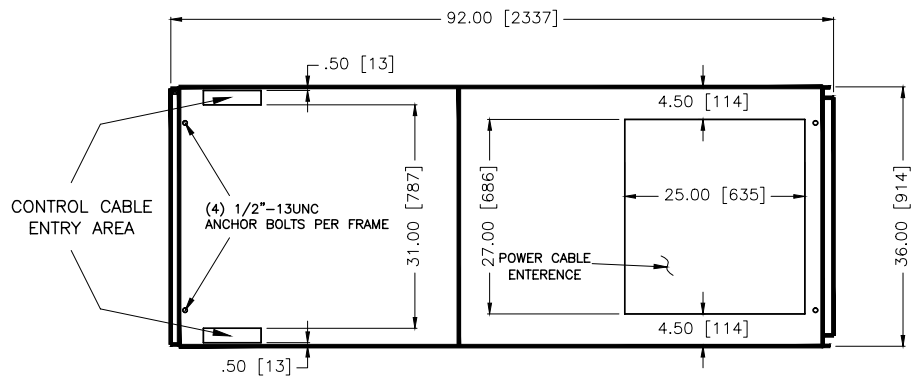
# Civil engineering details

## Typical side views, floor plans and clearances

Advance 27 switchgear one-high  
Circuit breaker: 2000 A



SIDE SECTION

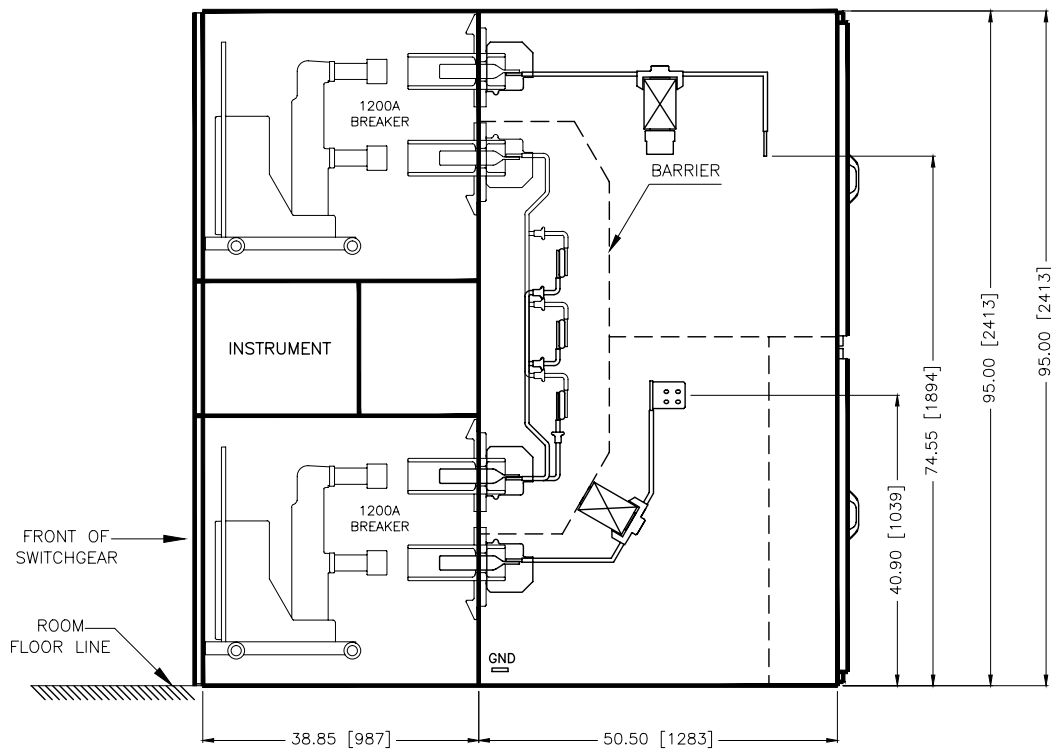


FLOOR PLAN

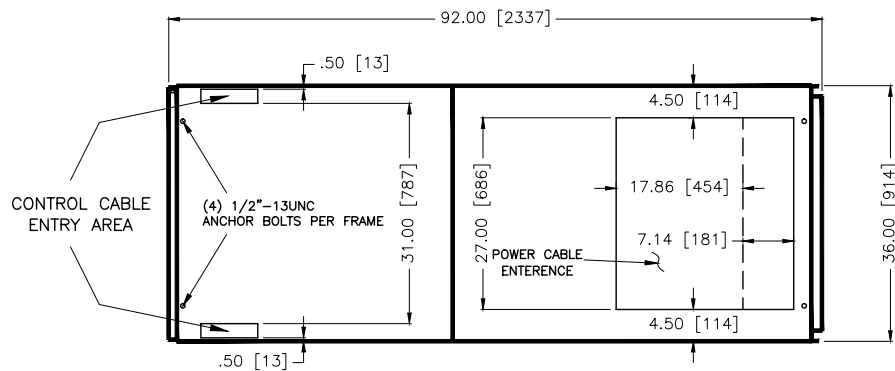
# Civil engineering details

## Typical side views, floor plans and clearances

Advance 27 switchgear two-high  
Circuit breaker: 1200 A/1200 A



SIDE SECTION

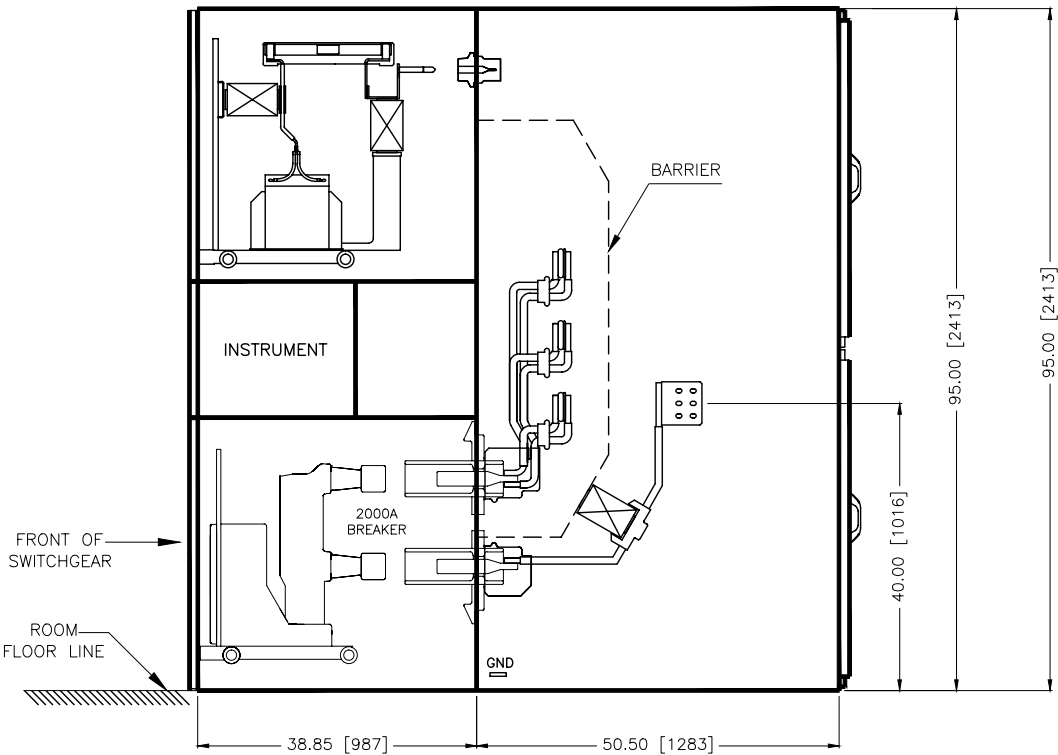


FLOOR PLAN

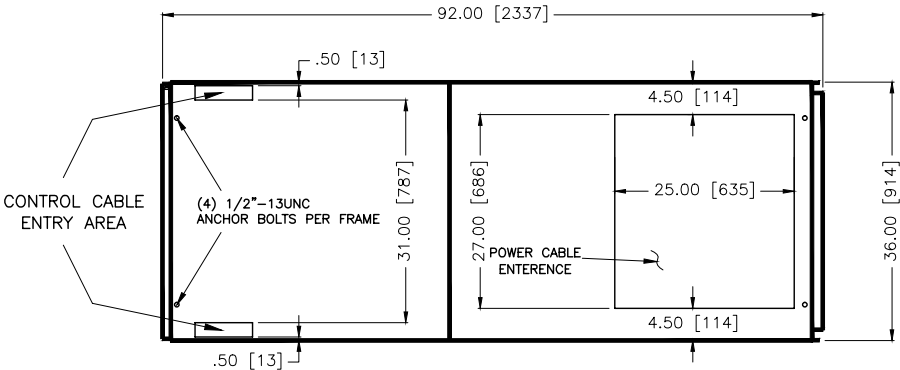
# Civil engineering details

## Typical side views, floor plans and clearances

Advance 27 switchgear one-high with PT drawout  
Circuit breaker: 2000 A



SIDE SECTION



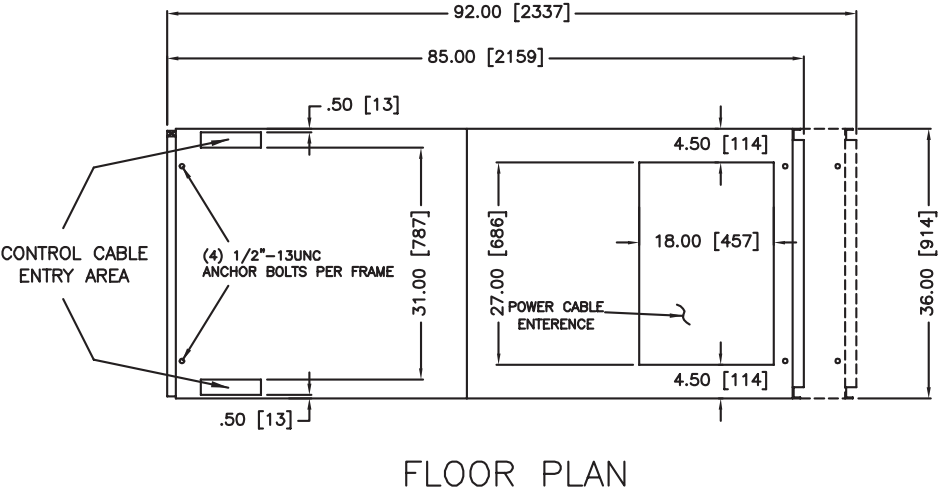
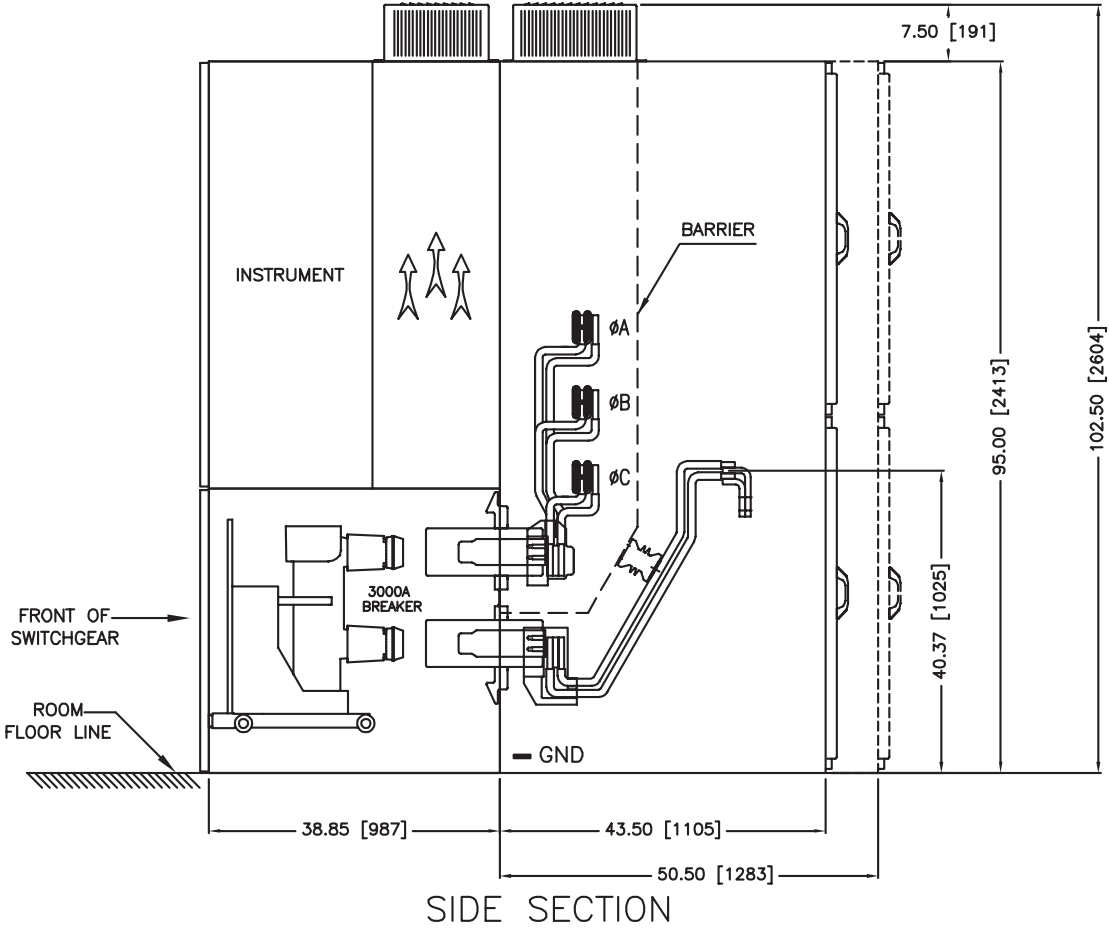
FLOOR PLAN

# Civil engineering details

## Typical side views, floor plans and clearances

### Advance switchgear one-high

Circuit breaker: 3000 A

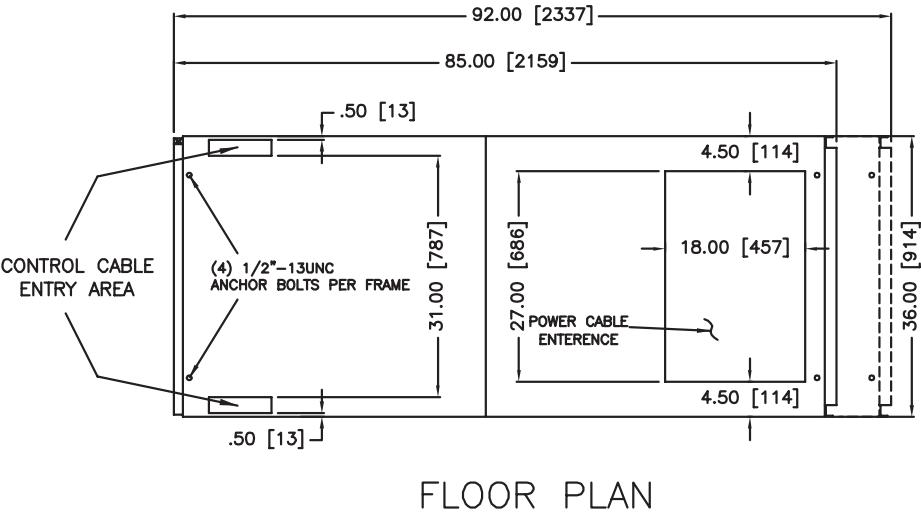
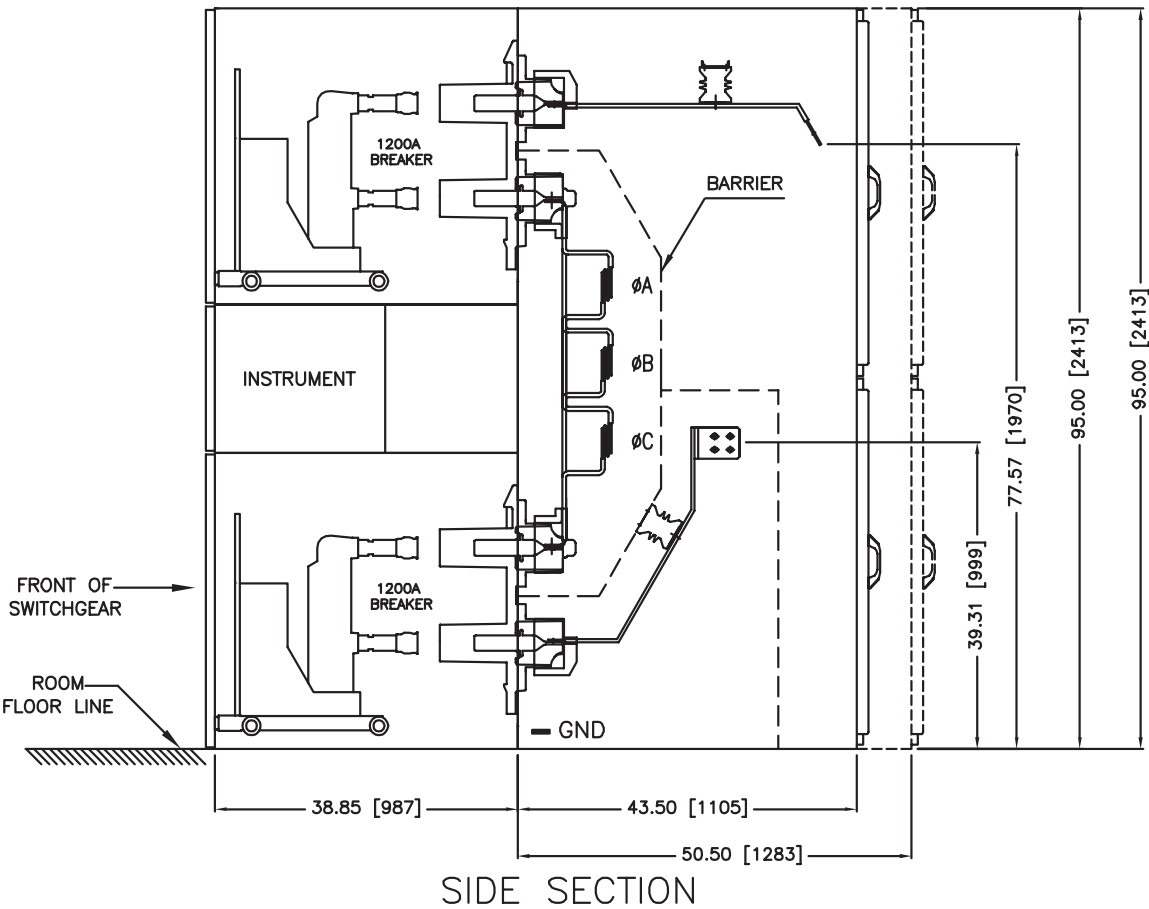




# Civil engineering details

## Typical side views, floor plans and clearances

Advance switchgear two-high  
Circuit breaker: 1200 A/1200 A

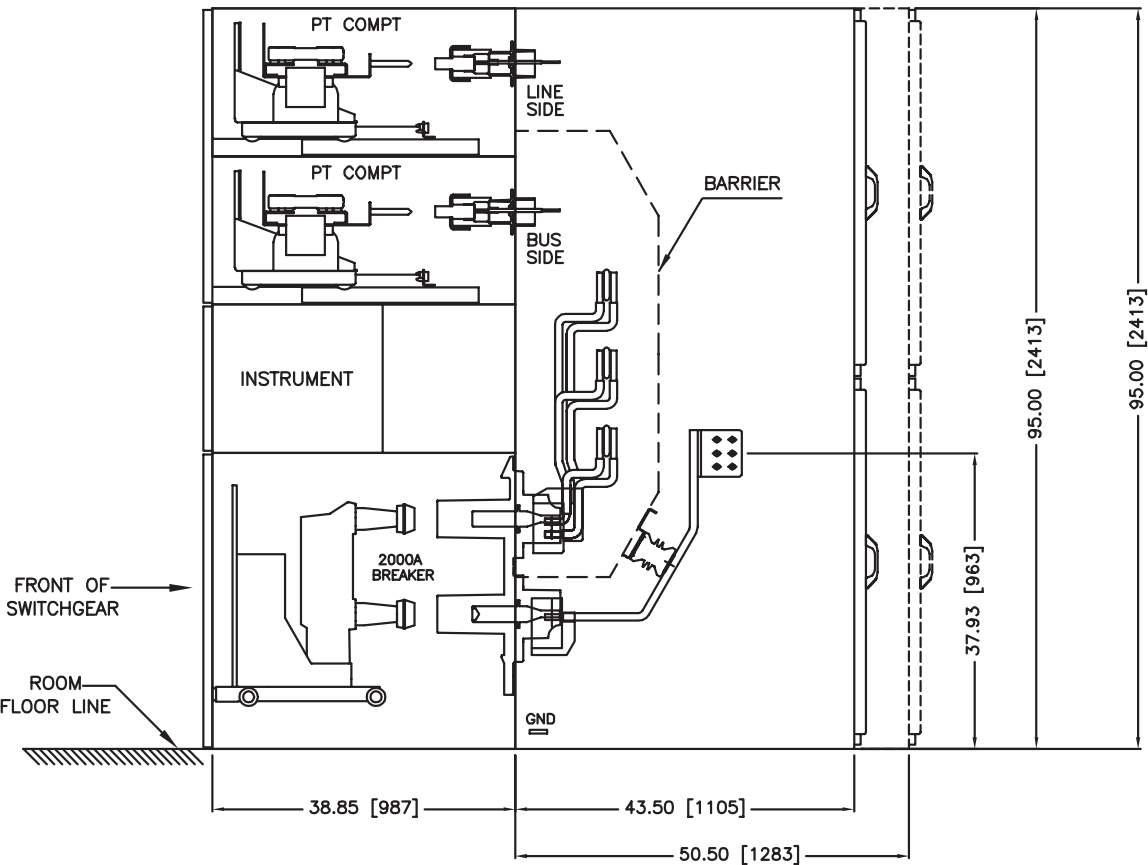


# Civil engineering details

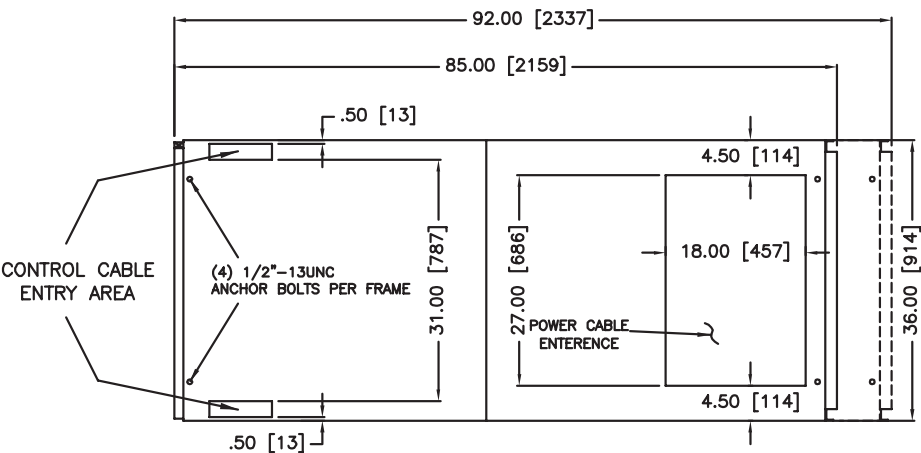
## Typical side views, floor plans and clearances

### Advance switchgear with 2 PTs

Circuit breaker: 2000 A



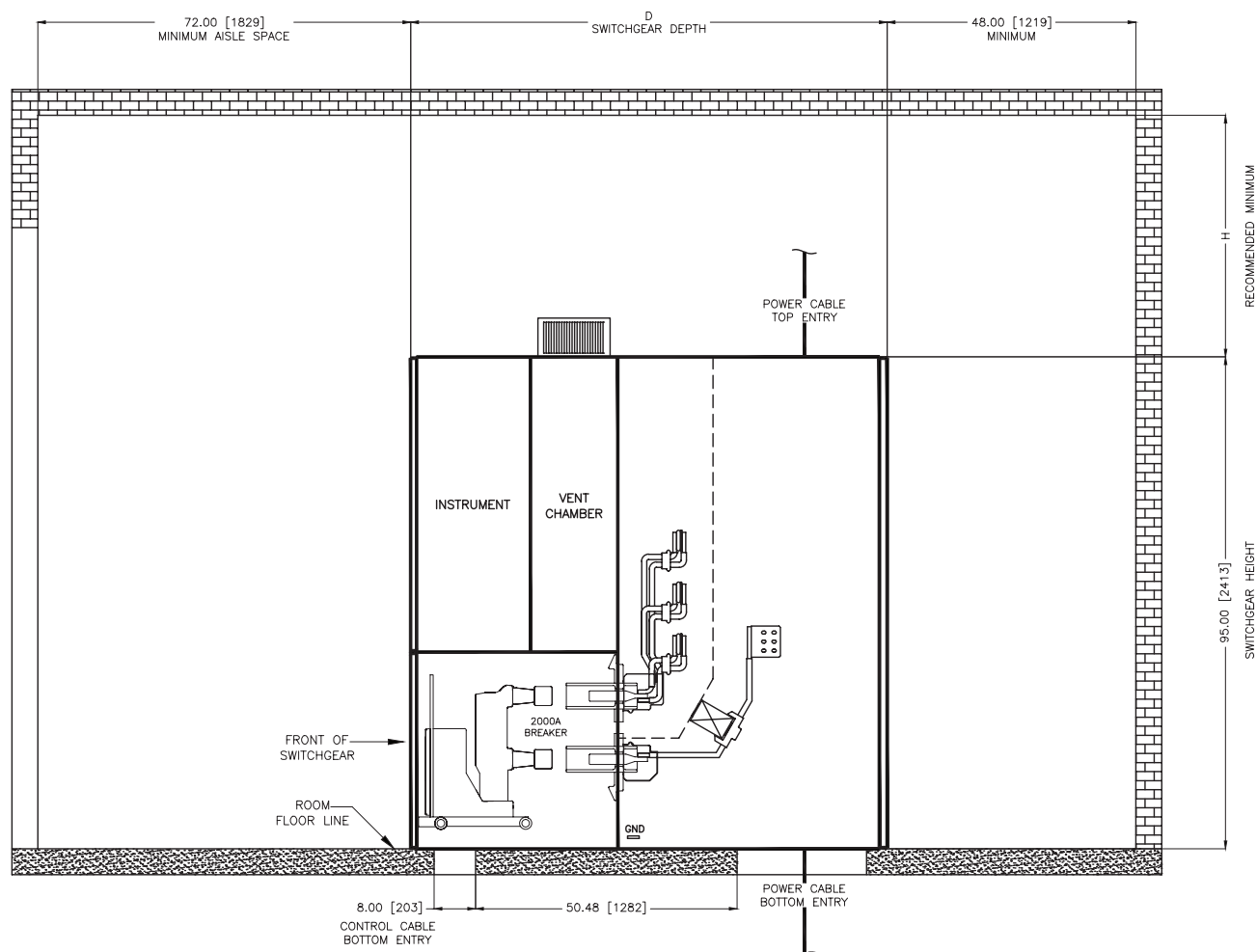
SIDE SECTION



FLOOR PLAN

# Civil engineering details

## Typical side views, floor plans and clearances



Typical civil engineering dimensions - inches	
	Depth (D)
Advance	85 or 92
Advance 27	92

### Dimension H:

6 inches for 1200A lineups  
14 inches for 2000A lineups

- Notes:
1. Additional height clearance may be needed during installation of the switchgear. Please allow for 6" shipping base for movement during installation.
  2. For outdoor installations without a rear aisle, the switchgear can be provided for direct access via a weatherproof rear door.

### Indoor and outdoor applications

The Advance line is available in indoor and outdoor construction. For outdoor applications, Advance can be provided in Outdoor Non-Walk-In (ODNWI), Outdoor Walk-In/Sheltered Aisle (ODWI), or installed in a PDC building. All applications offer the flexibility of one-high or two-high construction.

Standard indoor and outdoor construction meet the requirements of ANSI and IEEE standards.

# 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 components.

A frame consists of one bus and cable module and the appropriate circuit breaker is given separately and must be added.

Low voltage modules may contain significant amounts 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 low voltage 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 on pages 21-24. Weights include all modules and components as listed above.

Basic frame configuration	Circuit breaker (rating)	Weight	
		lbs	kg
One circuit breaker	1200	1902	863
	2000	2320	1052
	3000	3210	1456
Two circuit breakers	1200/1200	2859	1297
	1200/2000	3148	1428
One circuit breaker, one VT	1200	2319	1052
	2000	2737	1241
	3000	3627	1645
One circuit breaker, two VTs	1200	2738	1242
	2000	3156	1432
One circuit breaker, one VT	1200	2904	1317
	2000	3322	1507
One circuit breaker, one CPT fuse	1200	2284	1036
	2000	2702	1226

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



Technical and application guide

# ReliaGear® ND

## 5/15 kV ANSI narrow design metal-clad switchgear

Power and productivity  
for a better world™



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# General overview

## ReliaGear® ND switchgear

### Introduction

ReliaGear® ND is ABB's ANSI narrow design metal-clad switchgear. Complete sets of rugged, stackable circuit breaker and auxiliary compartment modules are assembled to form a ReliaGear ND lineup with flexible configurations.

### Certifications

ReliaGear ND metal-clad switchgear is certified to IBC region D with importance factor of 1.0. The manufacturing location for ReliaGear ND is both ISO 9001 and 140001 certified. ReliaGear ND switchgear is available with UL label.

### Applicable standards

The ReliaGear ND design is built, tested, and certified to IEEE C37.20.2-1999 metal-clad switchgear standard.

### Construction

ReliaGear ND is manufactured of, galvanized and stainless steel for superior rust and scratch protection. All parts of ReliaGear ND that are not galvanized or stainless steel are treated and painted ANSI 61 gray.

### Outdoor enclosures

ReliaGear ND can be supplied for outdoor sheltered-aisle enclosures or PDC (power distribution center) enclosures for outdoor applications.

### Breakers used in the ReliaGear ND platform

The ReliaGear ND platform uses ABB Vmax/A™ breakers. More details, including ratings tables, can be found in The Vmax Breaker Technical Guide (1VAL057601-TG).

### Instrument transformers

ReliaGear ND switchgear is available using SCH-3U CTs. Up to three sets of SCH-3U CTs can be fitted per phase.

For ground CT requirements, ReliaGear ND can be supplied with BYZ-S or BYZ-O ground CTs. The type of CT is chosen based on the necessary window size required for cables and cable bending.

ReliaGear ND switchgear utilizes ABB VIZ-11, VIZ-75, VIY-60 and TJC-5 potential transformers. Available in wye-wye, open delta, line to line and line to ground configurations, ABB VIZ-11, VIY-60 and TJC-5 PTs offer flexible options for PTs.

For more information on CTs, GCTs and PTs, please see the Switchgear Components and Accessories Technical Guide (1VAL104601-TG).

### Available Accessories

ReliaGear ND is available with the following accessories:

- Breaker maintenance kit
- Breaker racking handle
- PT and CPT draw-out handle
- Breaker lift truck
- Test cabinet and test jumper
- SmartRack remote racking device
- Manually operated ground and test device
- Breaker lifting yoke

Characteristic	Unit	Rated maximum voltage level	
		5 kV	15 kV
Rated nominal voltages	kV	2.4, 4.16, 4.8	6.9, 7.2, 8.4, 11, 12, 12.47, 13.2, 13.8, 14.4
Main bus continuous current	A	1200, 2000	1200, 2000
Short time/short circuit current (rms)	kA	25, 31.5	25, 31.5
Momentary	kA	65	82
Rated frequency	Hz	50, 60	50, 60
Low frequency withstand (rms)	kV	19	36
Impulse level (BIL, crest)	kV	60	95

\* Ratings given are for service conditions within temperature and altitude limitations as defined by IEEE C37.20.2-1999 metal-clad standard.

# General overview

## ReliaGear® ND

ABB ReliaGear ND 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 from 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

Factory witness testing is also available on request.

### Options

- Installation, operation and maintenance manuals are available in electronic (CD) or printed format.

### Mechanical options

- Tin plated bus
- Mimic bus
- Cable supports
- IR windows (IRISS or Fluke)
- Surge arrestors
- Ground studs

### Electrical options

- Separate or common pull-out fuse block or molded case circuit breaker trip and close coil protection
- 10%, 15%, 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 switch-gear configuration tool and helps engineers in creating a switch-gear 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
ReliaGear ND Descriptive Bulletin	1VAL107501-DB
ReliaGear ND Flyer	1VAL107501-FL
ReliaGear ND Installation, Operation and Maintenance Manual	1VAL107501-MB
Vmax/A Technical Guide	1VAL057601-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



# Compartment types

## Circuit breaker compartments

### Circuit breaker compartments

ReliaGear ND circuit breaker compartments are designed for operator safety by providing one large viewing window and three-position racking.

### Unique racking system and interlocks

The racking system is unique and features a three-state system for all circuit breakers. The racking mechanism is integral to the circuit breaker, so moving parts can be inspected and maintained outside the circuit breaker compartment and away from energized primary parts.

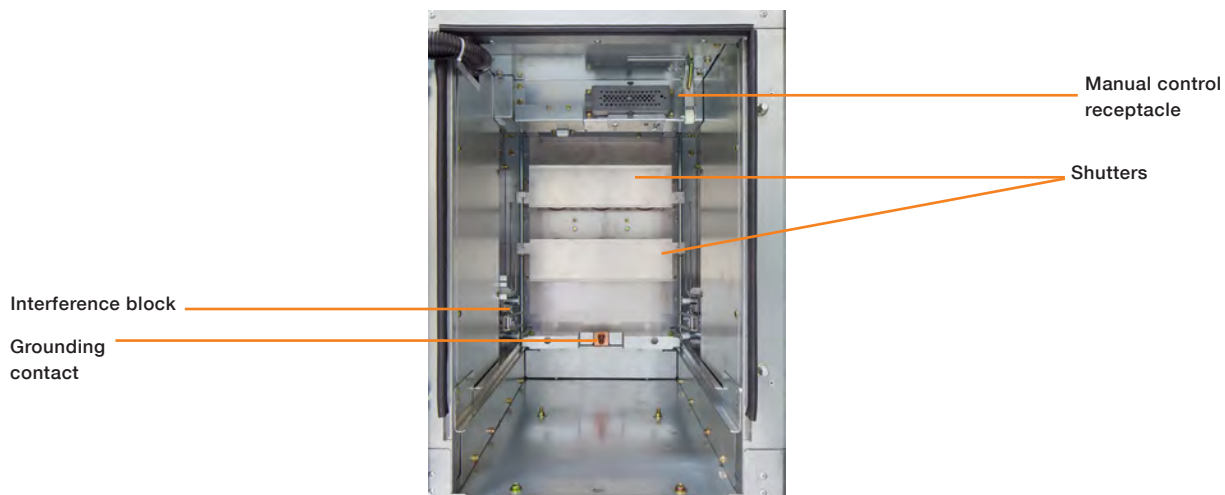
The three states are defined as follows:

- Disconnect: 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 in-between the test and connected position and prohibits insertion of an improperly rated breaker.

### Shutter system

Shutters automatically cover primary contacts when the breaker is not in the connected position. Shutter opening and closing is forced by circuit breaker movement. Padlocking provisions are provided to prevent opening the shutters when the circuit breaker is removed.



# Compartment types

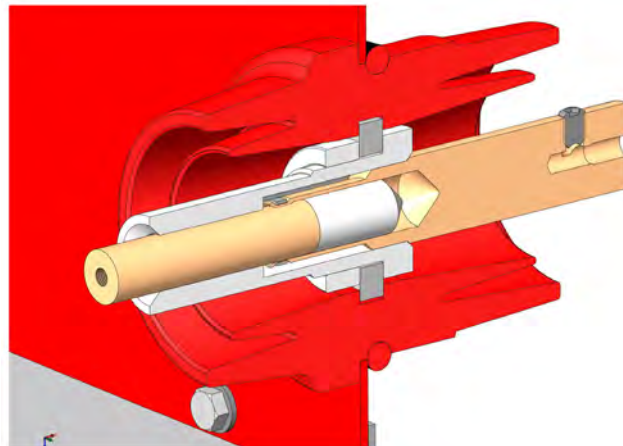
## Auxiliary primary modules

### PT/CPT compartments

Potential transformer and draw-out fuse compartments are inserted via push-pull mechanism which secondary contacts engage/disengage automatically and interlocks ensure proper operation.

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 a 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 rails, which allow easy access to the fuses for inspection or replacement.

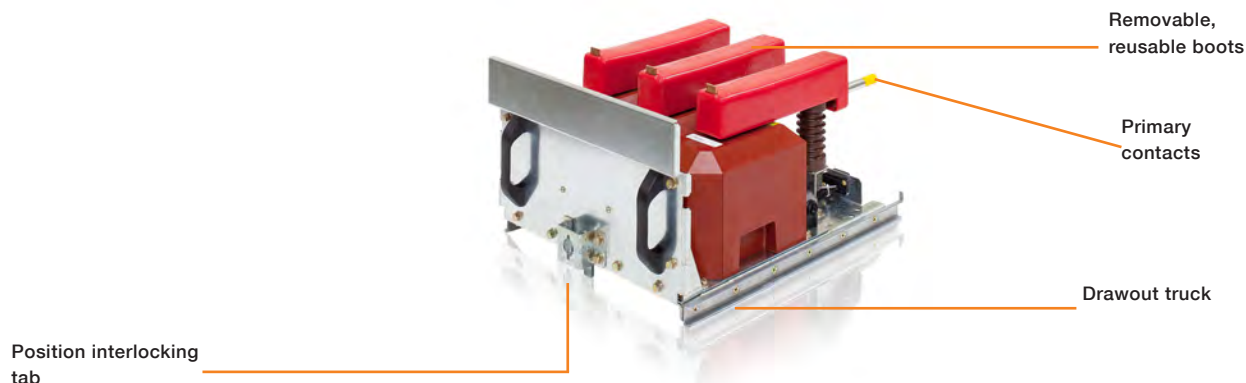


Delrin primary probe and recessed contact assembly

### Control Power Transformer (CPT)

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

### PT drawout assembly with three voltage transformers



# Compartment types

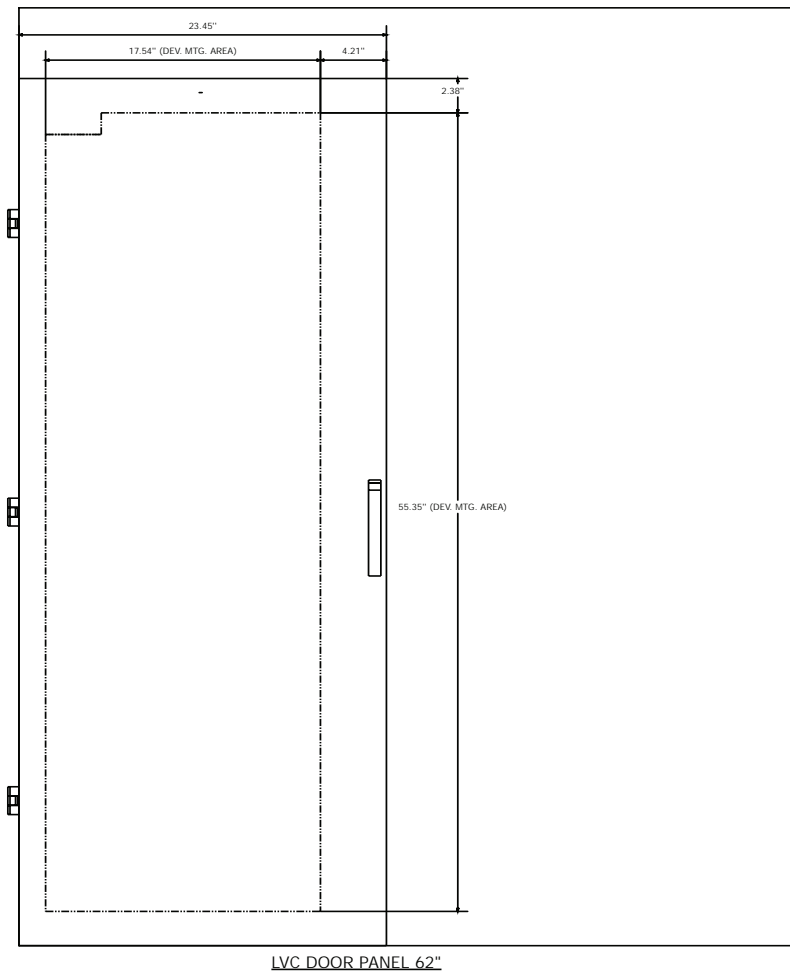
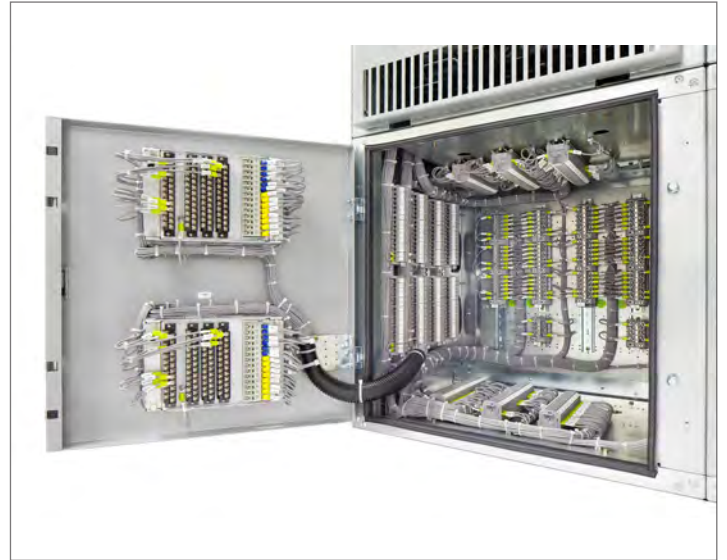
## Instrument compartment

### Instrument compartment

ABB mounts protection and control devices in a dedicated low voltage module. Each low voltage instrument module is completely isolated and segregated from high-voltage components which ensures the safety of operations and maintenance personnel while they work on control and auxiliary circuits. The LV wiring pans are designed to be removeable and customizable.

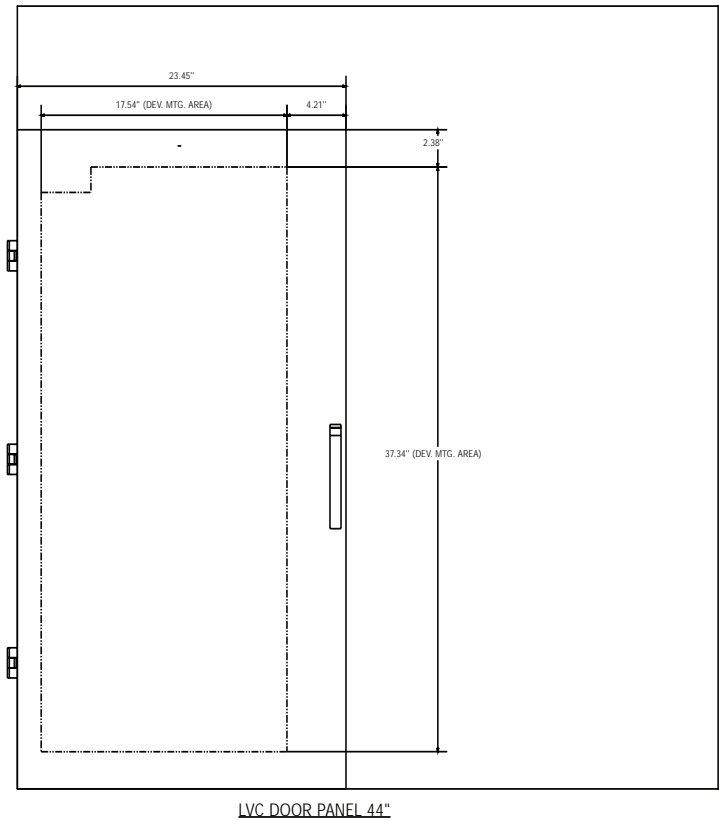
Devices and control switches are mounted on the door for easy readability and convenient access. Those devices that do not require immediate access are mounted inside the compartment.

Frame-to-frame interconnect wiring is achieved through access-holes located in the rear of the LV compartment. Each hole is 2.8" x 5" and provides with edge guard to ensure wires do not run over sharp edges.



# Compartment types

## Instrument compartment



# Compartment types

## Bus compartment

### Bus compartment

All primary buses are copper with corona-free design, and are available in 1200 A and 2000 A ratings. 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 coat system that eliminates voids and other potential defects, resulting in maximum integrity of the insulation system.

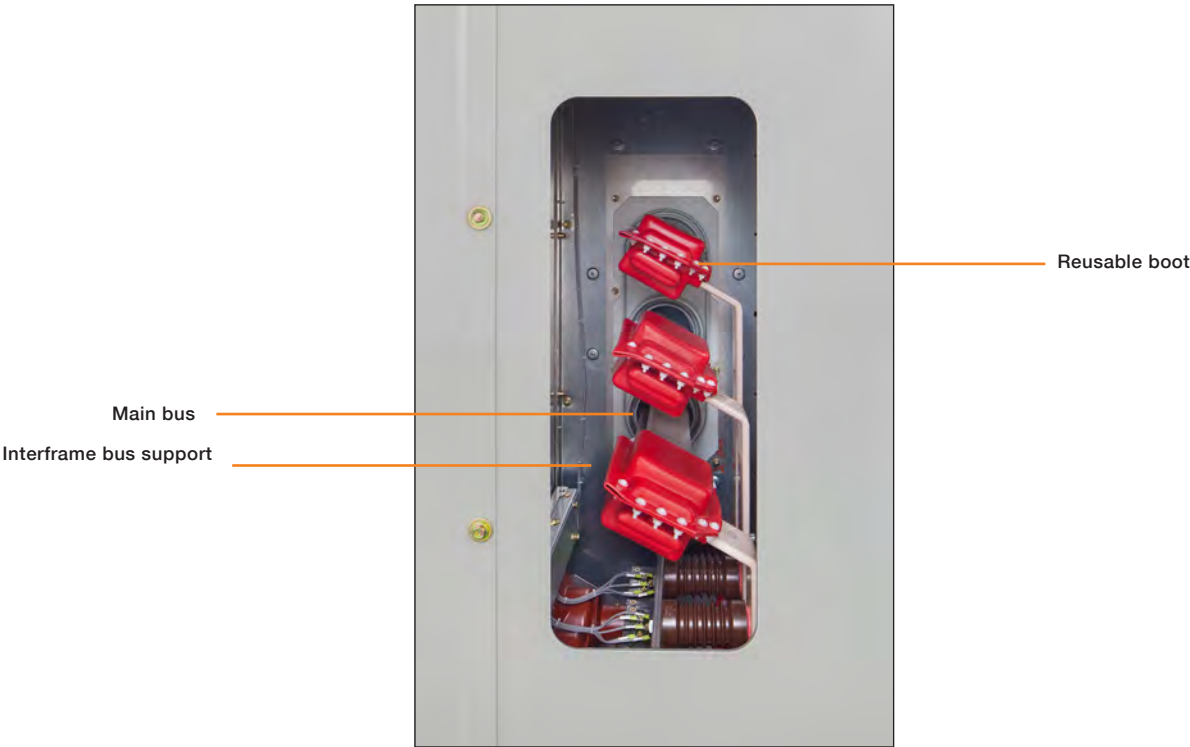
Removable, reusable boots are provided at each joint to simplify access and maintenance.

Insulating standoffs rigidly support the bus. This includes jumps, the connections from stationary primary contacts to the main bus and risers, and connections from the stationary primary contacts to line or bus terminations. Internal standoffs are epoxy for all ratings.

Continuous current	Rating	Quantity	Size (in)
1200 A	31.5 kA	1	.375 x 3.5
2000 A	31.5 kA	1	.75 x 3.5

ReliaGear ND metal-clad switchgear design certifications are based on epoxy primary bus supports. Epoxy is standard for standoff bus insulator supports, primary breaker bushings. Physical characteristics of the epoxy material is provided in the following table.

Characteristic	X-Run specification
Bending Strength, ksi	120-150 MPA per ISO 178
Tensile Strength, ksi	70-90 MPA per ISO 527
Izod Impact Strength, ft-lb/inch of notch	10-15 KJ/m2 per ISO 179
10-15 KJ/m2 per ISO 179	
Thermal Shock – cycles	Not Available
Dielectric Strength (Short Time), V/m	>23 kV/mm per IEC 60243



# Compartment types

## Cable compartment

Compartments for ReliaGear ND 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. Connections can also be provided for bus duct provisions

In two-high arrangements with stacked circuit breakers, steel barriers separate the compartments and 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 current transformers and surge arrestors on the bus risers.

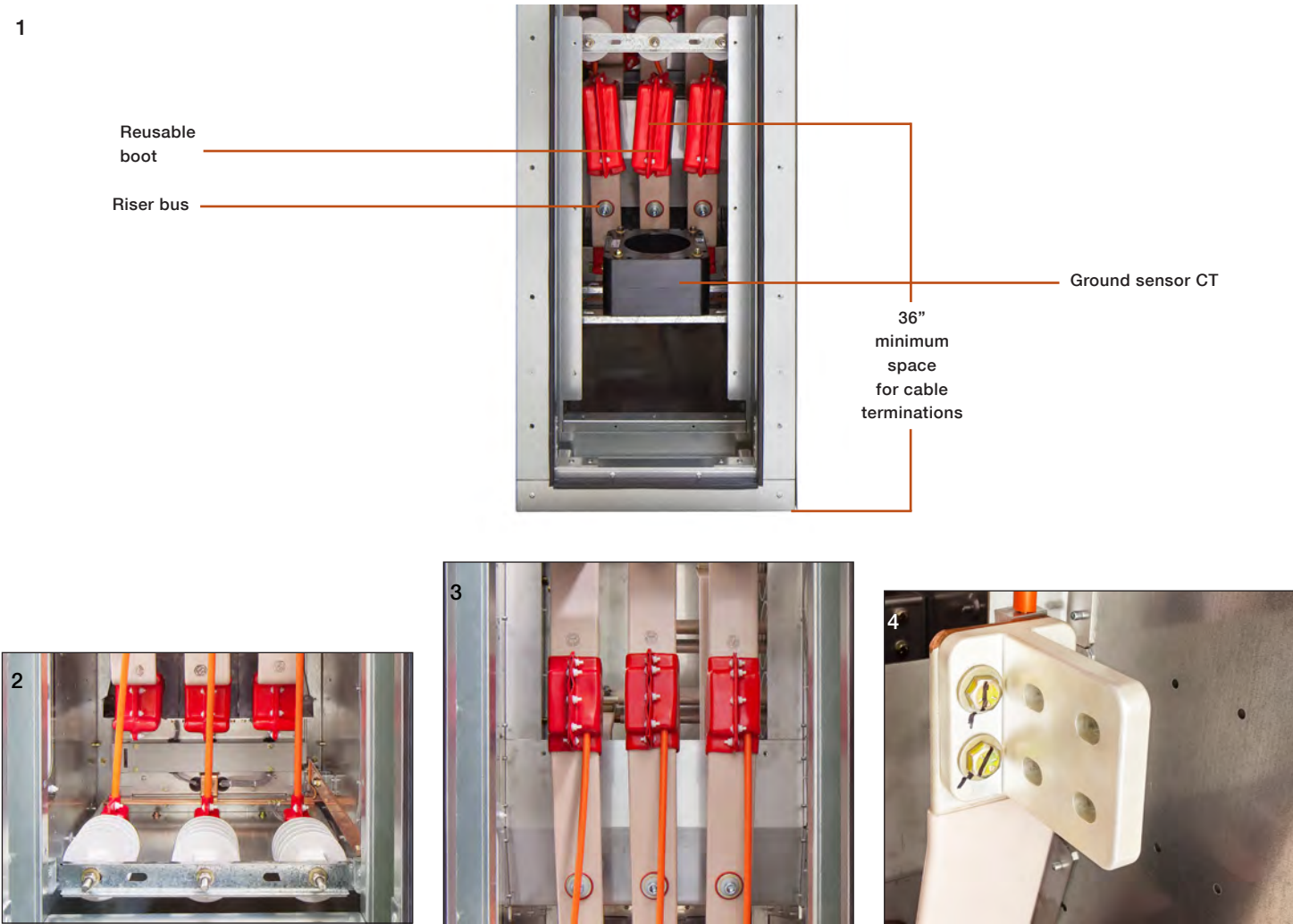
The 77-inch depth of one-high and 85-inch depth of two-high ReliaGear ND switchgear provides ample space for various cable terminations and protective, monitoring, and control devices as needed.

### Primary supports and current transformers

Primary contacts are encapsulated in epoxy bushings.

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

1 Cable compartment (main bus cover uninstalled) | 2 Surge arrestors | 3 PT line connection via Natvar | 4 Standard 2000 A lug pad (boot removed)



# Available frame types

## One-high frames

### Description

The one-high, bottom-mounted device frame consists of a 62-inch instrument compartment stacked over a 36-inch breaker compartment.

### Cable termination information

Cable size	# of Terms single pad per phase		
	W/O GCT	BYZ-O	BYZ-S
#2 AWG	4	4	4
4/O	4	4	4
500 MCM	4	4	4
750 MCM	4	3	2
(1000 MCM 4-hole)	2	2	2

### Dimensions

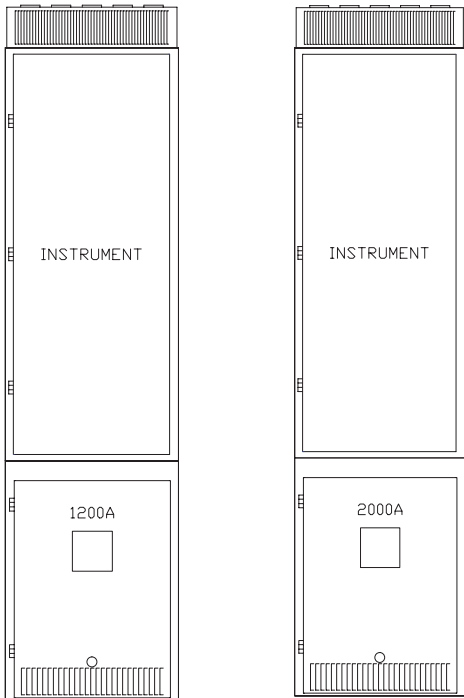
Frame	Width (in)	Height with vent box (in)	Depth (in)
All ratings	26	104	77*

\*If coupled with two-high frames, switchgear depth will be 85 inches for all frames

### Options

- Ground CTs
- Surge arrestors
  - Distribution
  - Intermediate
- Ground studs
- Space heaters

**Note:** Refer to page 20 for floorplan





# Available frame types

## Two-high frames

### Description

The two-high breaker frame consists of two 36-inch breaker compartments with a 26-inch instrument compartment in between for two breakers in a single frame.

### Cable termination information

Cable size	# of Terms single pad per phase		
	W/O GCT	BWZ-O	BWZ-S
#2 AWG	4	4	4
4/O	4	4	4
500 MCM	4	4	4
750 MCM	4	3	2
(1000 MCM 4-hole)	2	2	2

### Dimensions

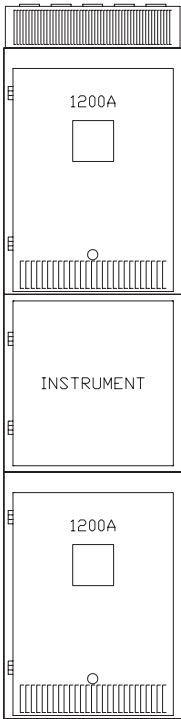
Frame	Width (in)	Height with vent box (in)	Depth (in)
All ratings	26	104	85*

\* If two-high frames are used in conjunction with one-high frames, line-up depth will be 85 inches

### Options

- Ground CTs
- Surge arrestors
  - Distribution
- Intermediate
- Ground studs
- Space heaters

Note: Refer to page 22 for floorplan





# Available frame types

## Breaker and auxiliary frames

### Description

The breaker and auxiliary frame consists of one 36-inch compartment, two 18-inch compartments (that can be combined for another 36-inch compartment) and a 26- or 44-inch instrument compartment.

### Cable termination information

Cable size	# of Terms single pad per phase		
	W/O GCT	BWZ-O	BWZ-S
#2 AWG	4	4	4
4/O	4	4	4
500 MCM	4	4	4
750 MCM	4	3	2
(1000 MCM 4-hole)	2	2	2

### Dimensions

Frame	Width (in)	Height with Vent (in)	Depth (in)
All ratings	26	104	77

### Options

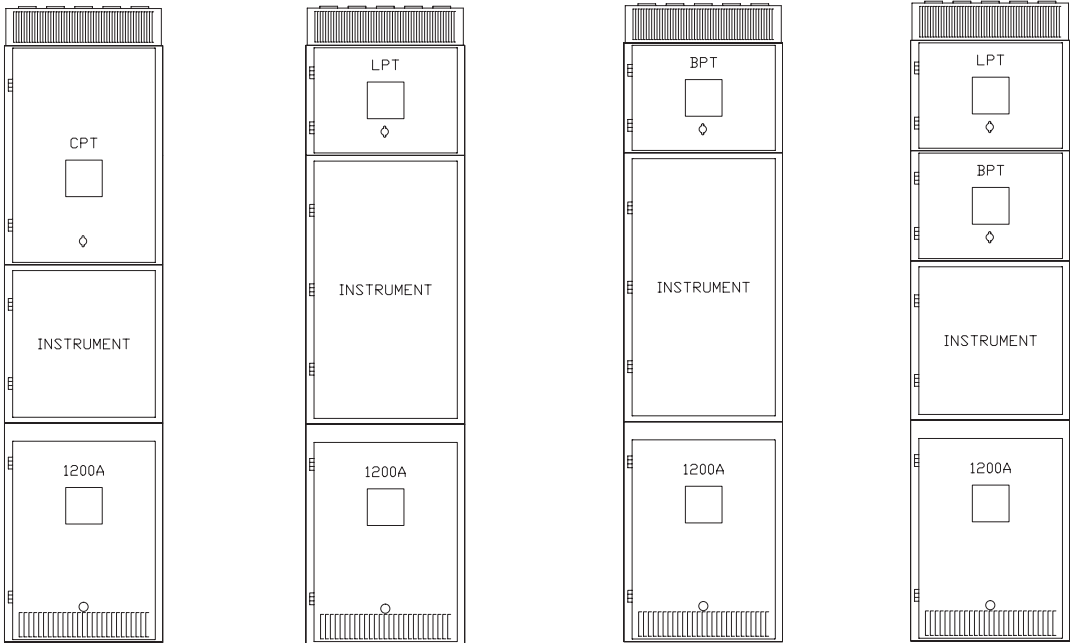
- Ground CTs
- Surge arrestors
  - Distribution
  - Intermediate
- Ground studs
- Space heaters

### Notes:

1. Refer to page 21 floorplans
2. CPT=control power transformer
3. LVC=low voltage compartment/instrument compartment

4. PT=potential transformer
5. DOF=drawout fuse
6. BPT=Bus PT
7. LPT=Line PT

### Breaker below



# Available frame types

## Breaker and auxiliary frames

Breaker above



# Available frame types

## Auxiliary frames

### Description

The auxiliary frame consists of four 18-inch compartments with a 26-inch instrument compartment in between. For CPTs, two 18-inch compartments are combined for a 36-inch CPT compartment.

### Cable termination information

Cable size	# of Terms single pad per phase		
	W/O GCT	BWZ-O	BWZ-S
#2 AWG	4	4	4
4/O	4	4	4
500 MCM	4	4	4
750 MCM	4	3	2
(1000 MCM 4-hole)	2	2	2

### Dimensions

Frame	Width (in)	Height with Vent (in)	Depth (in)
All frames	26	104	77

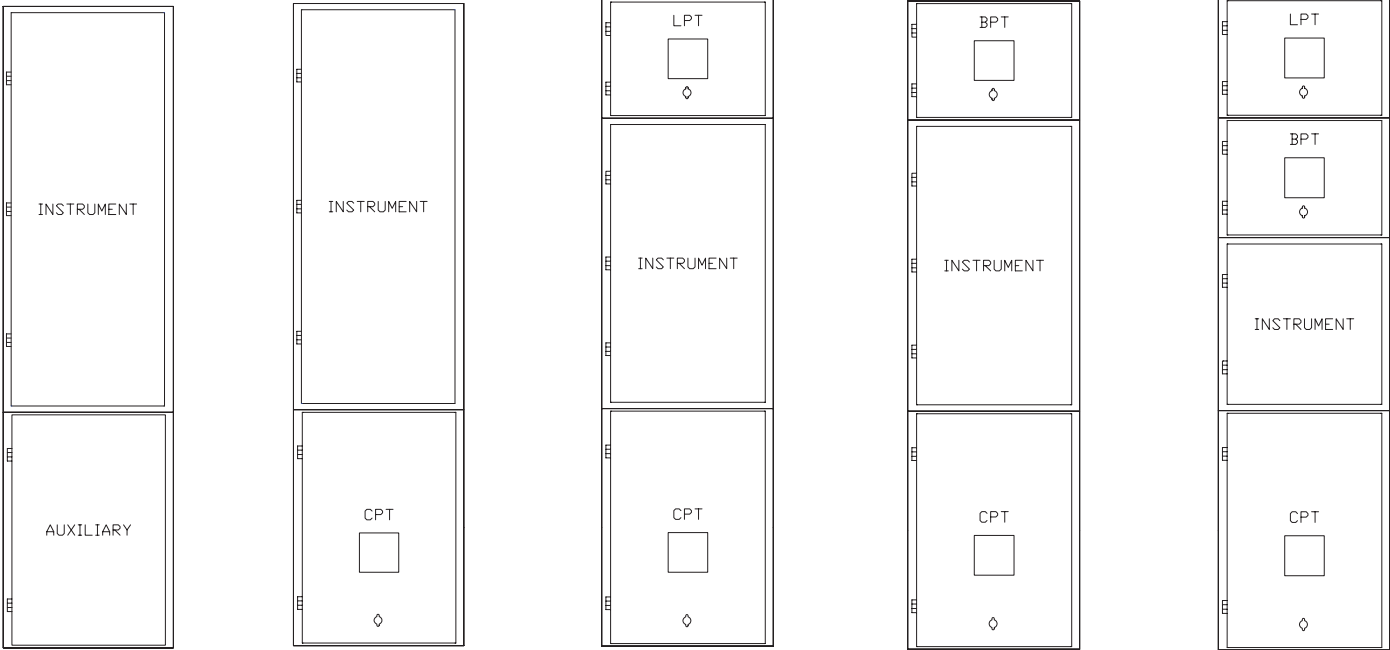
### Option

- Space heaters

### Notes:

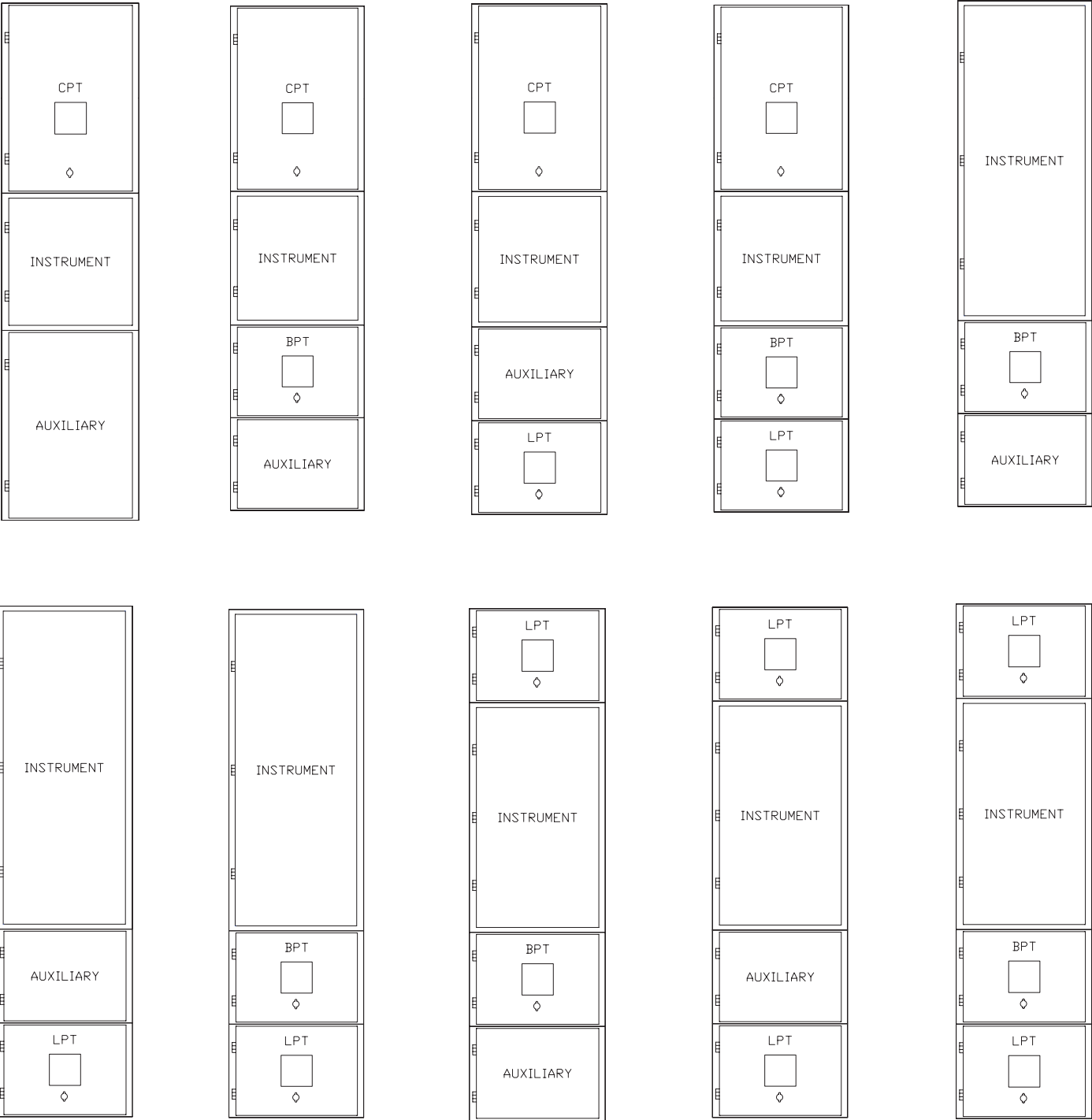
- 1. CPT=control power transformer
- 2. LVC=low voltage compartment/instrument compartment

- 3. PT=potential transformer
- 4. DOF=drawout fuse

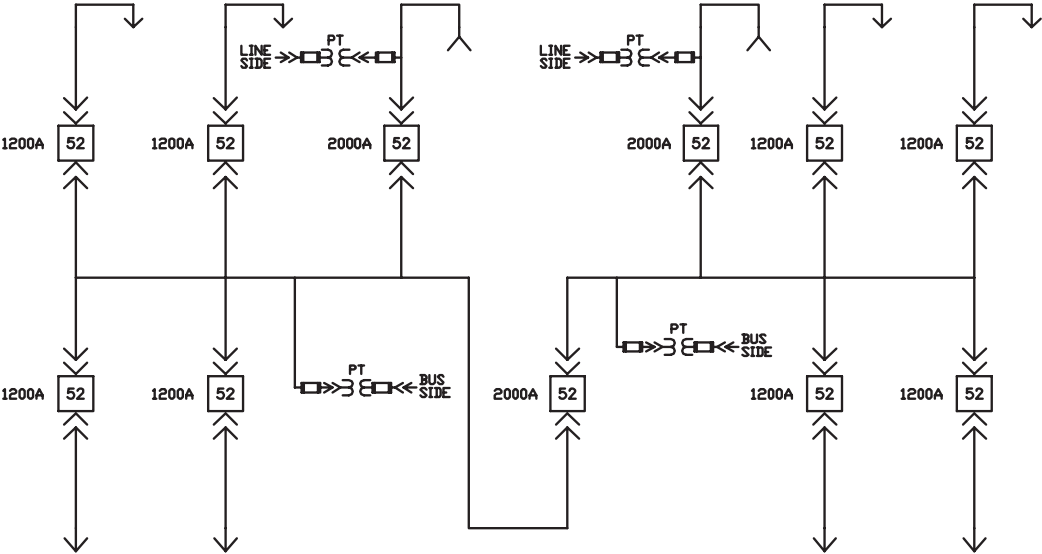
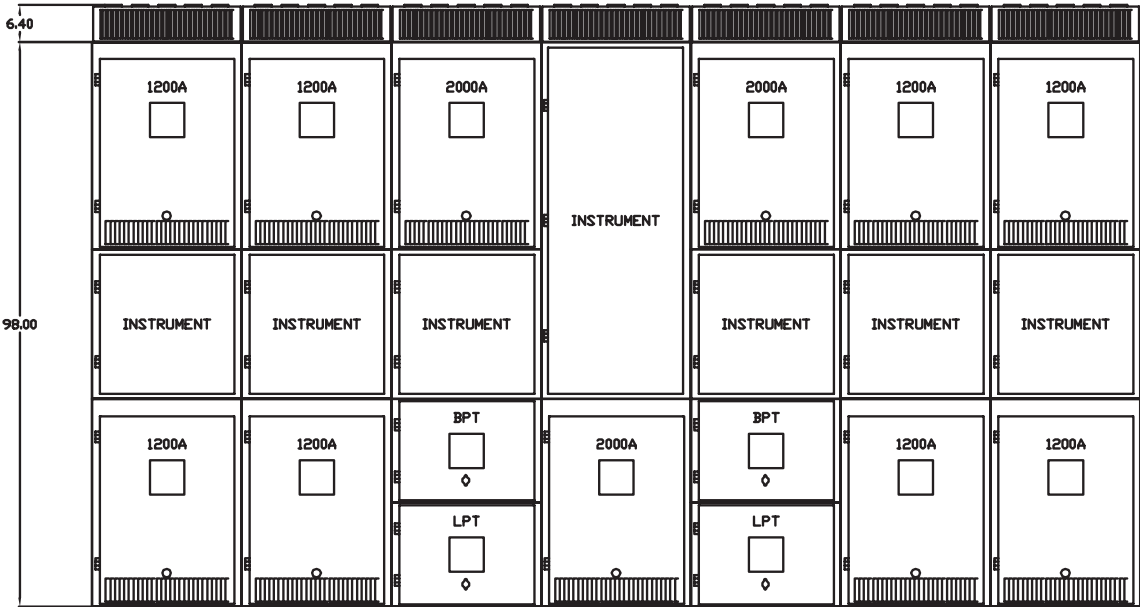


Available frame types

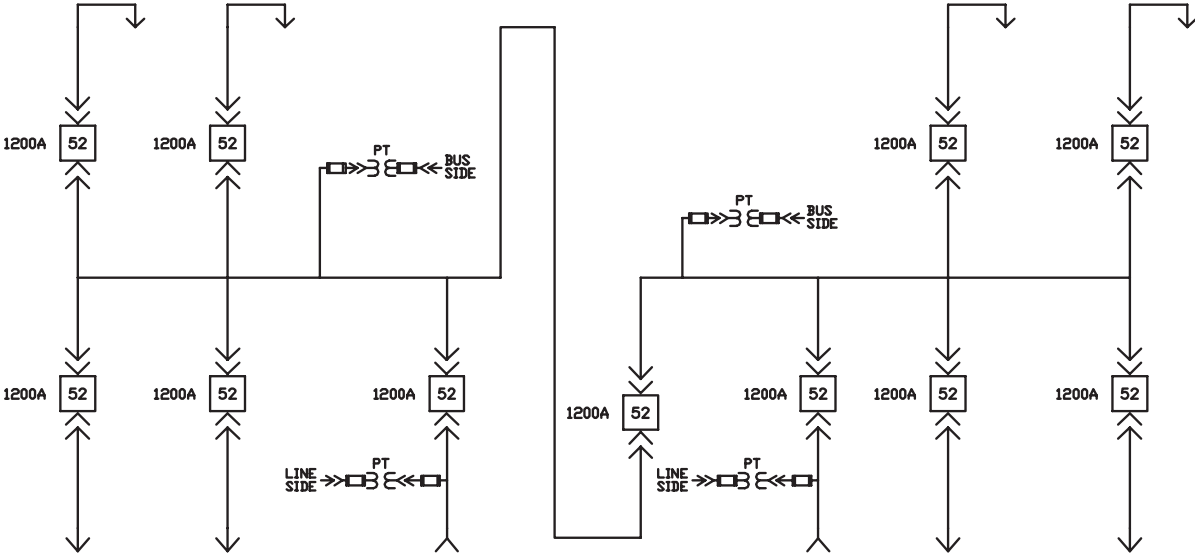
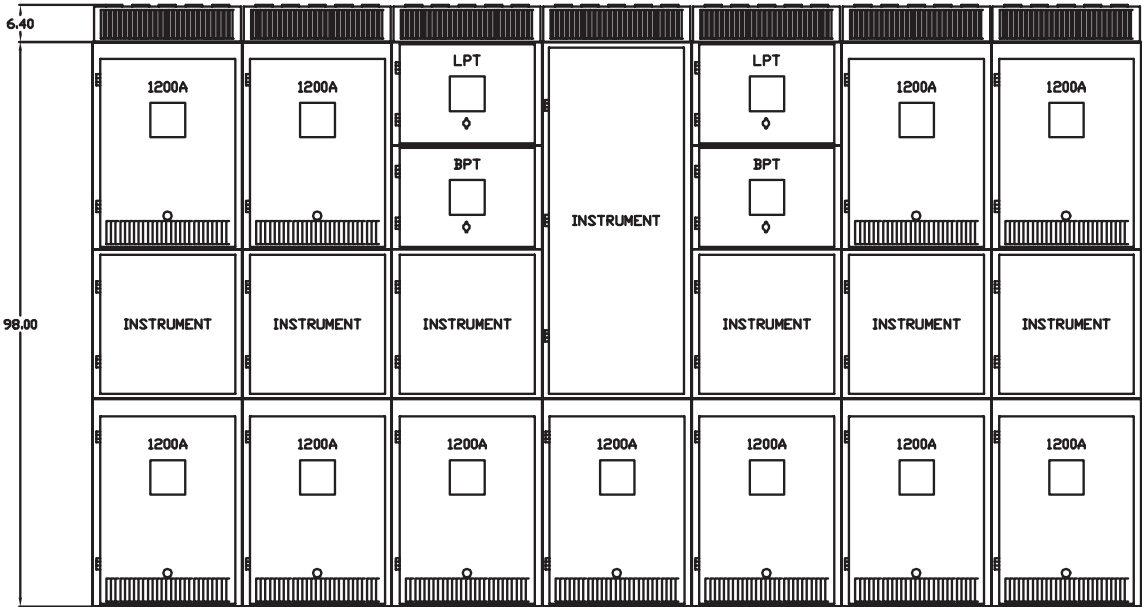
Auxiliary frames



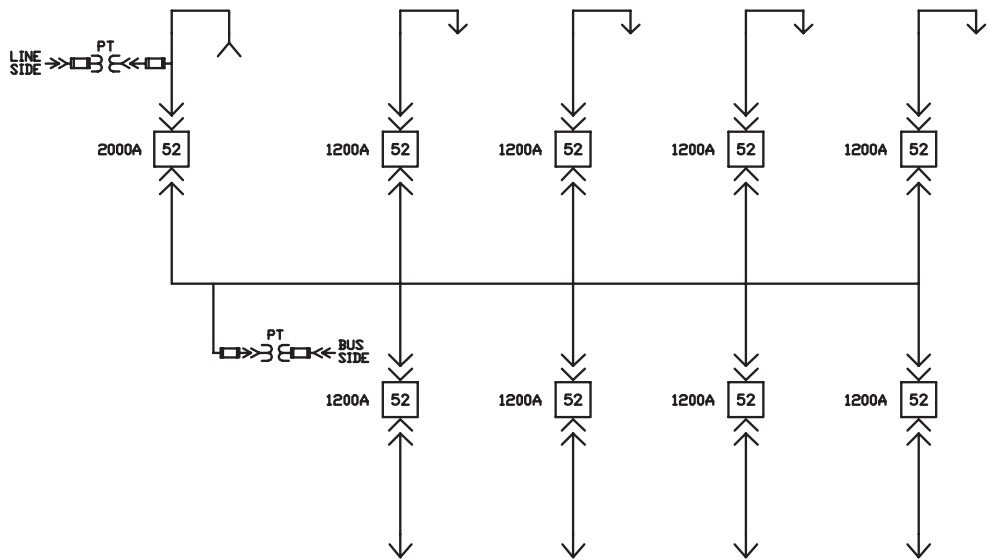
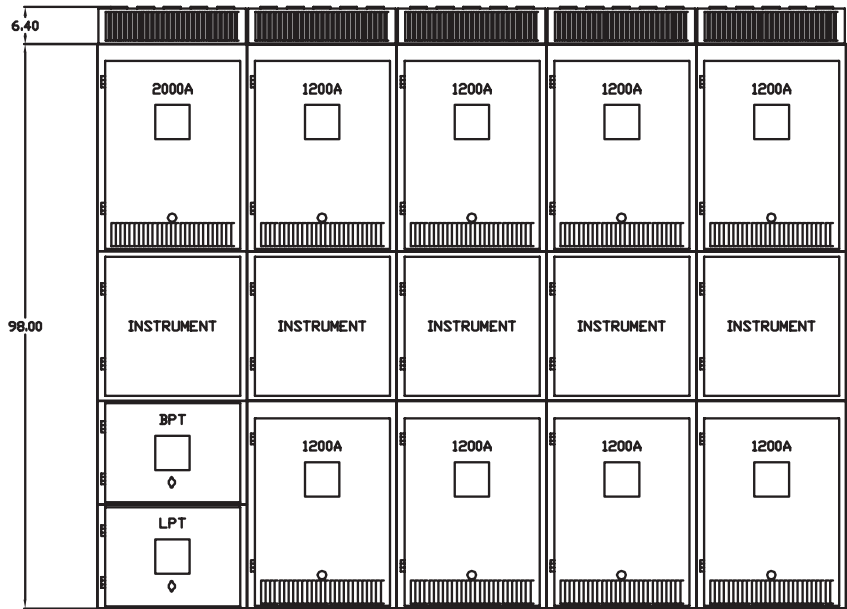
Typical arrangements  
Main-Tie-Main, 2000 A



# Typical arrangements Main-Tie-Main, 1200 A

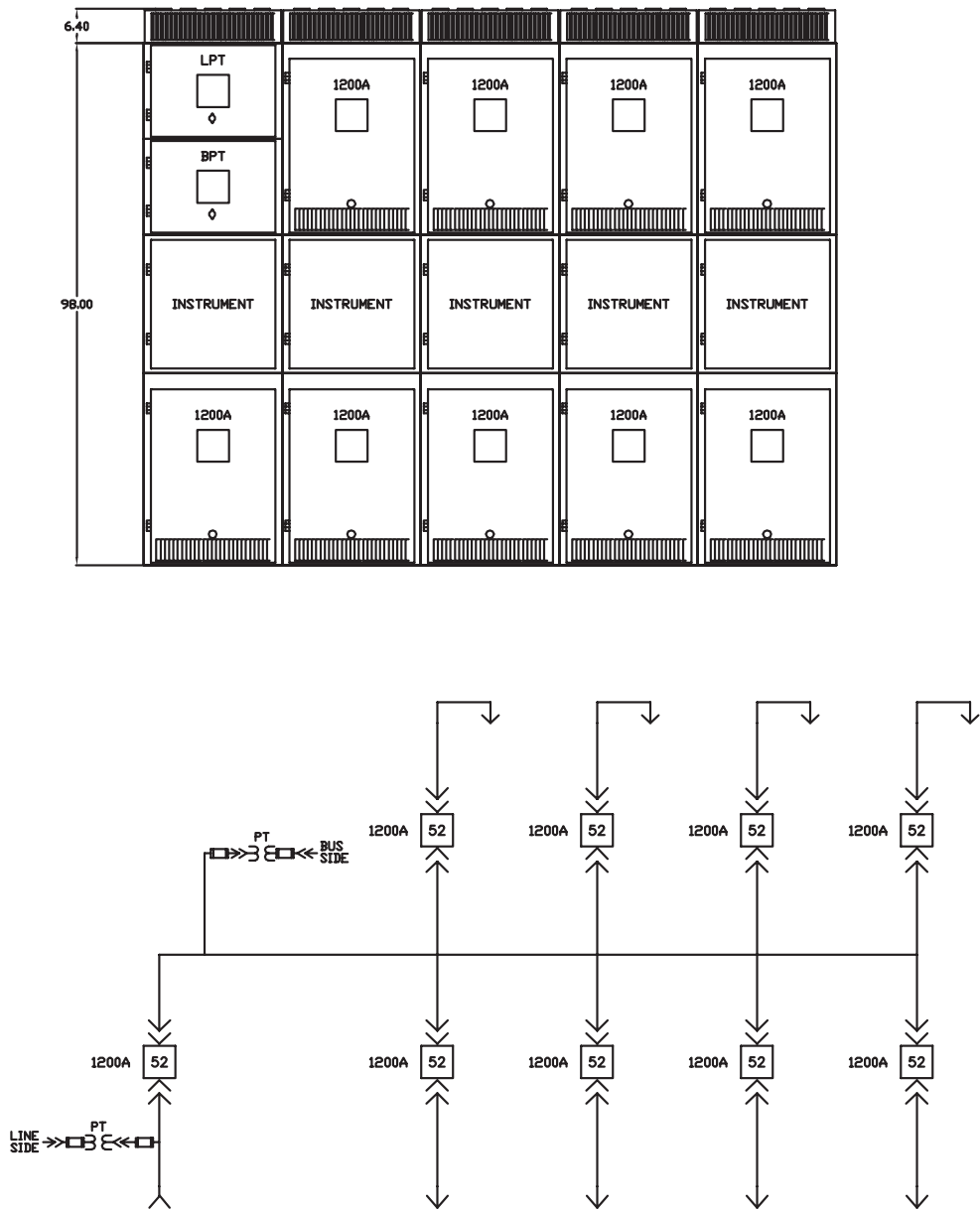


Typical arrangements  
Main with feeders, 2000 A



Typical arrangements

Main with feeders, 1200 A

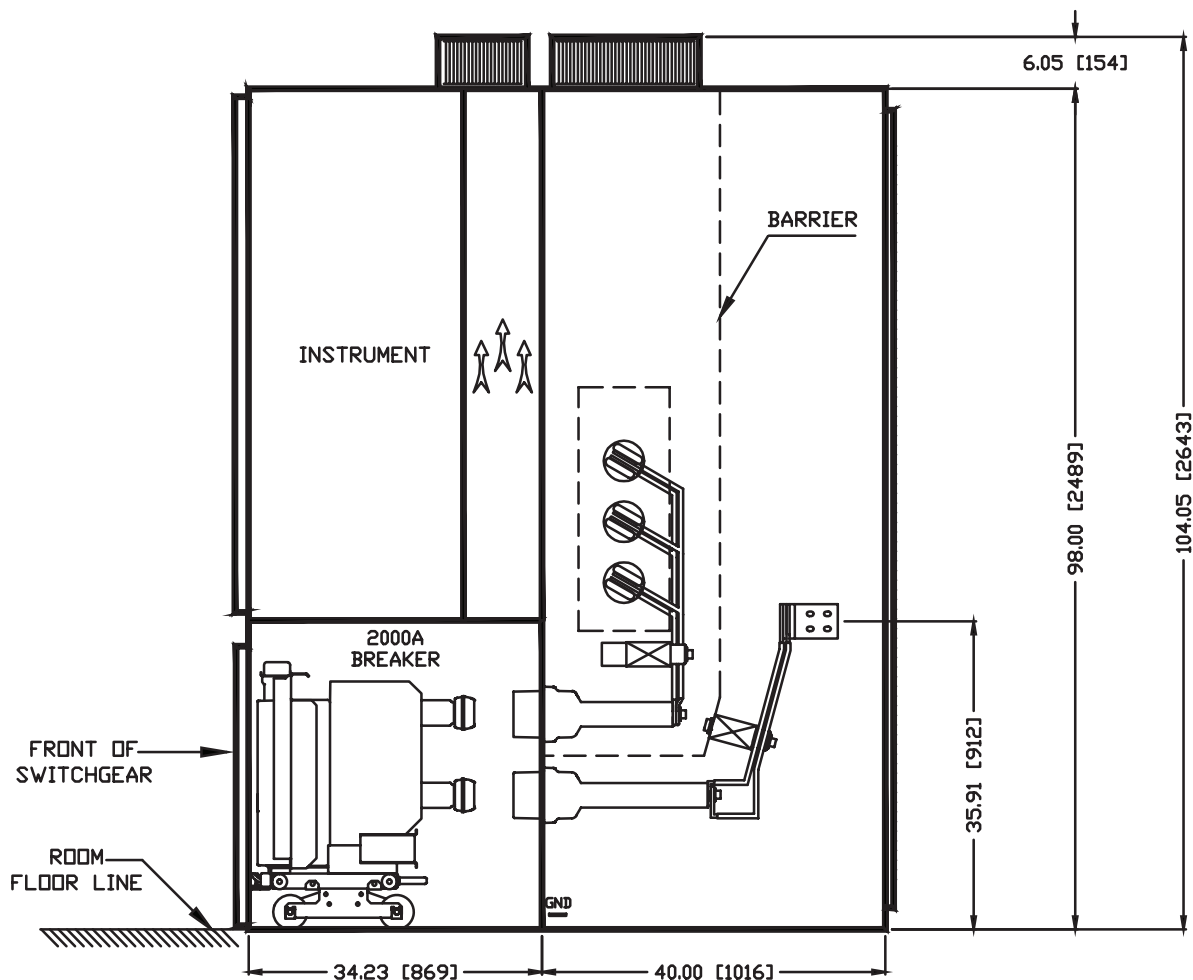




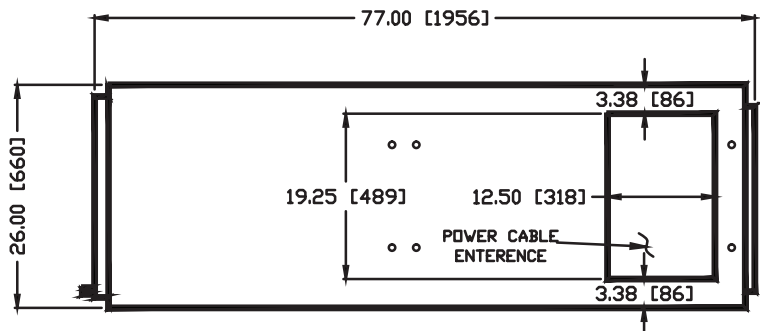
# Civil engineering details

## Typical side views, floor plans, and clearances

ReliaGear ND switchgear one-high frames  
Circuit breaker: 2000 A



SIDE SECTION

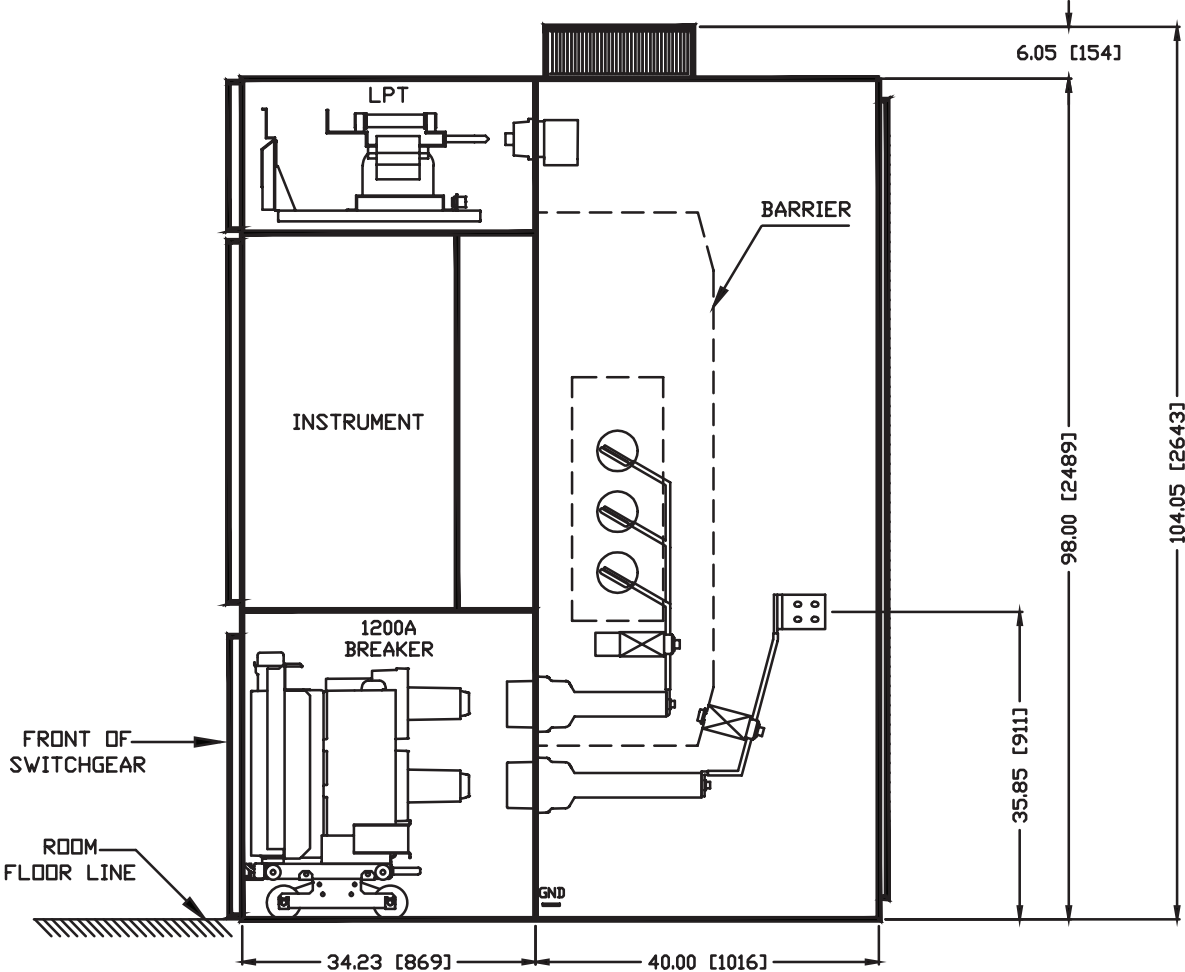


FLOOR PLAN

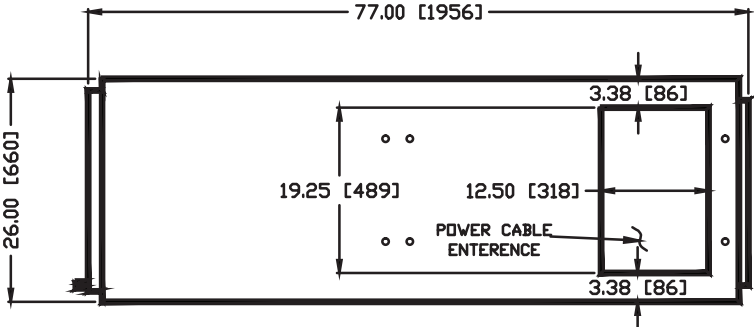
# Civil engineering details

## Typical side views, floor plans, and clearances

ReliaGear ND switchgear one-high frames  
Circuit breaker: LPT 1200 A



SIDE SECTION



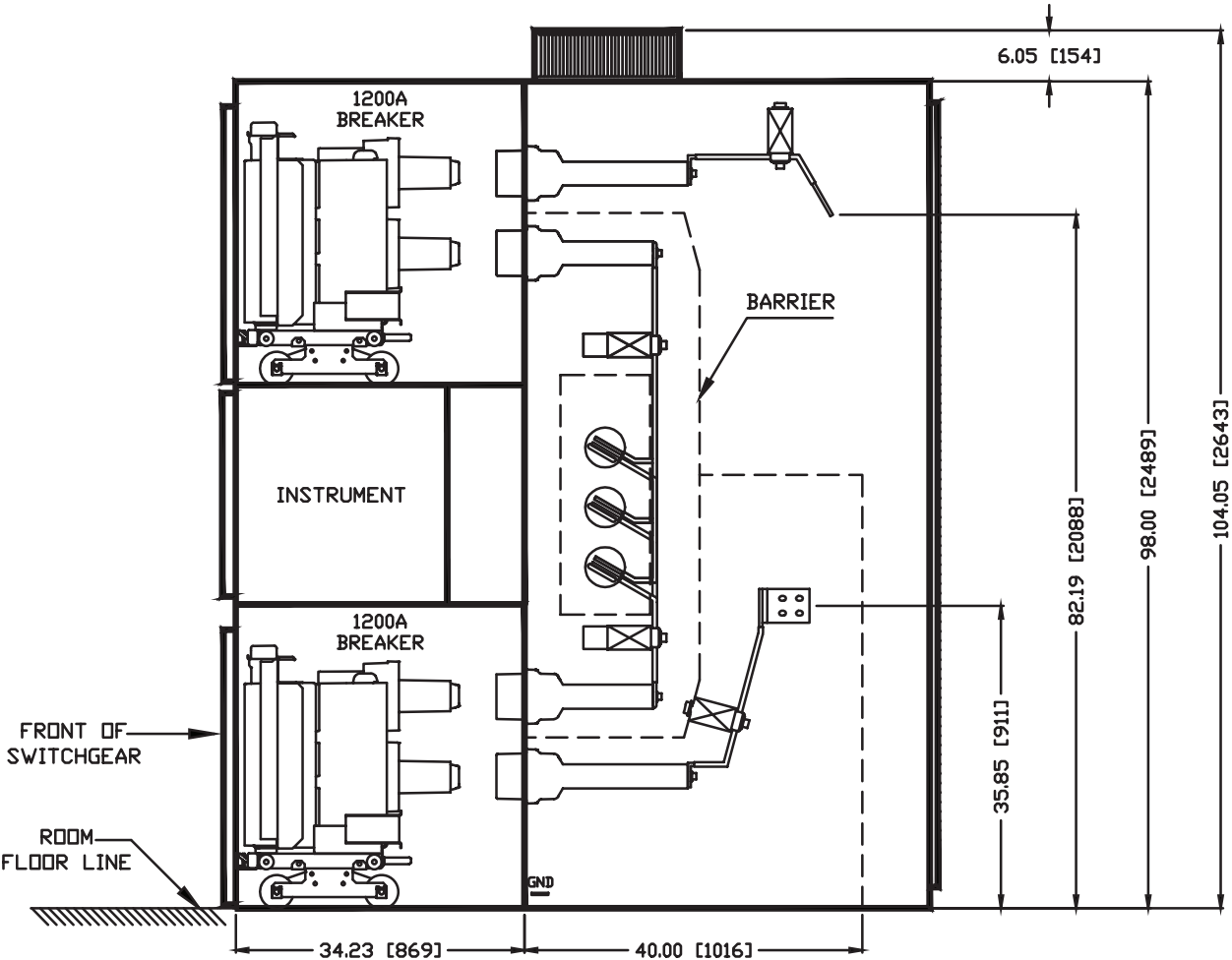
FLOOR PLAN

# Civil engineering details

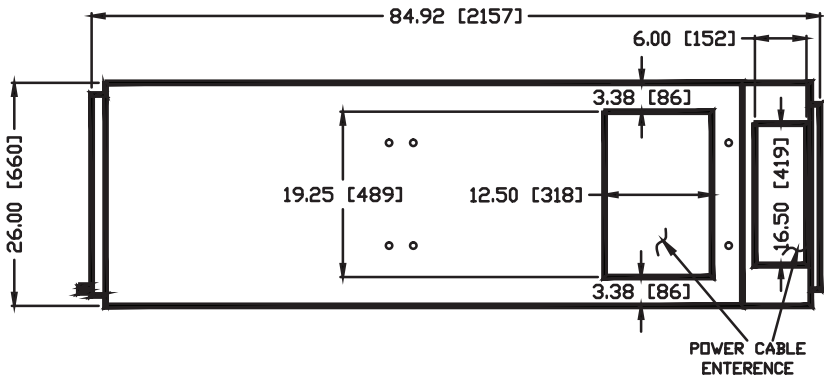
## Typical side views, floor plans, and clearances

### ReliaGear ND switchgear two-high frames

Two-high circuit breaker: 1200 A



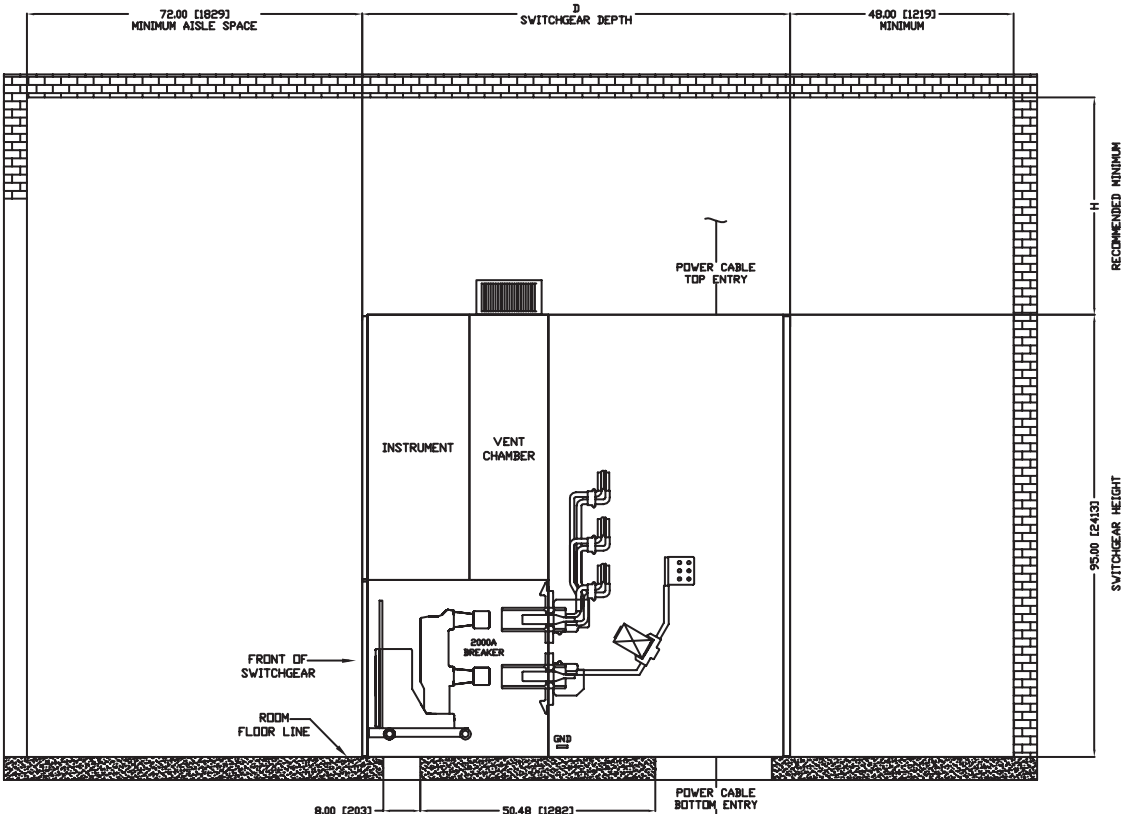
SIDE SECTION



FLOOR PLAN

# Civil engineering details

## Typical side views, floor plans, and clearances



### Typical civil engineering dimensions- inches (mm)

	Depth (D)
ReliaGear ND	77 or 85 (2337)

### Dimension H:

- 6 inches for 1200 A lineups
- 14 inches for 2000 A lineups

### Additional information

- Additional height clearance may be needed during installation of the switchgear. Please allow for 6-inch shipping base for movement during installation.

# 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 adjoining table for A components.

A frame consists of one bus and cable module and the appropriate circuit breaker is given separately and must be added.

Low voltage modules may contain significant amounts 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 low voltage 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. Weights include all modules and components as listed above.

Component	Rating/size (in)	Weight	
		lbs	kg
Vmax/A circuit breaker	1200	280	127
	2000	300	136.1
Circuit breaker module (including bus risers, runbacks and sub-ports)	1200	450	204.1
	2000	470	213.2
Low voltage module (not including instruments and wiring)	26	155	70.3
	62	385	174.6
Bus and cable module (rating is for main bus)	1200	530	240.4
	2000	530	240.4
PT module (including 3 PT's)	-	370	167.8
Rear extension	8	135	61.2
End panels (per lineup)		350	158.8

Basic frame configuration	Circuit breaker (rating)	Weight	
		lbs	kg
One circuit breaker	1200	1800	816.5
	2000	2020	916.3
Two circuit breakers	1200	2560	1161.2
One circuit breaker, one PT	1200	2060	934.4
One circuit breaker, one CPT	1200	2660	1206.6
	2000	2880	1306.3

# Auxiliary device ratings

## Current transformers

### Current transformer ratings

ReliaGear ND is designed and tested for use with the ABB SCH-3U current transformers. These CTs are used for voltage ratings of 5 and 15 kV. Each breaker can accommodate up to two load side and one bus side CT for a total possible three current transformers per phase.

The ABB SCH-3U current transformers are available in single and multi-ratio styles with primary ampere ratings from 50 to 2000 A. These current transformers are used as a source of

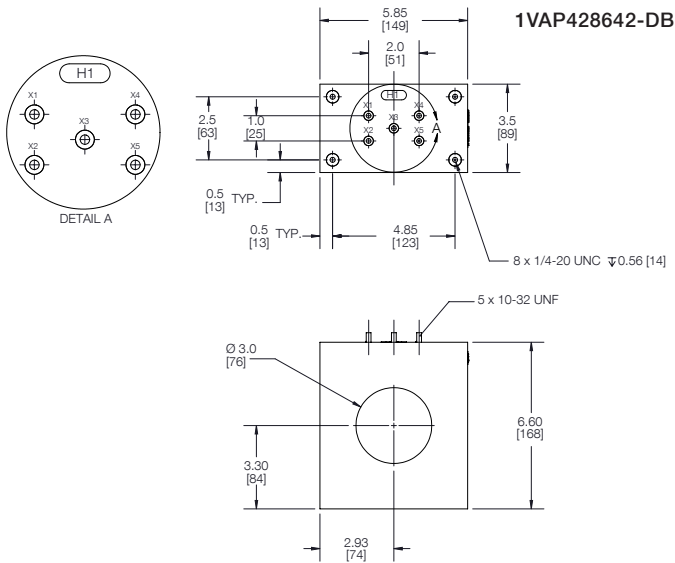
current for both relaying and metering.

The ring-type core is insulated and toroidally wound with a fully distributed secondary winding. The protective case, made of an impact-resistant polycarbonate, is assembled using self-tapping screws. Secondary terminals are 10-32 brass terminal screws with hardware.

These units meet all applicable IEEE and NEMA standards and are UL recognized components.

### SCH-3U

- 600 V indoor
- 10 kV BIL
- 60 Hz
- Mechanical rating: 180 x Normal



Type SCH-3U (3.0" window)

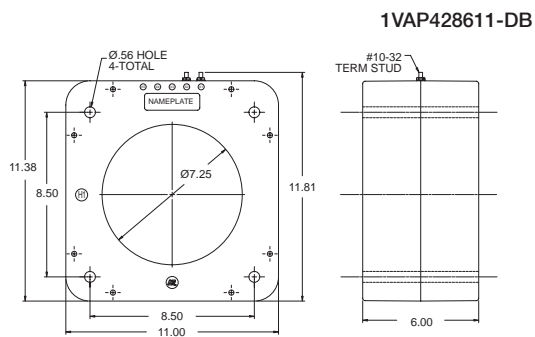
Primary amps	Rating factor		IEEE Metering Accuracy					Relay Accuracy	Weight lbs
	30°C	55°C	B-0.1	B-0.2	B-0.5	B-0.9	B-1.8		
50	2.0	1.5	4.8	-	-	-	-	C5	12
75	2.0	1.5	2.4	2.4	4.8	-	-	C10	12
100	2.0	1.5	1.2	2.4	4.8	4.8	-	C10	12
150	2.0	1.5	0.6	1.2	2.4	2.4	4.8	C20	12
200	2.0	1.5	0.6	0.6	1.2	2.4	2.4	C20	12
300	2.0	1.5	0.3	0.3	0.6	1.2	1.2	C40	12
400	2.0	1.5	0.3	0.3	0.3	0.6	1.2	C50	12
600 MR	2.0	1.5	0.3	0.3	0.3	0.3	0.6	C80	12
800 MR	1.5	1.0	0.3	0.3	0.3	0.3	0.3	C100	12
1200 MR	1.33	1.0	0.3	0.3	0.3	0.3	0.3	C100	12
1500 MR	1.25	1.0	0.3	0.3	0.3	0.3	0.3	C100	12
2000 MR	1.25	1.0	0.3	0.3	0.3	0.3	0.3	C100	12

# Auxiliary device ratings

## Ground sensor current transformers

### BYZ-S

- 600 V indoor
- 10 kV BIL
- 60 Hz
- Mechanical rating: 180 x Normal

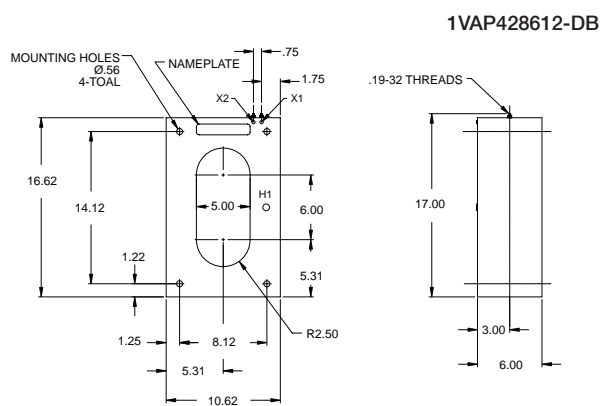


### BYZ-S

Primary current rating	Relaying accuracy	Thermal rating (x Normal, 1 sec)	Window diameter (in)	Weight (lb)
50	C10	100	7.25	52
100	C20	100	7.25	52

### BYZ-O

- 600 V indoor
- 10 kV BIL
- 60 Hz



### BYZ-O

Primary current rating	Relaying accuracy	Thermal rating (x Normal, 1 sec)	Window size (in)	Weight (lb)
50	C20	100	5 x 10 oval*	110
100	C50	100	5 x 10 oval*	110

\* See drawing above

# Auxiliary device ratings

## Potential transformers

### VIY-60, VIZ-75, VIZ-11,TJC-5

Potential transformers (PTs) 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.

PTs 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.



Three phase 60 Hz, 208/120 V secondary, epoxy-cast			
Primary voltage (V)	BIL (kV)	Ratios	Metering accuracy
2400, 4200, 4800	60	20:1, 35:1, 40:1	0.3 W, X, Y and 1.2 Z at 120 V
7300, 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	95	100:1, 120:1, 60:1	0.3 W, X and 1.2 Y



# Auxiliary device ratings

## Control power transformers

CPTs are designed to provide control power in medium voltage switchgear. 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	15
7200, 7620, 8320	95	15
12000, 12470, 13200, 13800	95	15
12000, 14400	125	15



# Power Distribution Center (PDC)

Power Distribution Centers are prefabricated, modular, skid-mounted enclosures for electrical distribution systems including low and medium voltage switchgear and motor control as well as auxiliary equipment such as batteries, SCADA systems and unit substation transformers.

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



# Accessories

The accessory group for ReliaGear ND metal-clad switchgear and the Vmax/A circuit breaker includes a complete array of required and optional special tools for proper handling, operation and maintenance.

Required accessories include the circuit breaker racking crank for inserting and removing the circuit breaker, a lift truck to insert/remove breakers in top cells, and a PT/CPT tool to connect/disconnect PT and CPT trucks.

### Lift truck

A lift truck is required for all primary devices in upper cubicles or breakers in lower cubicles without roll-on-the-floor provisions. The lift truck is available in manual hydraulic or electric winch versions. 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.

### 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.

### 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 circuit breaker secondary contacts, and serves as an aid to breaker inspection and maintenance in switchgear aisles or work areas.

### Breaker ramp

A breaker ramp is available to insert breakers without roll-on-the-floor provision into lower cubicles without the use of a lift truck.

### PT/CPT tool

The PT/CPT tool is required to connect and disconnect PT and CPT drawout trucks with the door closed.

1 Racking crank | 2 Lift truck | 3 Test jumper | 4 Test cabinet



2



3



4



# Ground and Test device (G&T)

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.

## Grounding feature

The 15 kV manual G&T device is for use with the ABB ReliaGear ND platform. These devices are supplied when specified by the customer.

## Insertion and withdrawal

The device is able to be inserted and withdrawn from the circuit breaker compartment in the same manner as the circuit breaker, including use of the same lift truck and racking tools.

## Coordination

The device is equipped with mechanical interlock that coordinates with the circuit breaker compartment. The device is blocked from being inserted into a circuit breaker compartment where the required ratings exceed those of the G&T device.

## Terminal sets

The device features one terminal set that can be configured to test and ground the line or load side. Only one set can be grounded at any time.



## Notes:

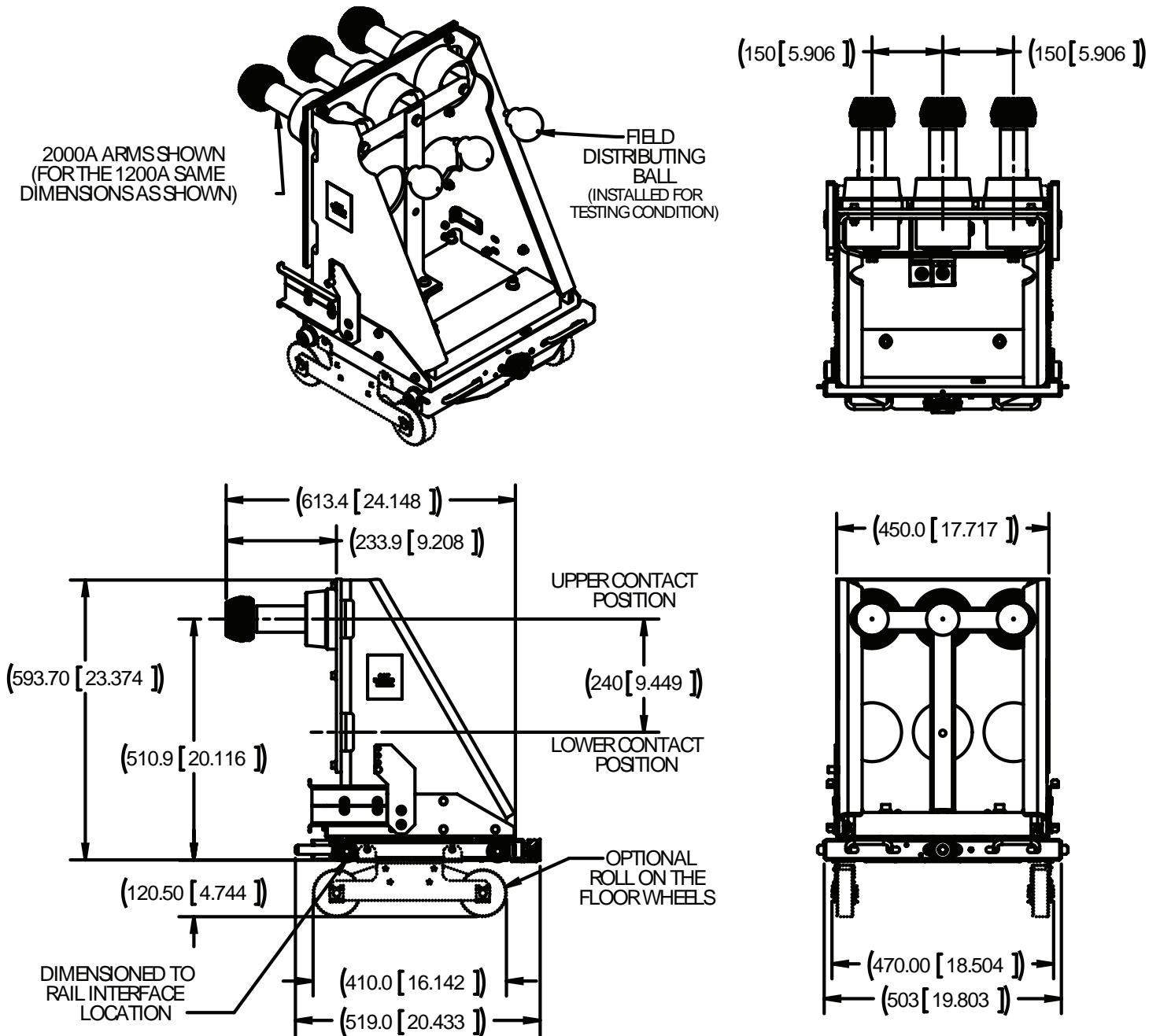
1. The device is for use with cells designed for Vmax/A breakers.
2. Either upper or lower terminals are grounded at any time.

## Grounding connection system

The device features a grounding connection system that operates with the use of grounding bus bars. The grounding bus bars and related hardware provided with the device satisfy the requirements of the design tests for the short time and momentary tests as required per IEEE C37.20.6.

## Interrupting or closing capability

The ABB manual G&T device does not feature closing or interrupting. The device does not have a mechanism by which to open or close a circuit. Different devices are required for 1200 A and 2000 A compartments.



# SmartRack™ electrical remote racking device

The ABB SmartRack™ Electric Remote Racking Device is intended to assist technicians with the process of racking ABB medium voltage circuit breakers and most auxiliary devices. The main function of the device is to perform the racking operation with minimal manual interaction. This allows the operator of the device to maintain a significant distance between themselves and the removable element while racking is performed as compared to the traditional hand-crank method of racking.

The ABB SmartRack Electric Remote Racking Device is able to perform this complex task through the use of a programmable logic controller and servomotor. Throughout operation, the controller and motor are in constant communication allowing the device to accurately position a circuit breaker or other device in the switchgear cell.

### SmartRack application guide

The SmartRack remote racking device is designed to operate with the following devices.

	Breaker/ Contactor	G&T Device	PT Unit	CPT Unit	CPT Fuse Unit
Advance	X	X	X	X	X
Advance 27	X	X	X	X	X
SafeGear	X	X	X	X	X
SafeGear HD	X	X	X	X	X
ReliaGear ND	X	X	N/A	N/A	N/A
SafeGear MCC	X	N/A	N/A	N/A	N/A





Technical and application guide

# SafeGear®

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

Power and productivity  
for a better world™



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# General Overview

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

### Introduction

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 locations for SafeGear are both ISO 9001 and 140001 certified. SafeGear switchgear is available with UL label or as a CSA certified lineup.

### Applicable standards

SafeGear is built per IEEE C37.20.2 metal-clad switchgear construction standards and tested per IEEE C37.20.7 for arc-resistance with a 10-cycle duration.

### 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 2 BC.

### 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. SafeGear'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 used in the SafeGear platform

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).

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 circuit current (rms)	kA	25, 31.5, 40, 50		
Rated frequency	Hz	50, 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 C37.20.2-1999 metal-clad standard

\*\* 4000 A is achieved by forced-air cooling

# General Overview

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

### 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

- Installation, operation and maintenance manual by CD or printed
- Mechanical options
  - Tin plated bus
  - Mimic bus
  - Cable supports
  - Mechanical trip on breaker doors
  - IR windows (IRISS or Fluke)
  - Channel sills
- Electrical options
  - Separate or common pull-out fuse block or molded case circuit breaker trip and close coil protection
  - Maximum 20% spare terminal blocks per row
  - 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	1VAL108001-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	1VAL108001-AP
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.
- 3000 A and 4000 A must be located in their own frame with a 57-inch instrument compartment located above the breaker.

# Construction

## Doors

SafeGear front doors consist of the breaker compartment, auxiliary unit compartments and LV compartments. These doors are provided with a single handle, multi-point latch (MPL) door as standard up to 31.5 kA and with bolted doors at 40 and 50 kA. Bolted doors are available as an option. 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:

- Full height hinged and bolted
- 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.

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 a viewing window 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.



# Compartment types

## Circuit breaker compartment

### Circuit breaker compartments

SafeGear circuit breaker compartments are designed for maximum operator safety by providing one large viewing window 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 feature 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 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 the primary or 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.



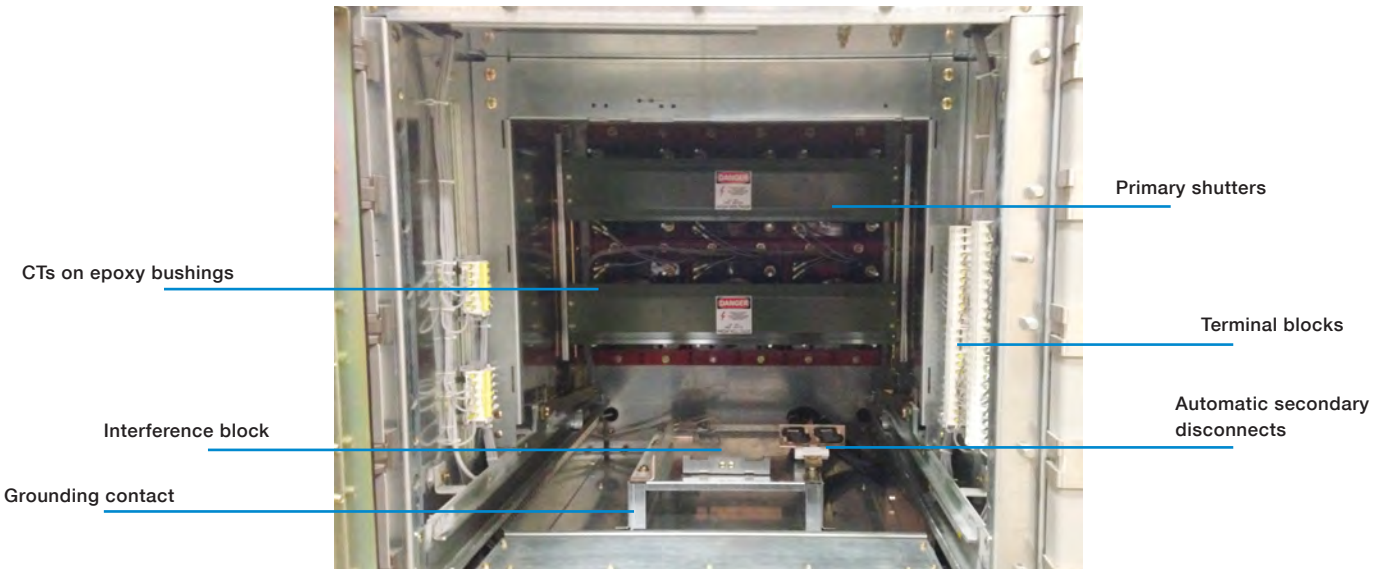
### Secondary disconnect system

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.

**Note:** Terminal blocks normally covered by grounded metal barrier have been removed in this photo



# Compartment types

## Auxiliary modules

### PT/CPT/Draw-out fuse compartments

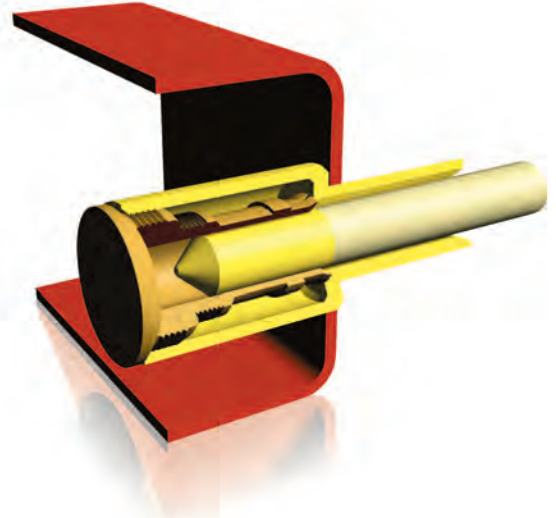
Similar to breaker compartments, potential transformer, control power transformer and draw-out fuse compartments are inserted via an automatic latching insertion mechanism which allows for closed door insertion of auxiliary equipment. The cell interface uses the same components as the circuit breaker module and is compatible with ABB's remote racking device, the Smart-Rack. 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 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,

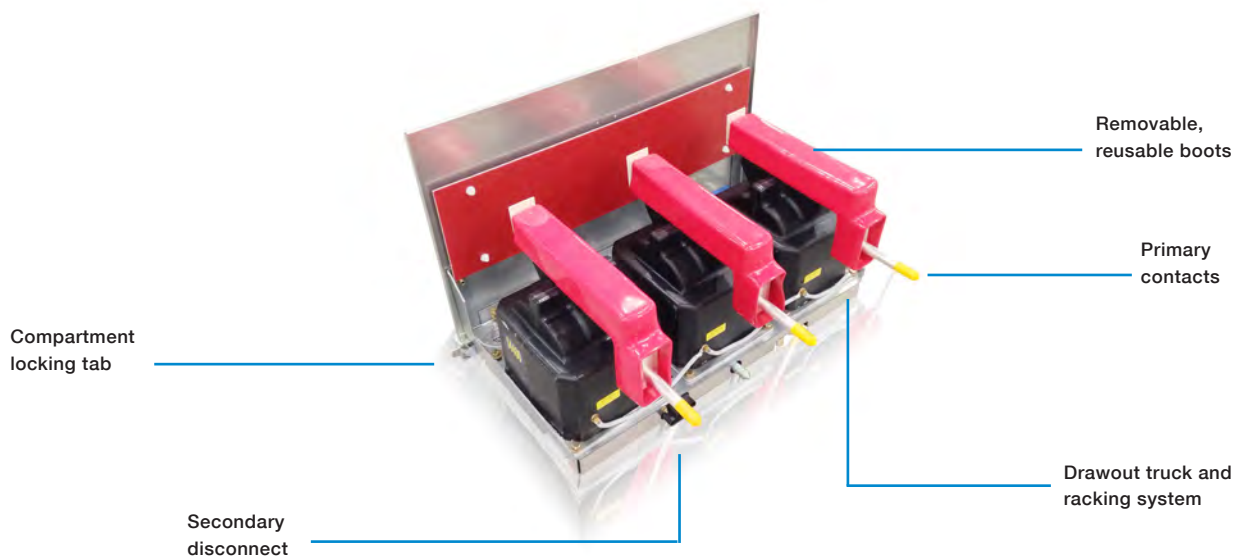


Delrin primary probe and recessed contact assembly

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.

PT drawout assembly with three voltage transformers - the fuses can be removed without removing the PT truck from the rails





# Compartment types

## Instrument compartment

### Instrument compartment

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. The LV wiring pans are designed to be removeable and customizable.

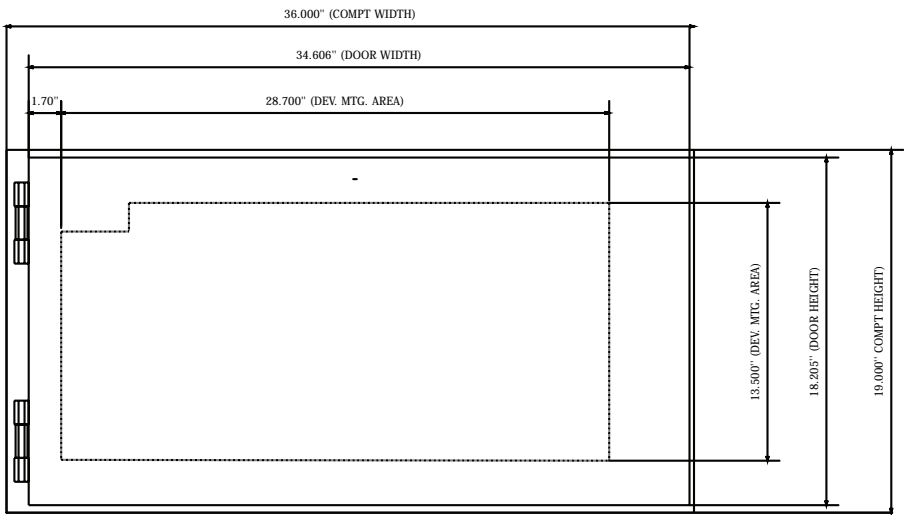
Plastic enclosed wireways are used to provide protection for the wiring, as well as a neat and organized appearance. This allows for easy addition of wiring, should it be needed.

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.



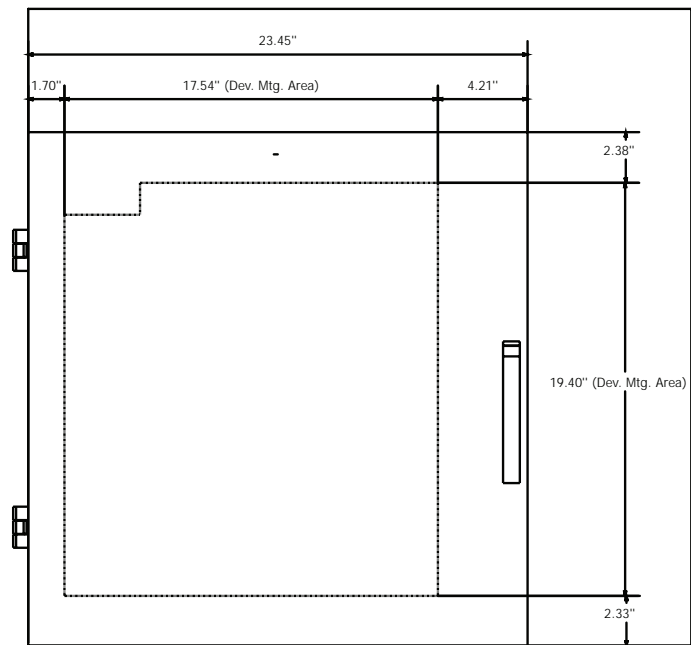
Low voltage instrument module isolated for maximum safety when working with low voltage circuits



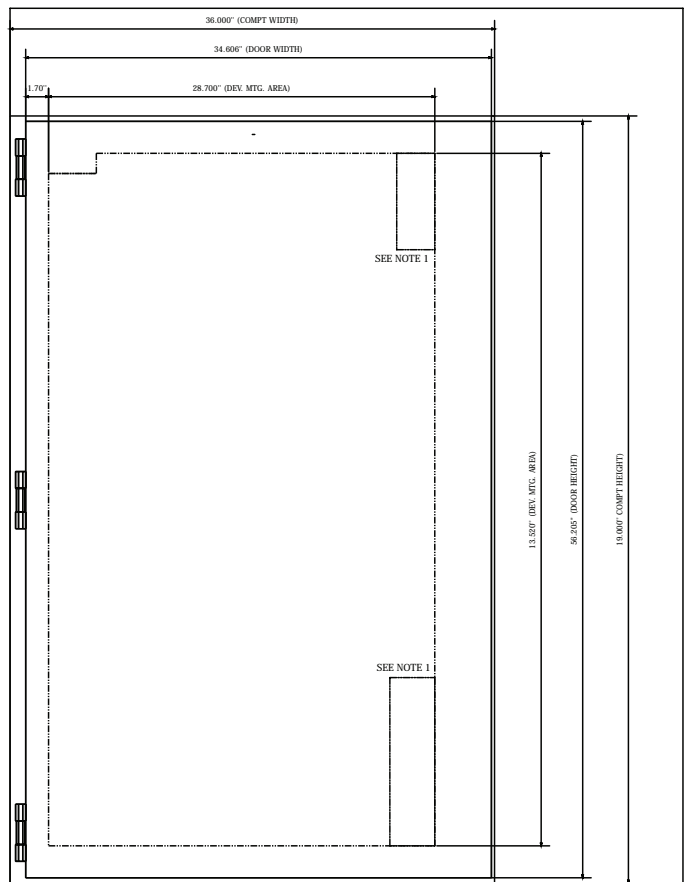
LVC DOOR PANEL 19"

# Compartment types

## Instrument compartment



LVC DOOR PANEL 26"



LVC DOOR PANEL 57"

# 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 advance 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.

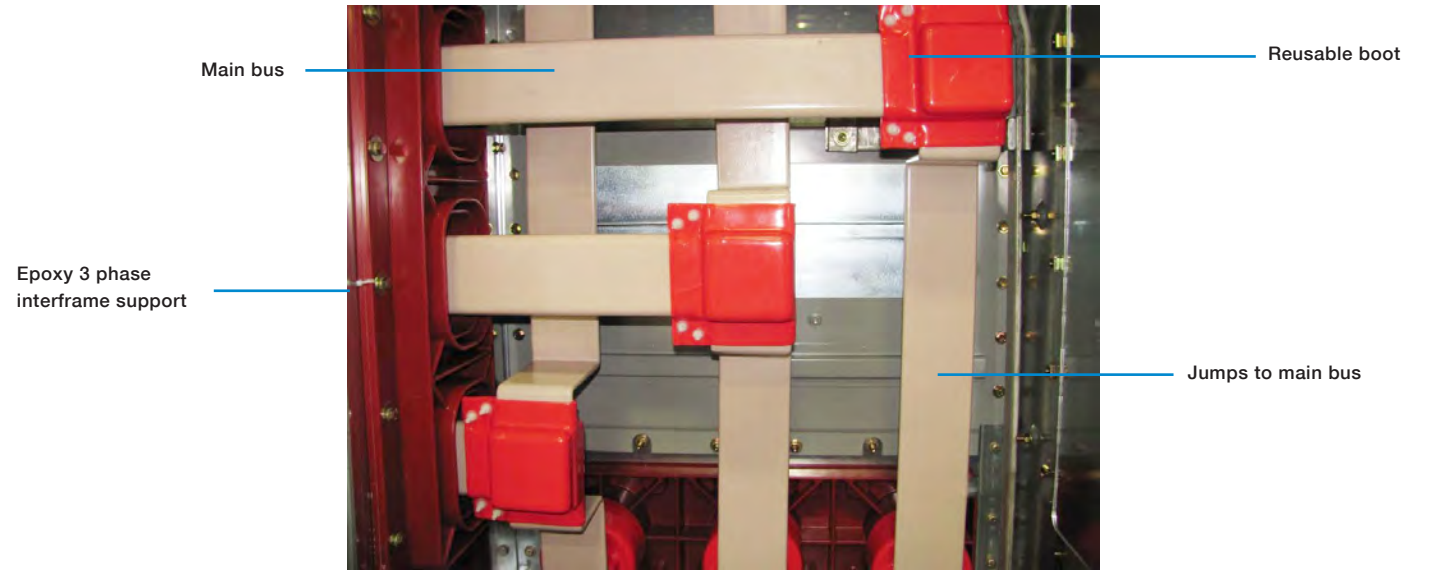
Insulating standoffs rigidly support the bus. This includes risers, the connections from stationary primary contacts to the main bus and runbacks the connections from the stationary primary contacts to line or bus terminations. Internal standoffs and inter-frame supports are epoxy for all ratings. For applications requiring porcelain, contact the factory.

SafeGear arc-resistant, metal-clad switchgear design certifications are based on 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. If porcelain bus supports and insulators are needed, contact factory.

Characteristic	Epoxy
Flexural strength, MPA	120 - 150
Tensile strength, MPA	70 - 90
Impact strength, KJ/m2	10 - 15
Thermal class	F
Dielectric strength (short time), kV/mm	> 23

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	350-375	300
.125" thick, 25°C		
Dielectric constant	4-6	6

Continuous current	Short-circuit rating	Quantity/phase	Size
1200 A	25, 31.5, 40, 50	1	.395" x 4"
2000 A	25, 31.5, 40, 50	1	.75" x 4"
3000 A	25, 31.5, 40, 50	2	.75" x 4"
4000 A	25, 31.5, 40, 50	2	.5" x 6"





# Compartment types

## Cable compartment

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.

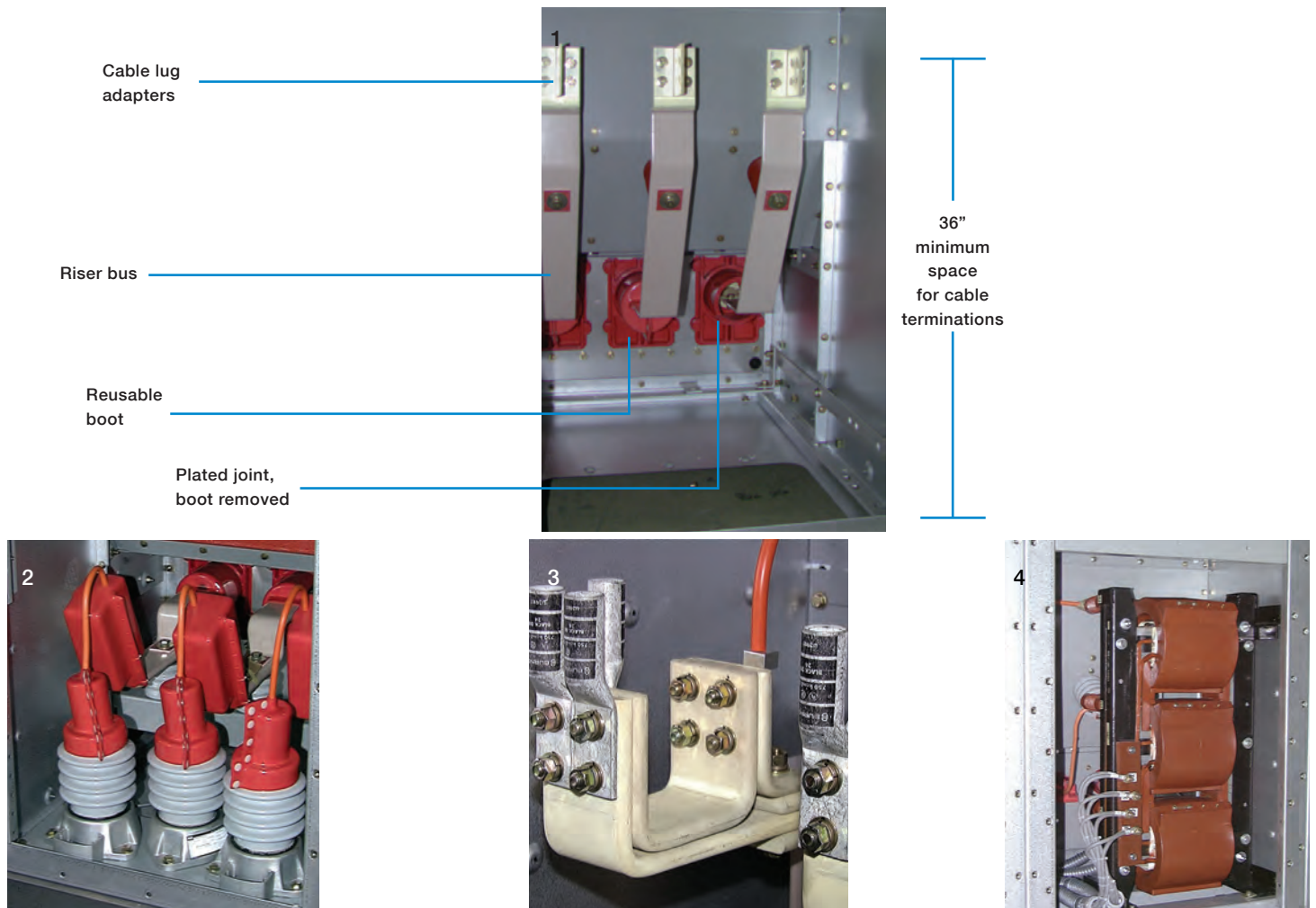
In two-high arrangements with stacked circuit breakers, steel barriers separate the compartments and isolate the primary circuits. All configurations come standard with lug boots and have the option for cable supports to make field connections more secure.

Cable compartments are available with optional readily accessible zero sequence current transformers, surge arrestors and

capacitor and 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 transformer up to 75 kVA.

Primary cable compartments are provided with removable, non-painted stainless steel cover plates used to install conduit or cable sealing glands. 14-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.

1 Cable compartment (main bus - cover installed) | Various application designs in cable compartments: 2 Surge arrestors | 3 Connection of up to eight cables per phase (three cable lugs shown) | 4 Large fixed-mount CPT up to 75 kVA 3-phase or 50 kVA single-phase



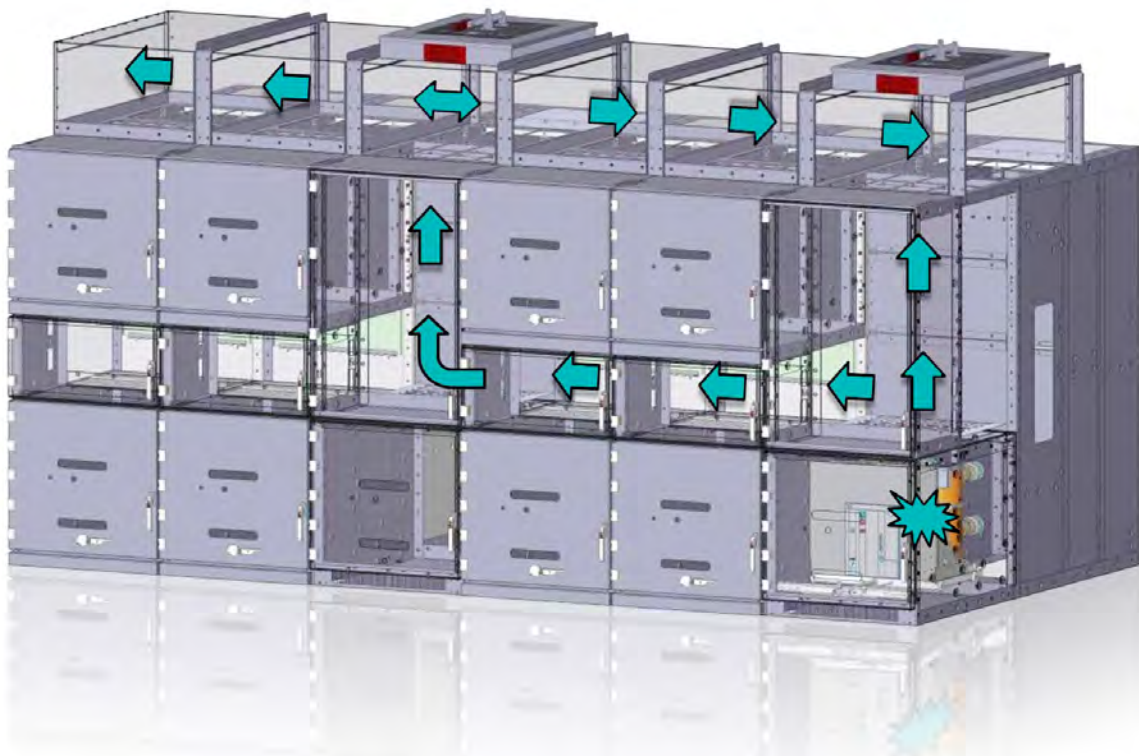
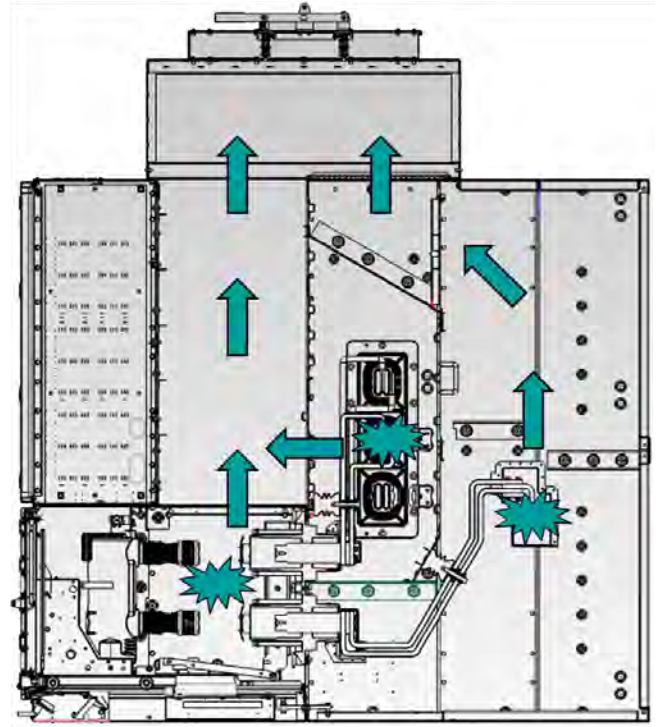
# Arc chamber and plenum

A system of chambers inside the switchgear lineup serves as an exhaust system which vents 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 top-mounted plenum, the gases and pressure are directed to an area outside the building and away from personnel. The plenum sections feature external flanges for ease of bolting sections together at assembly and 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 Application Guide, 1VAL108001-AP, 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 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.



# 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 92-inch depth

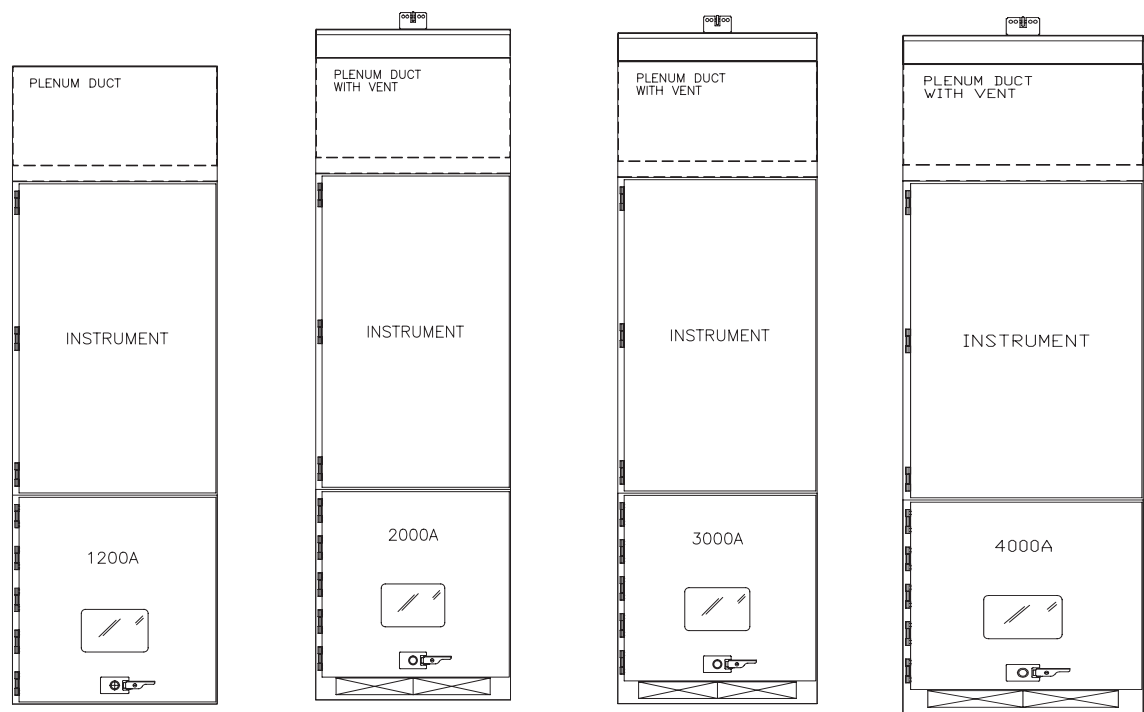
Dimensions			
Frame	Width (in)	Height with plenum including vent box with handle (in)	Depth (in)
2000/3000/4000	36	129.5	85 or 92
A Breaker			
All other frames	36	118	85 or 92

### Options

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

Note: Refer to page 31 for floorplans

### All ratings



# 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.

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

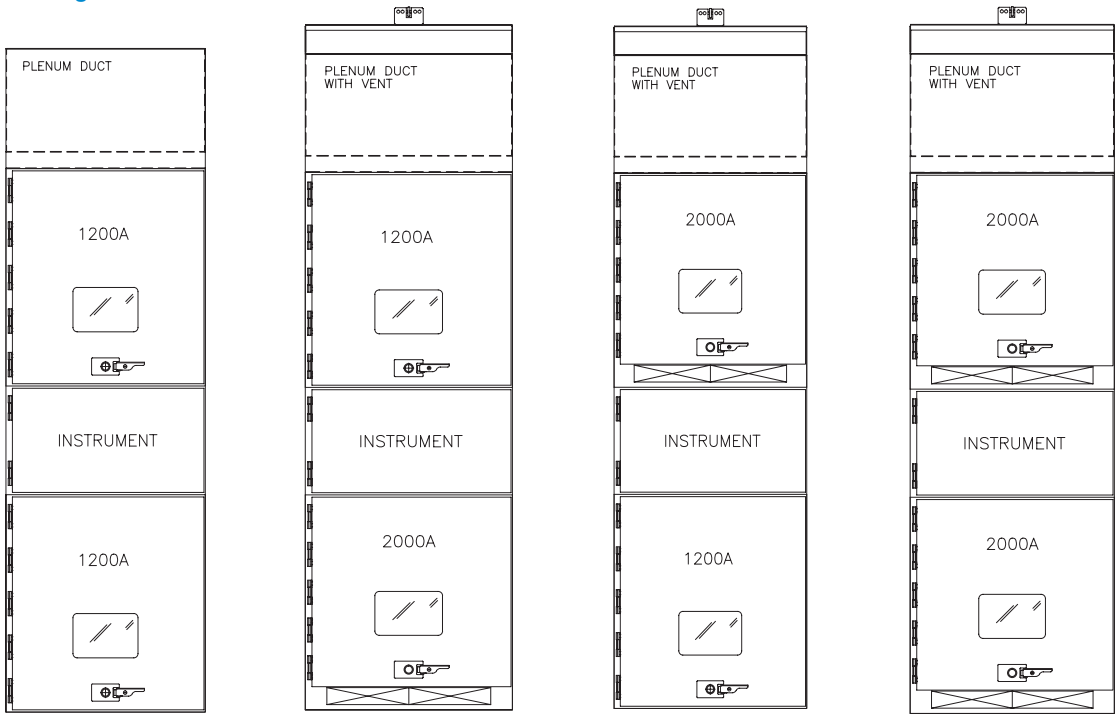
Dimensions			
Frame	Width (in)	Height with plenum (in)	Depth (in)
2000/3000 A breaker	36	129.5	85 or 92
All other frames	36	118	85 or 92

### Options

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

Note: Refer to page 28 for floorplans

### All ratings



# 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

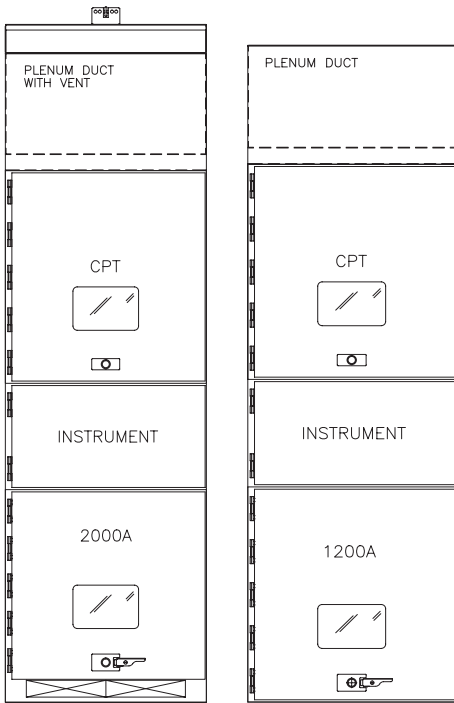
\* Bifurcated lug pad requires 92-inch depth

### Notes:

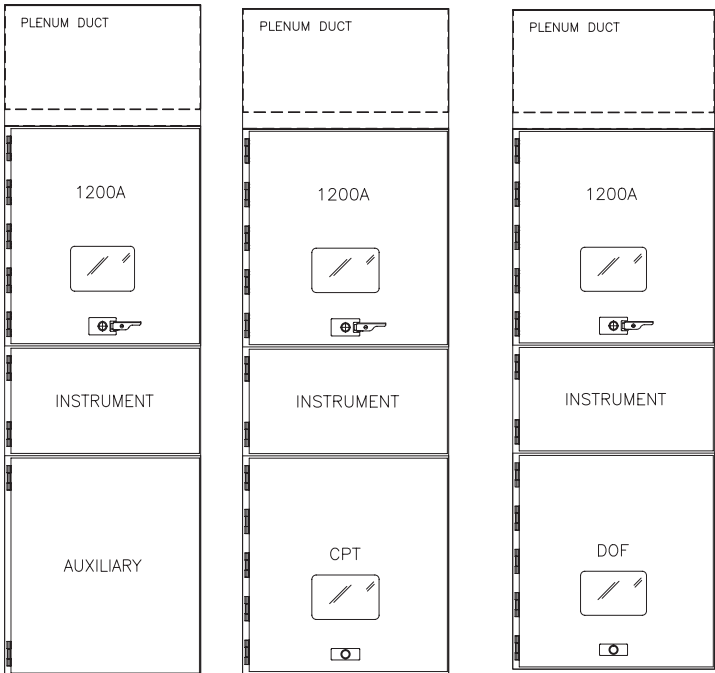
1. Refer to pages 29 and 30 for floorplans
2. LVC=low voltage compartment/instrument compartment

### All ratings

Breaker below



Breaker above



Dimensions			
Frame	Width (in)	Height with plenum (in)	Depth (in)
2000/3000 A breaker	36	129.5	85 or 92
All other frames	36	118	85 or 92

### Options

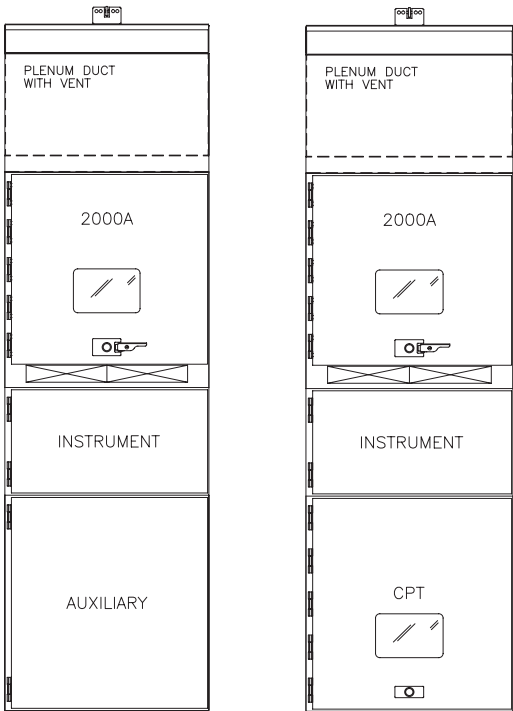
- Ground CTs
- Surge arrestors
  - Distribution
  - Intermediate
  - Station
- Surge capacitor
- Ground studs
- Space heaters
- Cable supports

# Available frame types

## Breaker and auxiliary frames

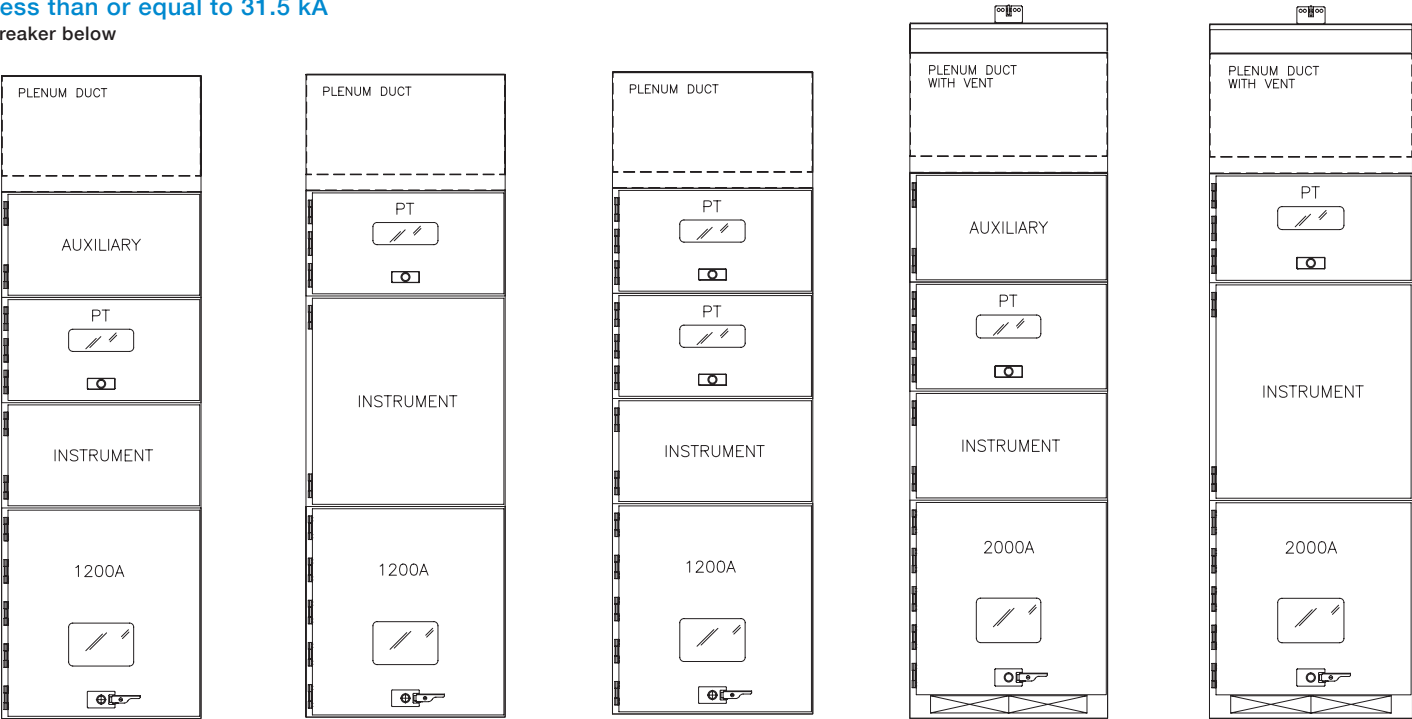
### All ratings

Breaker above



### Less than or equal to 31.5 kA

Breaker below

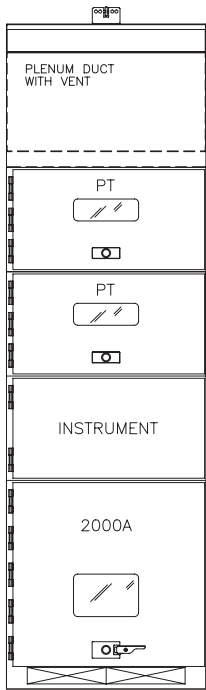


# Available frame types

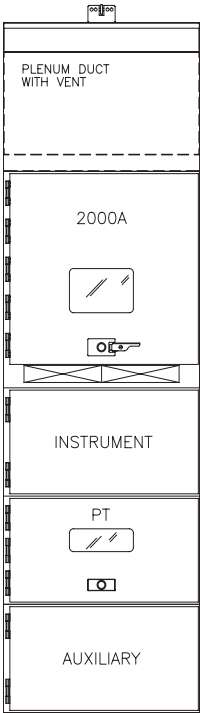
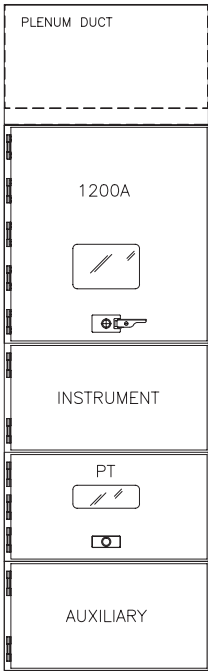
## Breaker and auxiliary frames

### Less than or equal to 31.5 kA

Breaker below

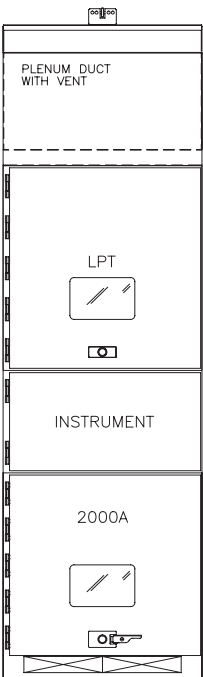
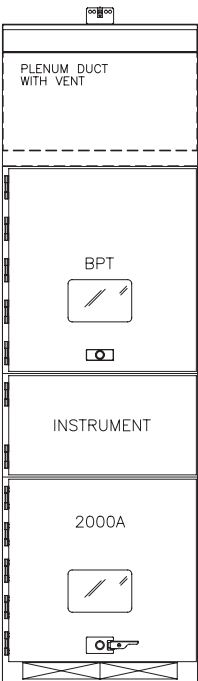
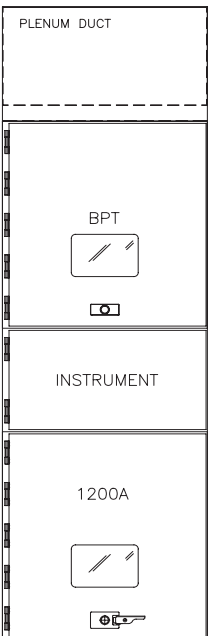
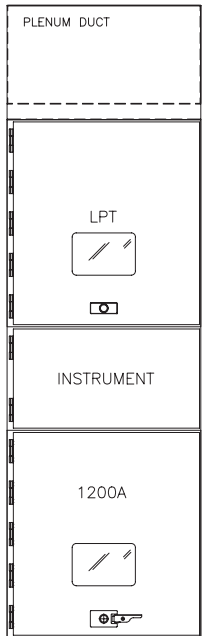


Breaker above



### Greater than or equal to 40 kA

Breaker below



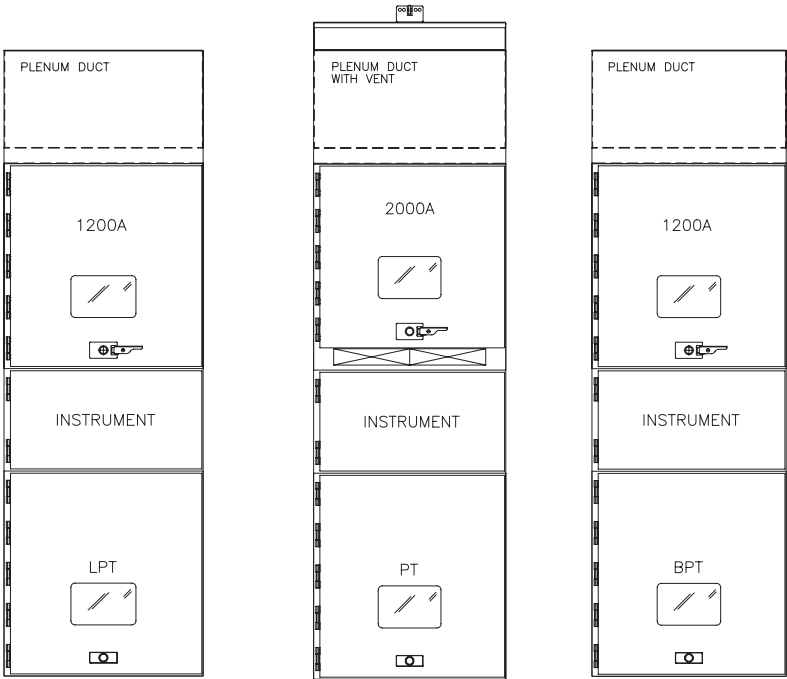


# Available frame types

## Breaker and auxiliary frames

Greater than or equal to 40 kA

Breaker above





# 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 with plenum (in)	Depth (in)
All frames	36	118	112

### Options

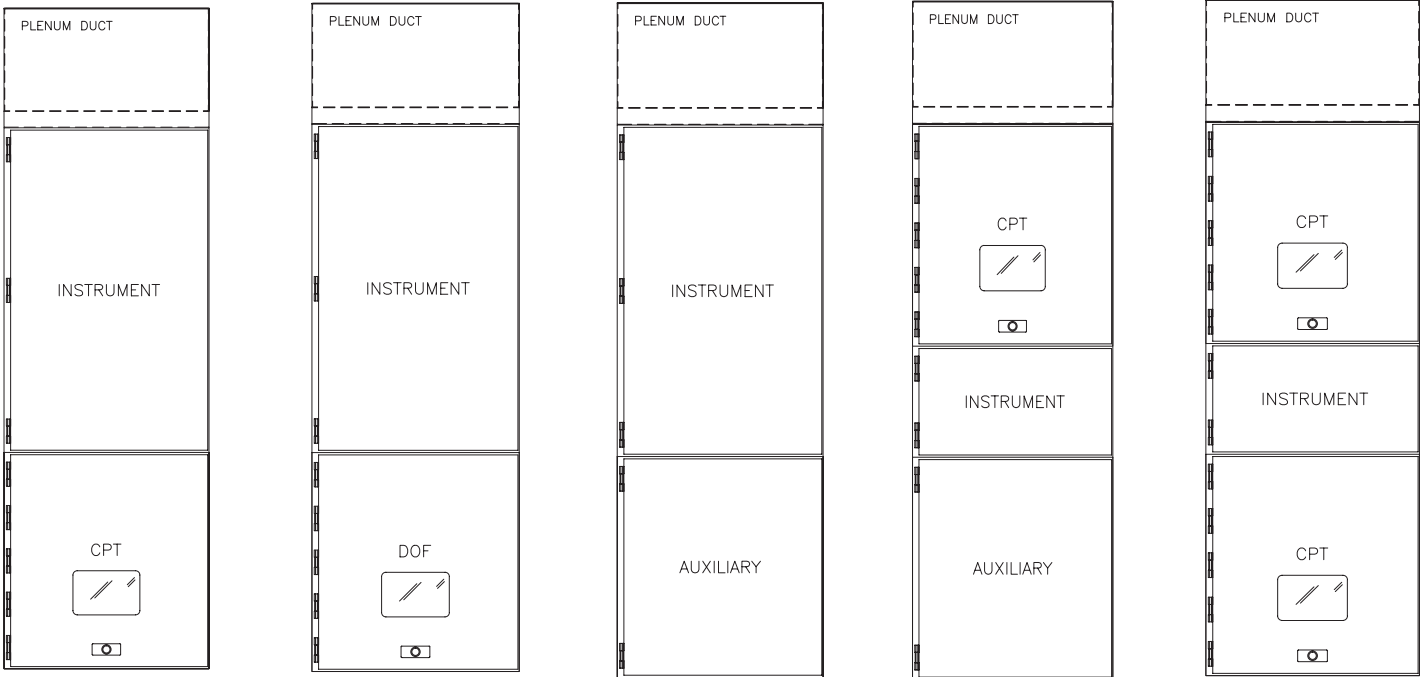
- Space heaters

### Notes:

- 1. CPT=control power transformer
- 2. LVC=low voltage compartment/instrument compartment

- 3. PT=potential transformer
- 4. DOF=drawout fuse

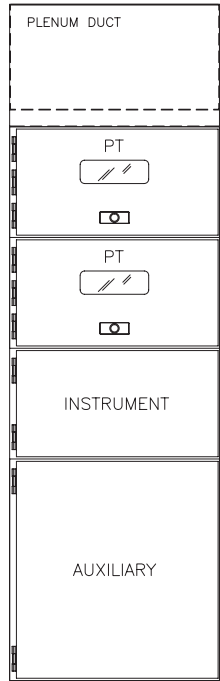
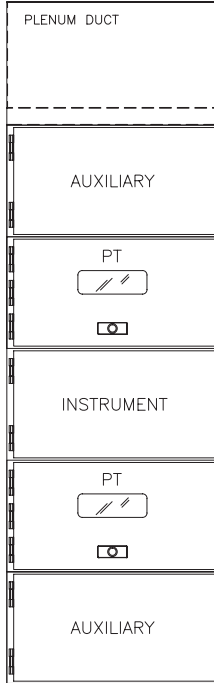
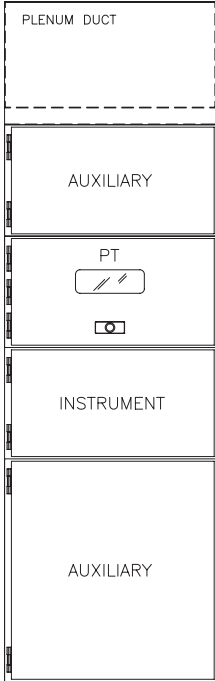
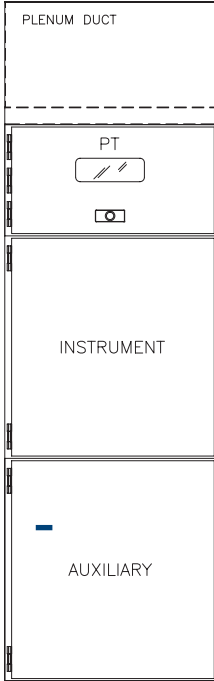
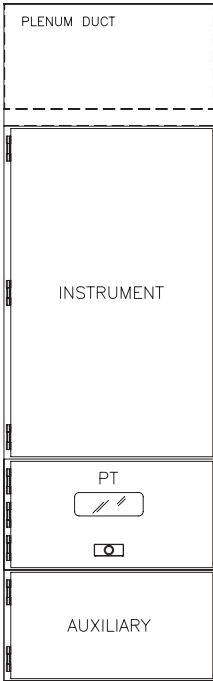
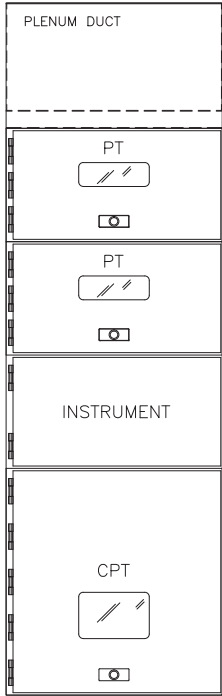
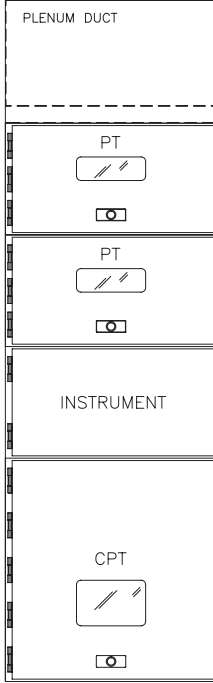
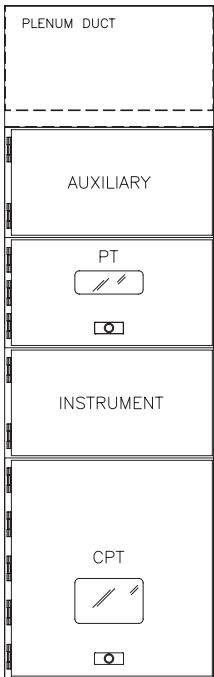
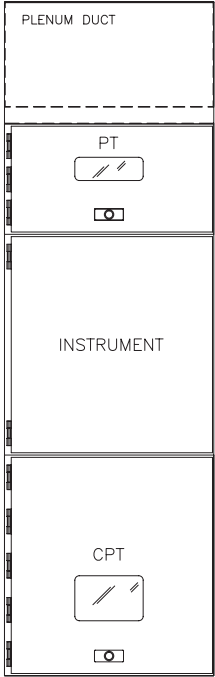
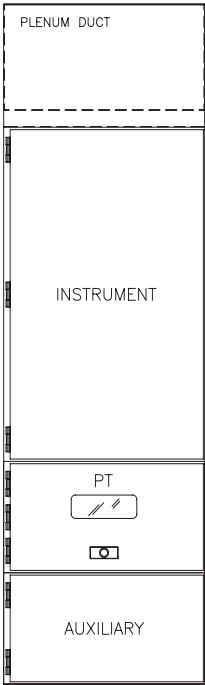
### All ratings



# Available frame types

## Auxiliary frames

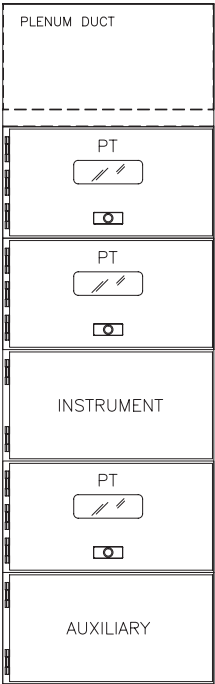
Less than or equal to 31.5 kA



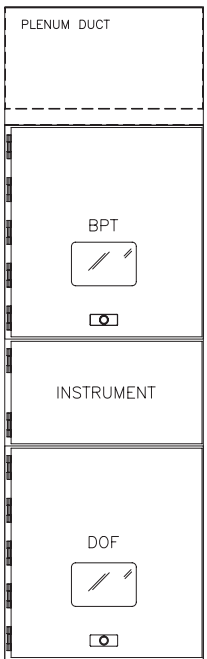
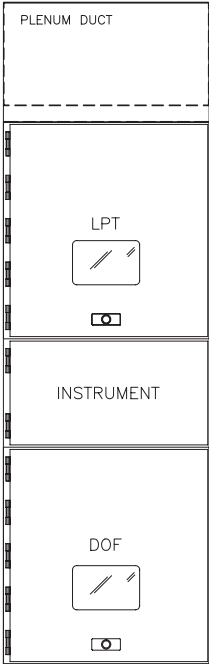
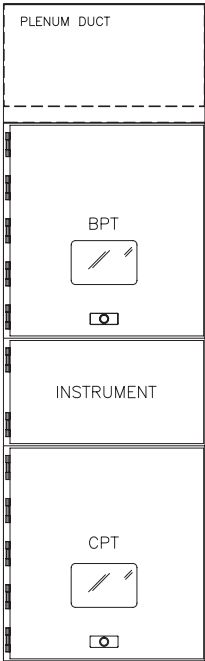
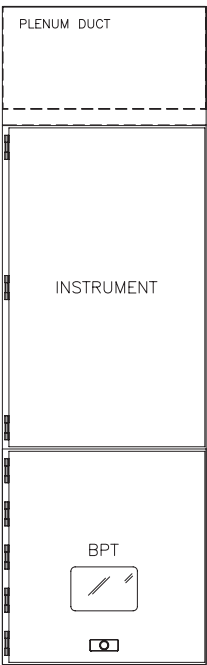
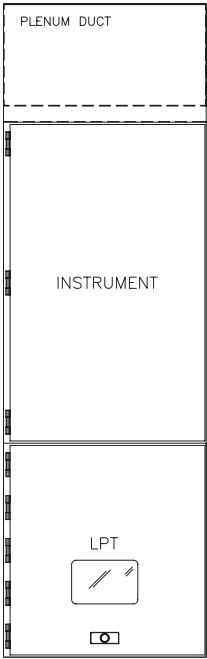
# Available frame types

## Auxiliary frames

Less than or equal to 31.5 kA



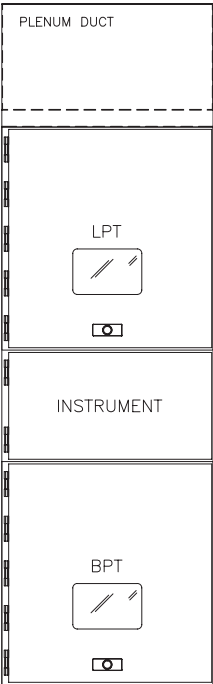
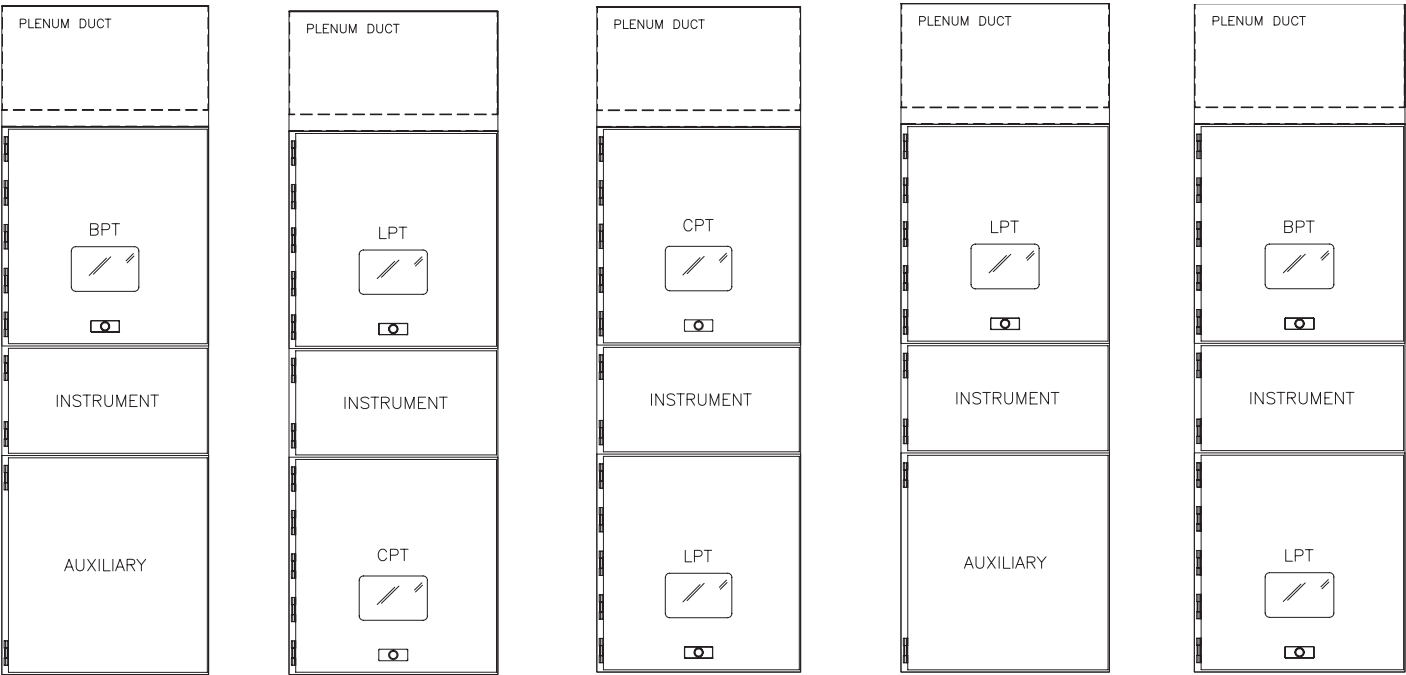
Greater than or qual to 40 kA



# Available frame types

## Auxiliary frames

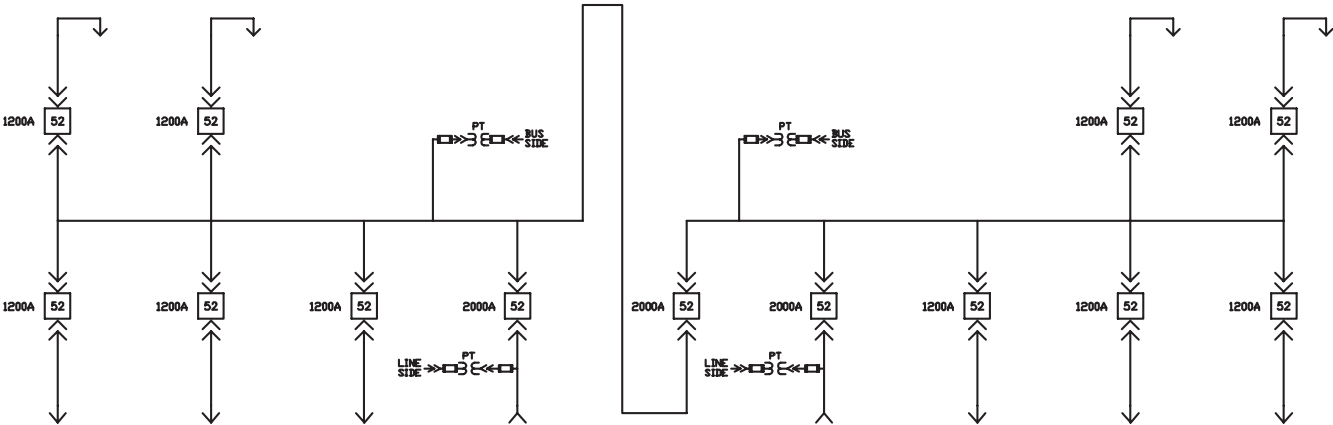
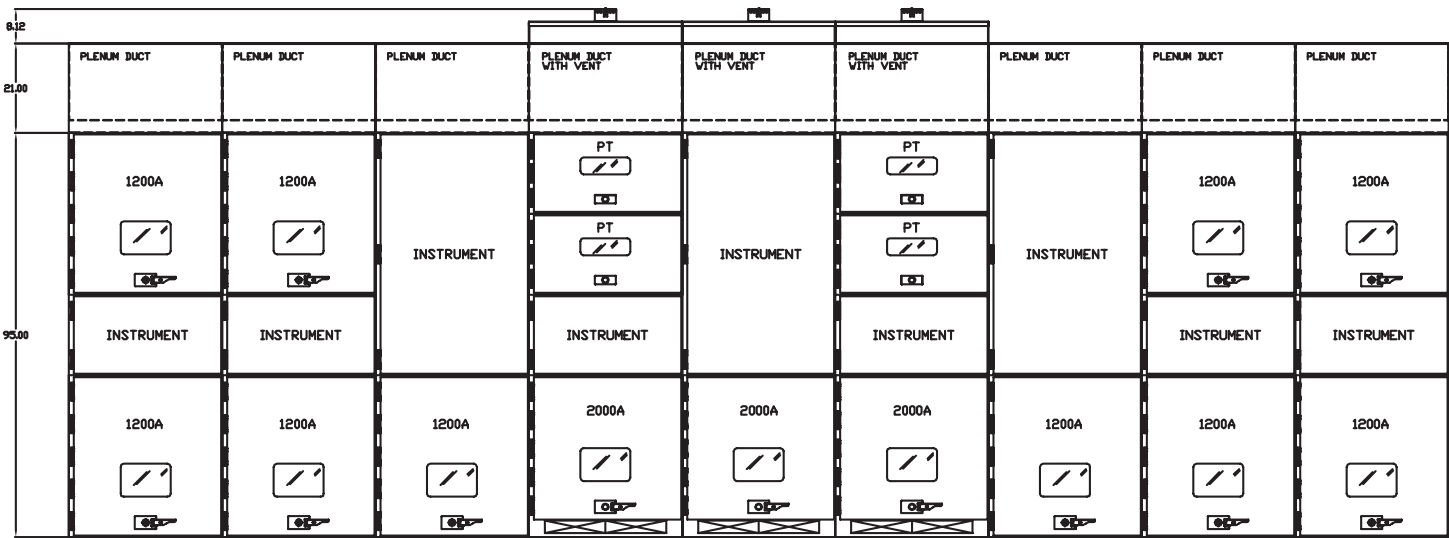
Greater than or equal to 40 kA



# Typical arrangements

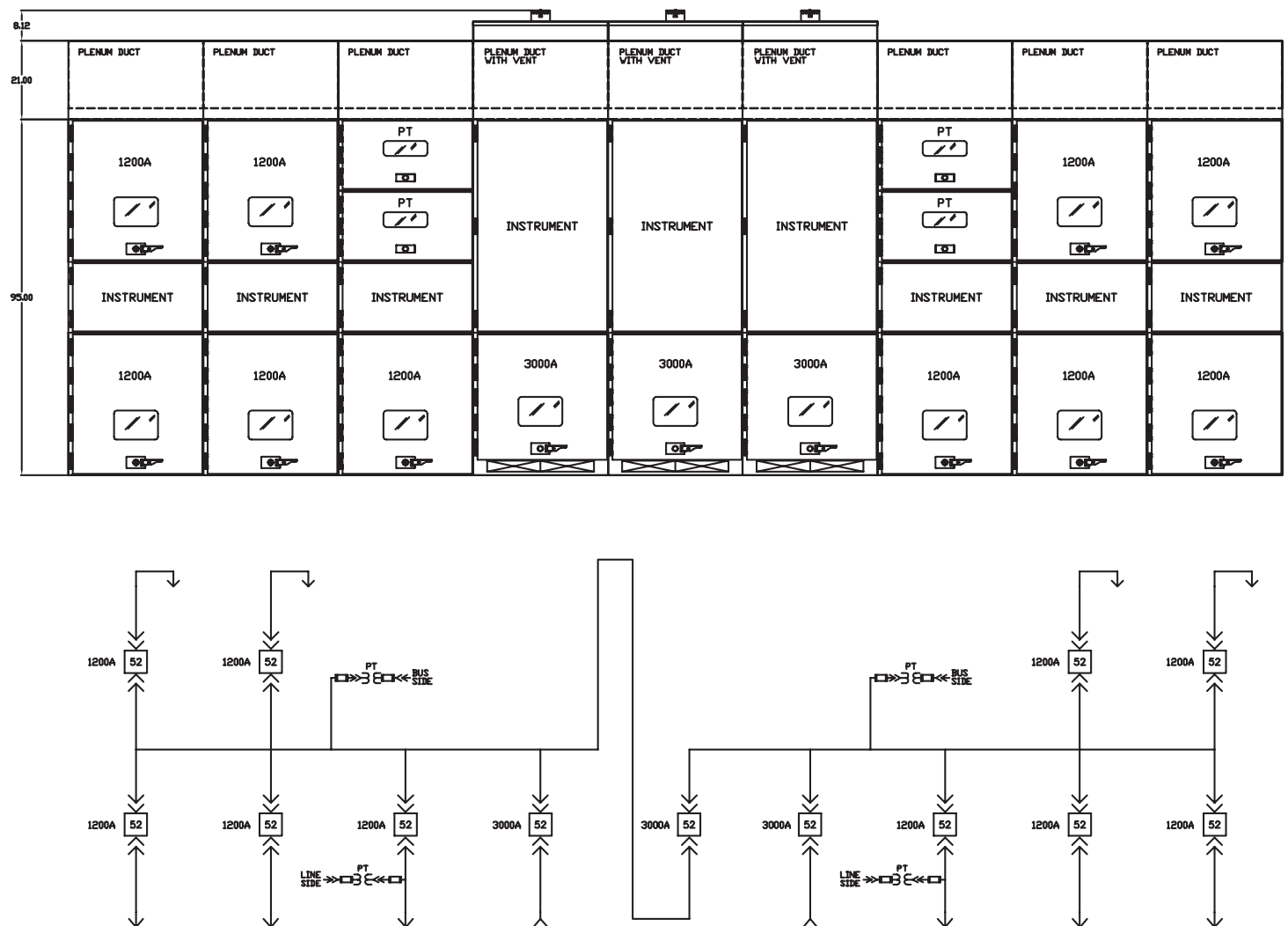
## Main-Tie-Main - 2000 A/1200 A, less than 31.5 kA

Arrangements are the same for 5, 8.25 and 15 kV



Typical arrangements  
Main-Tie-Main - 3000 A less than 31.5 kA

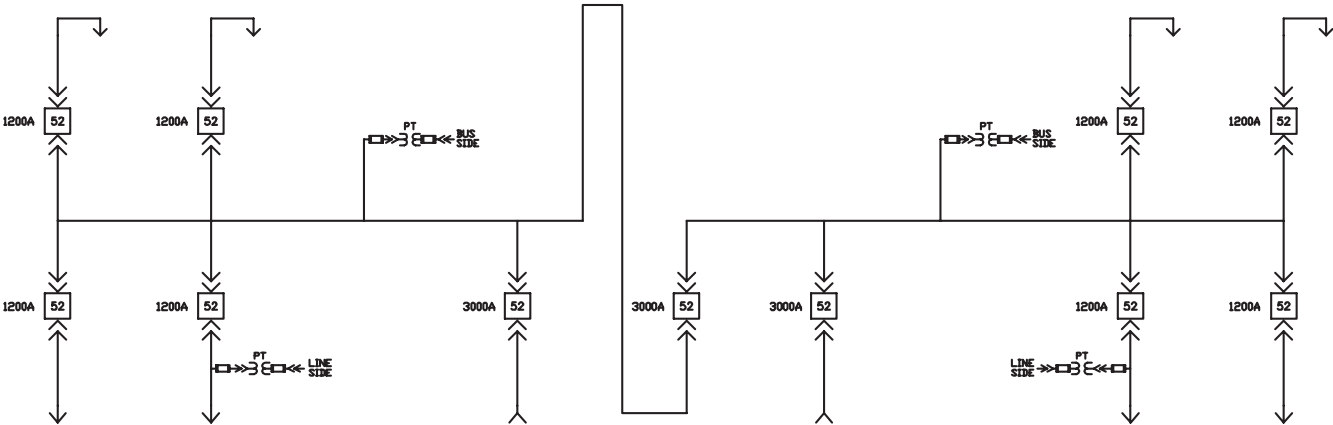
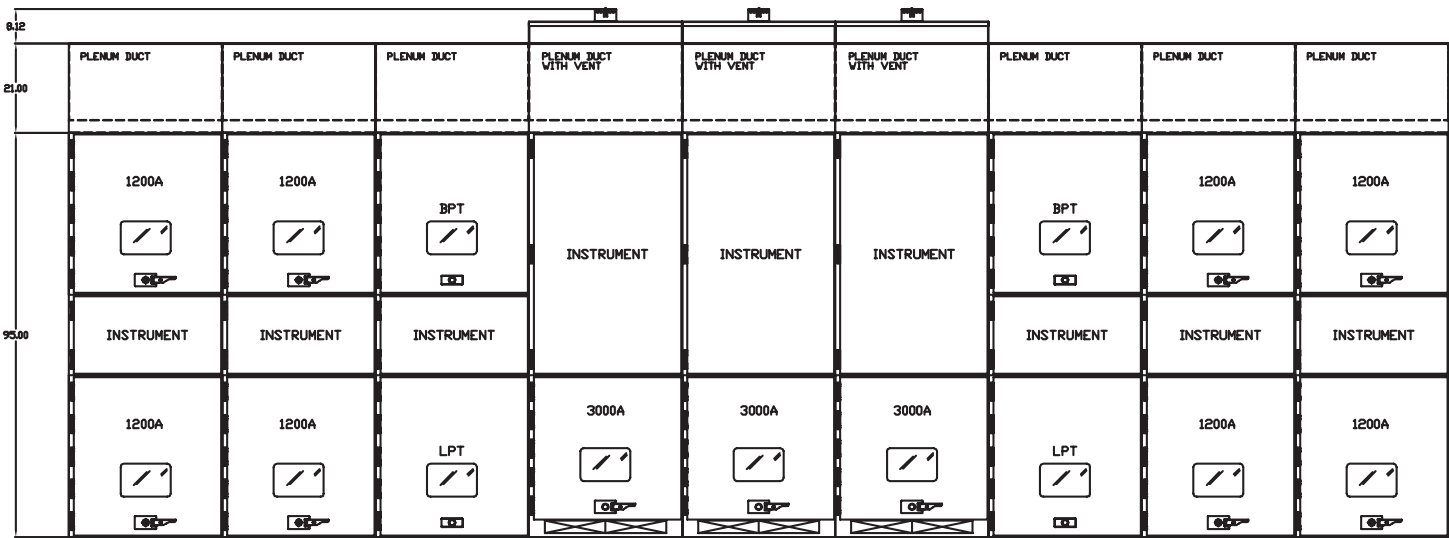
Arrangements are the same for 5, 8.25 and 15 kV



# Typical arrangements

## Main-Tie-Main - 3000 A greater than 40 kA

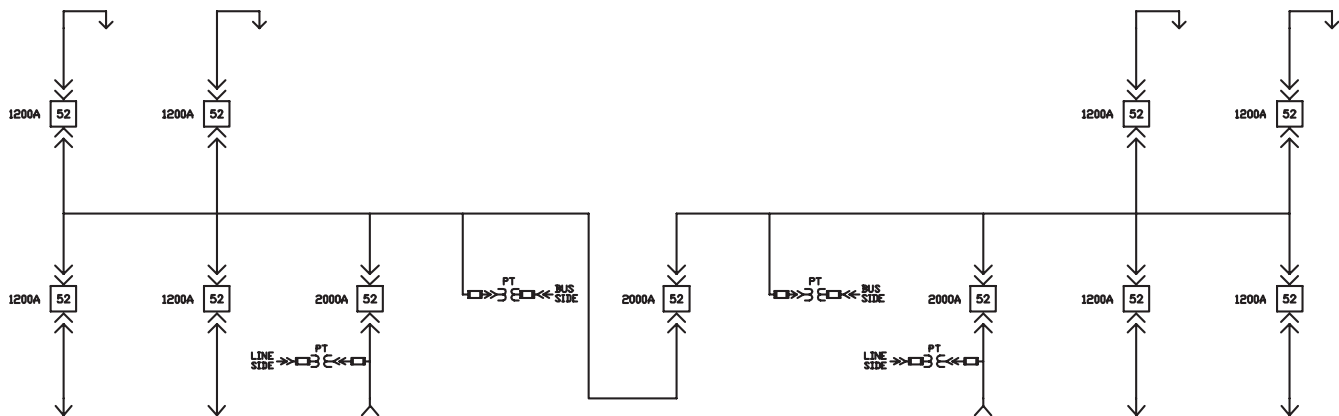
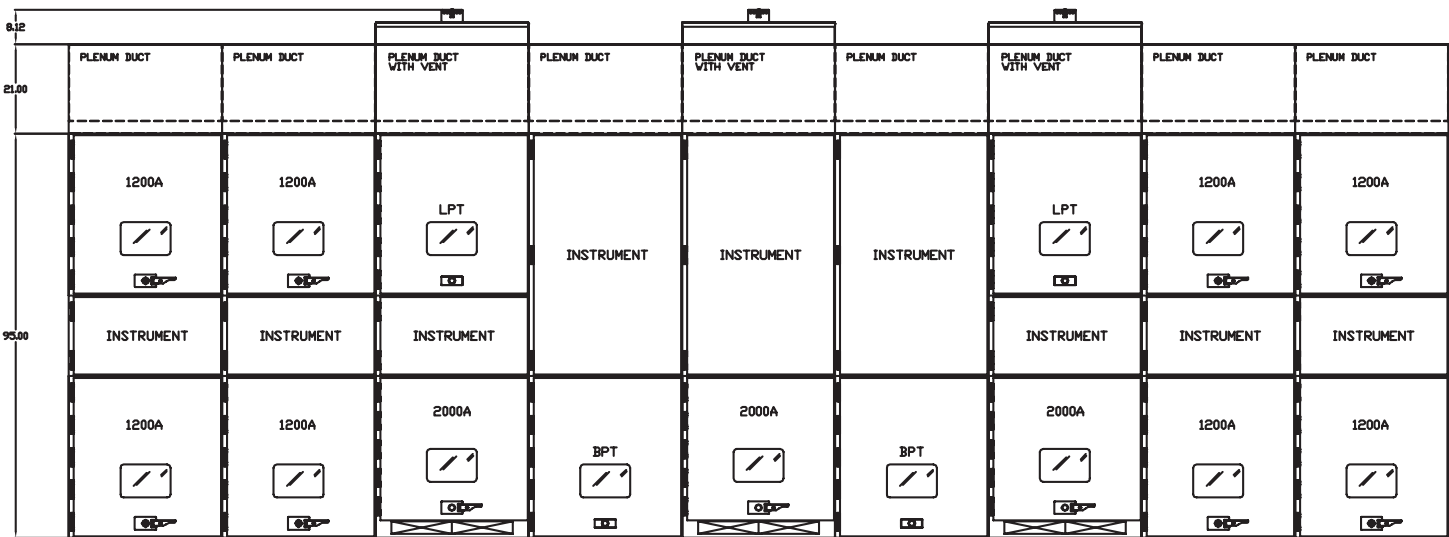
Arrangements are the same for 5, 8.25 and 15 kV



# Typical arrangements

## Main-Tie-Main - 1200 A/2000 A greater than 40 kA

Arrangements are the same for 5, 8.25 and 15 kV

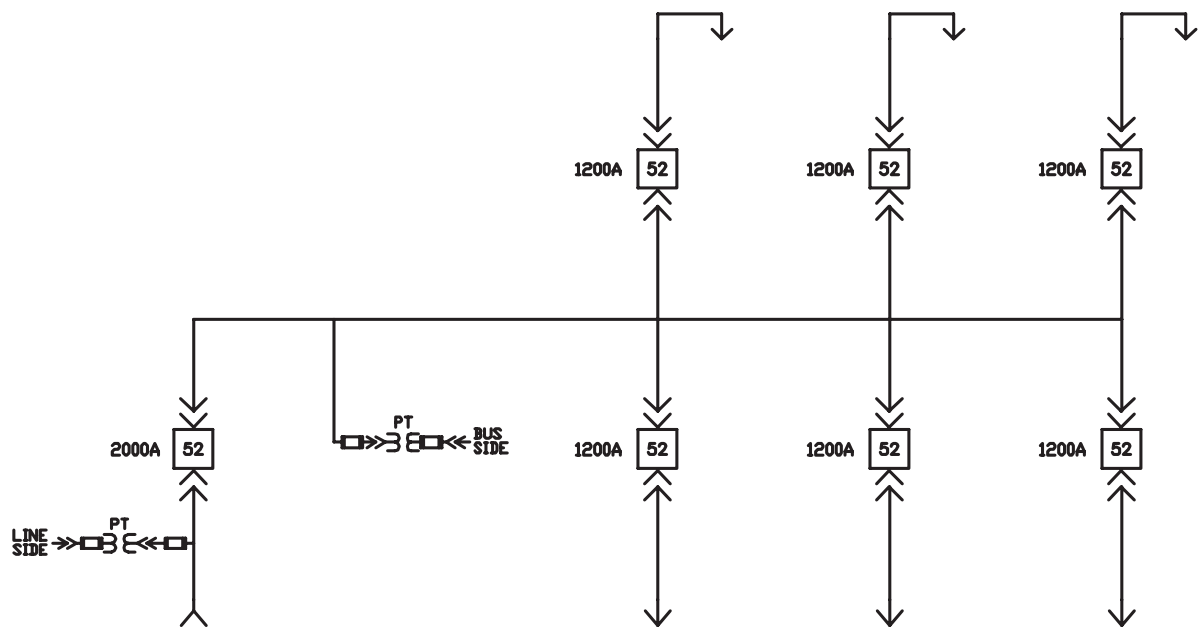
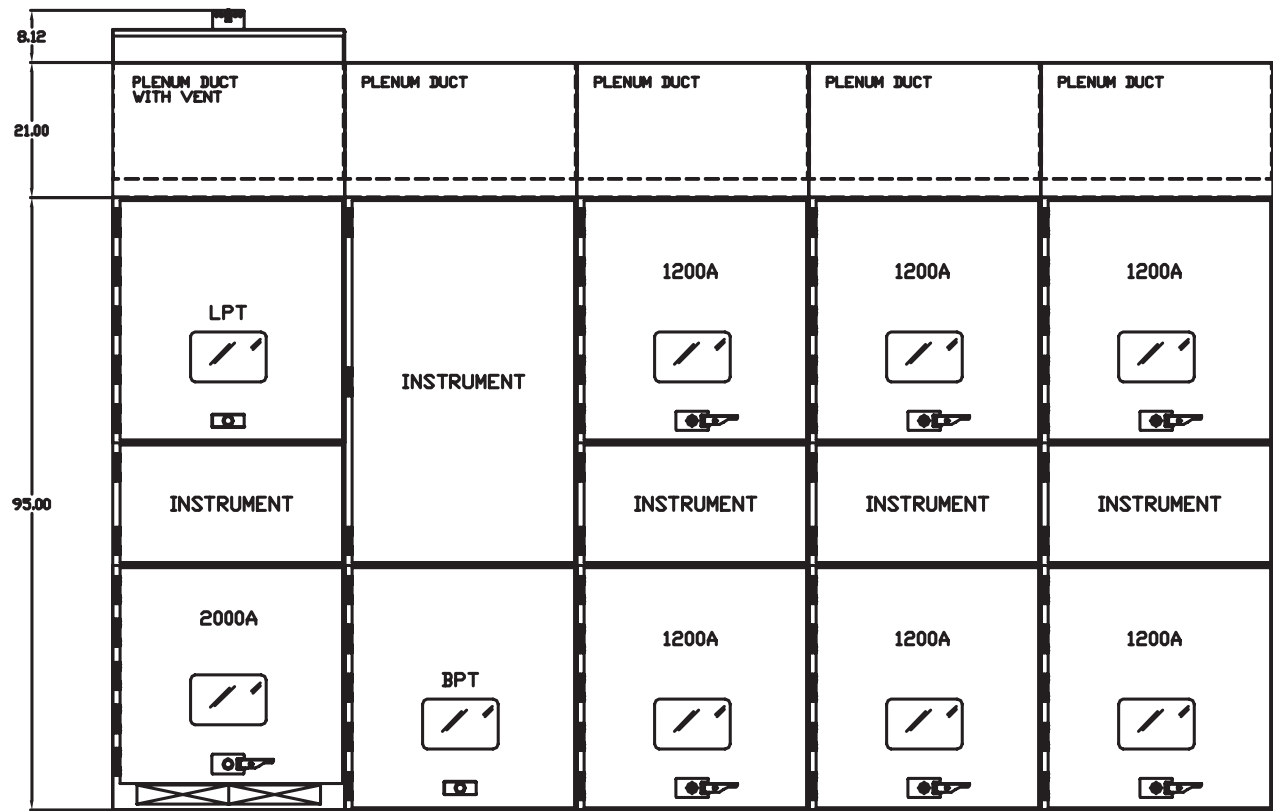




# Typical arrangements

## Main with feeders - 2000 A/1200 A greater than 40 kA

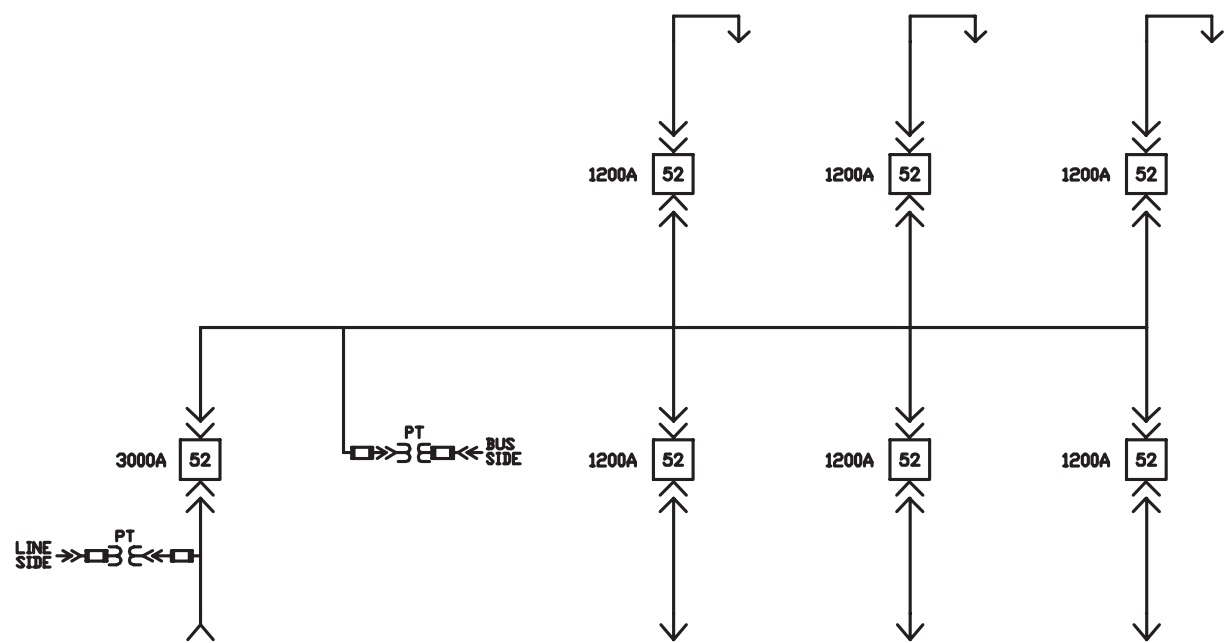
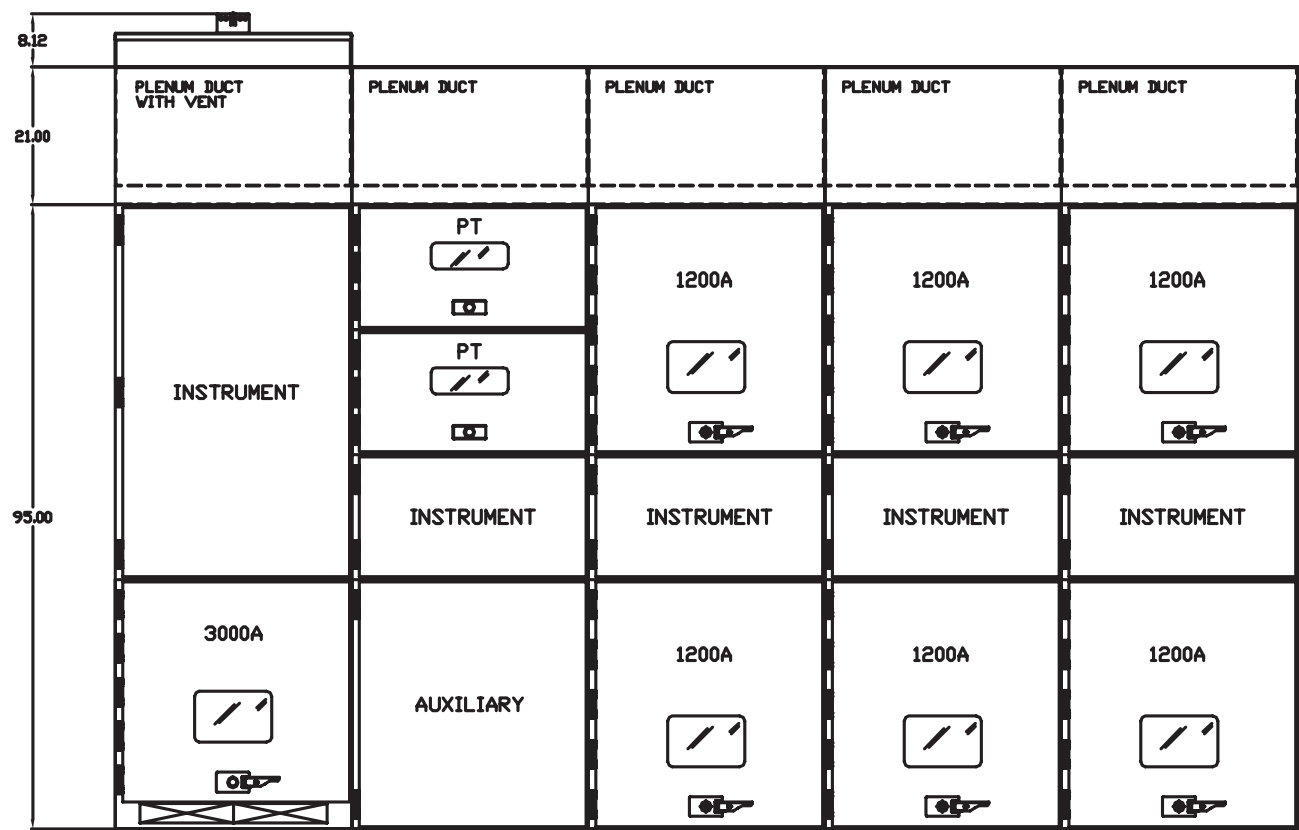
Arrangements are the same for 5, 8.25 and 15 kV



# Typical arrangements

## Main with feeders - 3000 A less than 31.5 kA

Arrangements are the same for 5, 8.25 and 15 kV

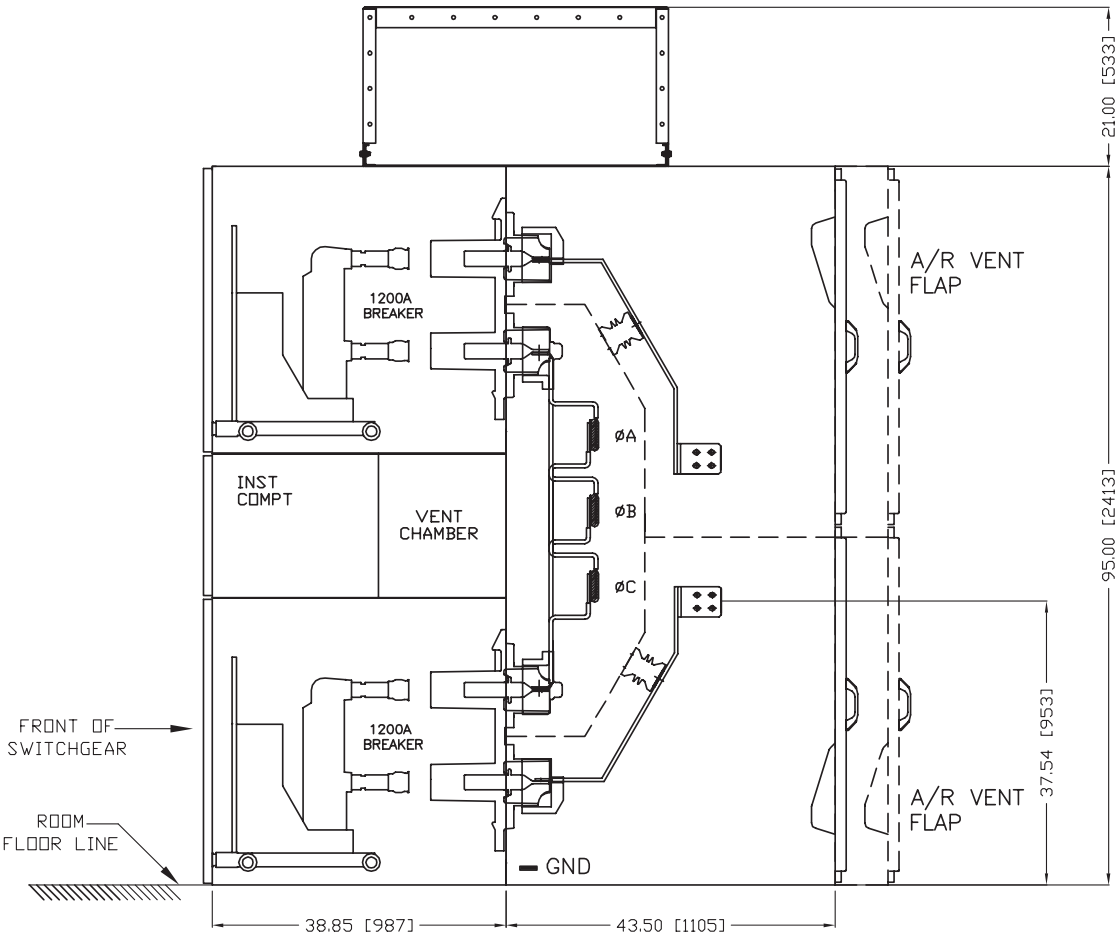


# Civil engineering details

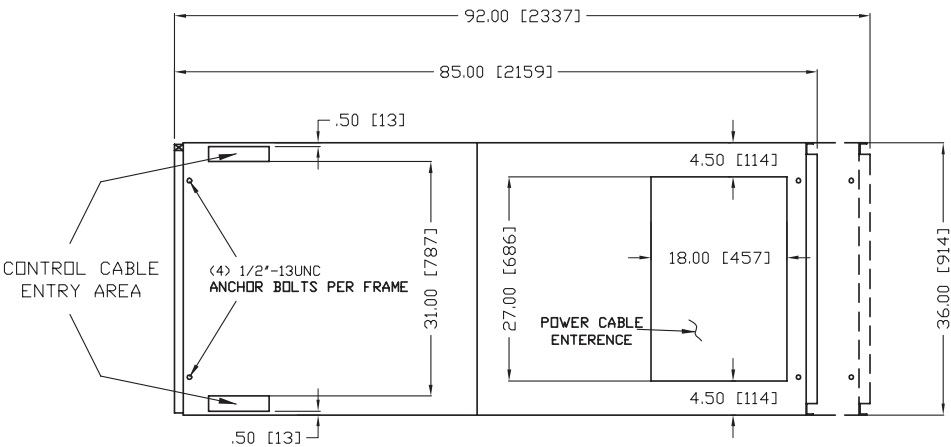
## Typical side views, floor plans and clearances

### SafeGear switchgear two-high frames

Circuit breaker: 1200 A/1200 A



SECTION VIEW



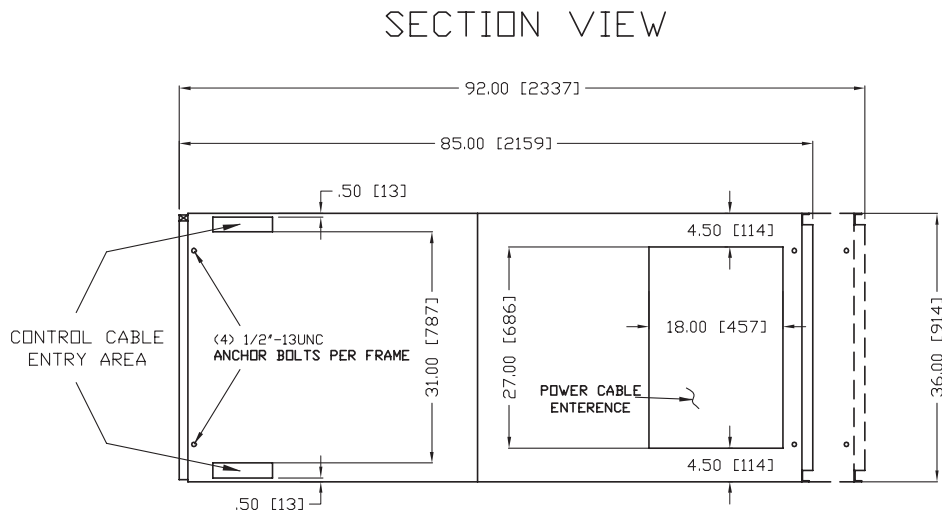
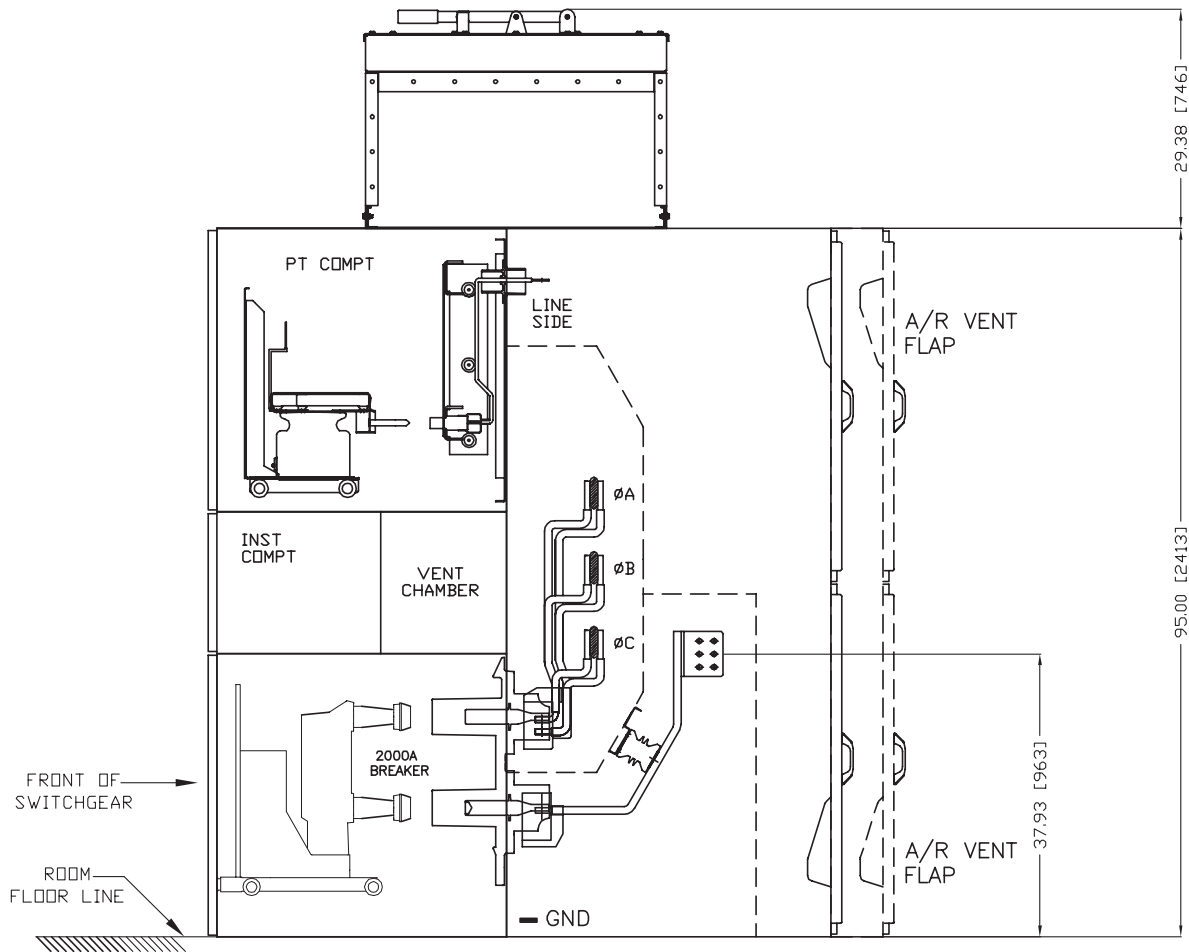
FLOOR PLAN

# Civil engineering details

## Typical side views, floor plans and clearances

### SafeGear switchgear breaker and auxiliary

Circuit breaker: 2000 A with PTs greater than 40 kA



Circuit breaker: 2000 A, with PTs less than 31.5 kA

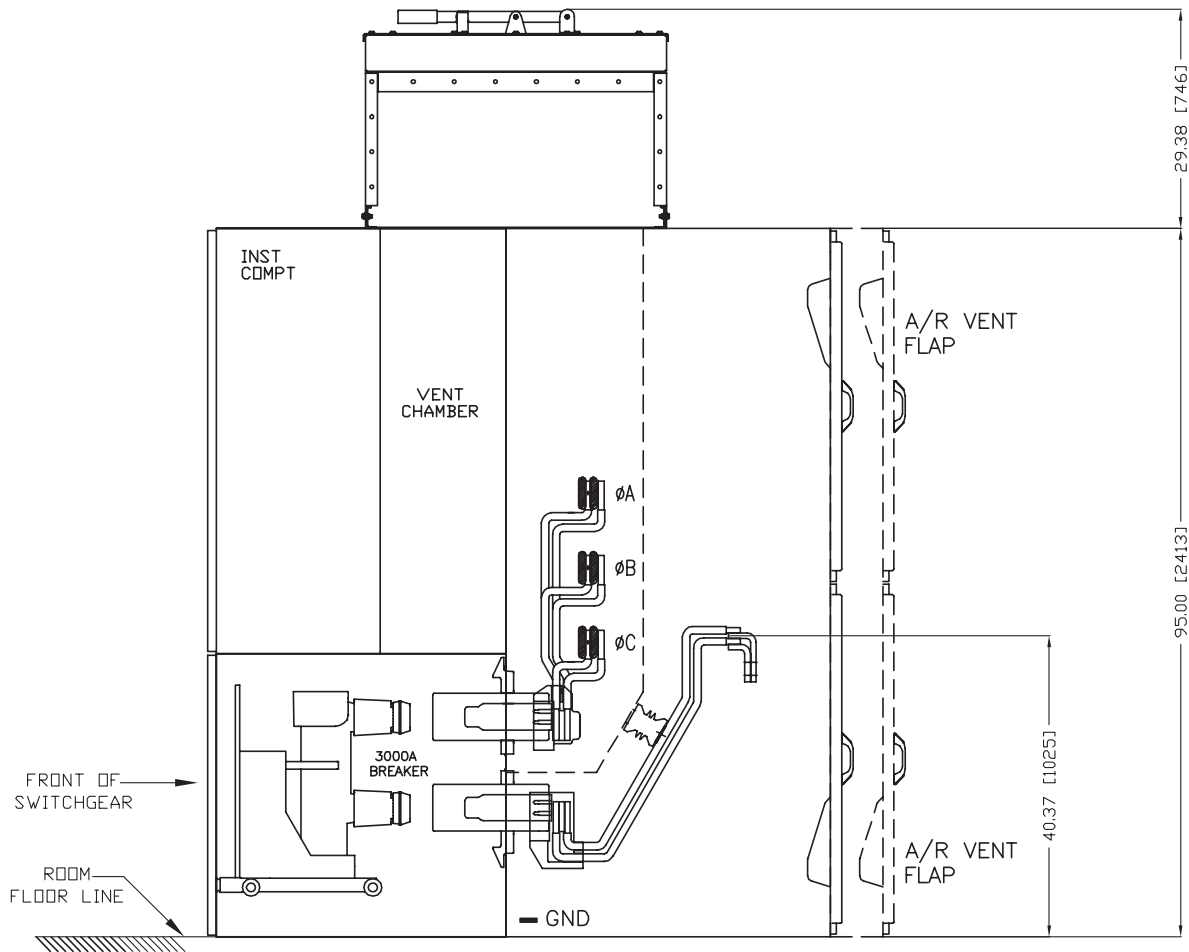


# Civil engineering details

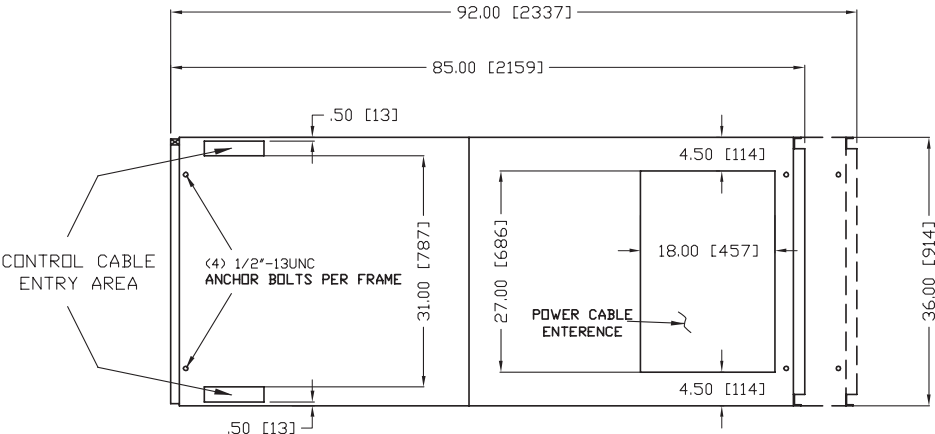
## Typical side views, floor plans and clearances

### SafeGear switchgear one-high frames

Circuit breaker: 3000 A



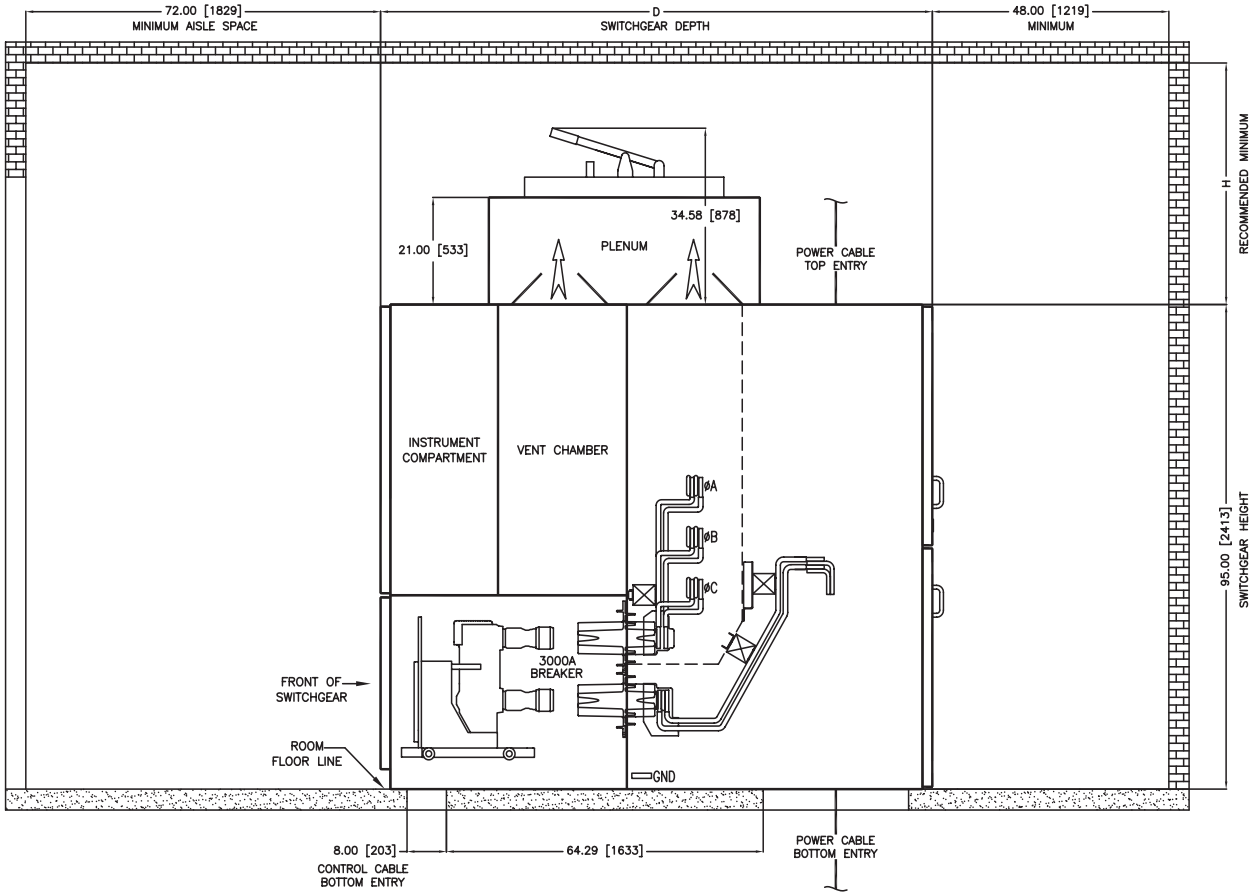
SECTION VIEW



FLOOR PLAN

# Civil engineering details

## Typical side views, floor plans and clearances



Typical civil engineering dimensions - inches (mm)	
	Depth (D)
SafeGear	85" or 92"

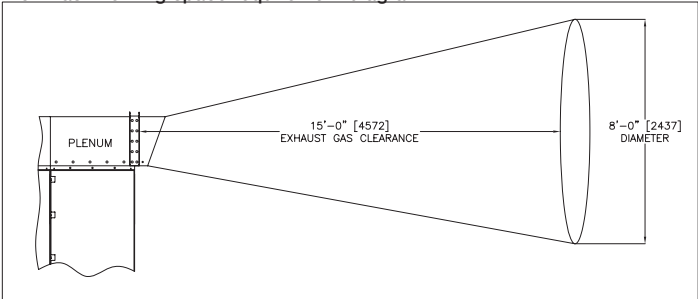
- Dimension H:**
- 24 inches for 1200 A lineups
  - 40 inches for 2000 A/3000 A lineups

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 and IEEE standards.

Arch-flash venting space requirement diagram



# 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.

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.

Basic frame configuration	Circuit breaker (rating)	Weight	
		lbs	kg
One circuit breaker	1200	2023	918
	2000	2441	1107
	3000	3331	1511
Two circuit 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





Technical and application guide

# SafeGear® HD

## 5/15 kV, 63 kA arc-resistant high duty switchgear

Power and productivity  
for a better world™



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# General Overview

## SafeGear® HD arc-resistant high-duty switchgear

### Introduction

SafeGear® HD is ABB's ANSI arc-resistant, metal-clad switchgear line for short circuit currents at 50 or 63 kA providing the proven safety of the SafeGear platform at higher short circuit current capacities.

### Certifications

SafeGear HD is seismic certified to IBC region D with importance factor of 1.0. The manufacturing location for SafeGear HD is both ISO 9001 and 140001 certified. SafeGear HD switchgear is available with UL label or as a CSA certified lineup.

### Applicable standards

SafeGear HD is built per IEEE C37.20.2 metal-clad switchgear construction standards and tested per IEEE C37.20.7 for arc-resistance with a 0.5 second arc-duration.

### 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 and panels closed and latched.
- Type 2B: Front, sides, rear and LV compartment. LV compartment door can be open. All other doors and panels must be closed and latched.

SafeGear HD is offered in accessibility types 2 and 2B.

### Construction

SafeGear HD is manufactured of hem bent, 12-gauge galvanized steel for superior rust and scratch protection. All non-galvanized steel parts are treated and painted ANSI 61 gray.

SafeGear HD's modular design and bolted frame with 19, 38 or 57-inch compartments provides highly flexible design configurations, and makes field changes faster to prevent downtime.

### Outdoor enclosures

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

### Breakers used in the SafeGear HD platform

The SafeGear HD 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). For 63 kA requirements, only ADVAC breakers can be used.

### Instrument transformers

SafeGear HD 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. SafeGear HD is available with AWG #12 or AWG #10 wire for CT secondaries. Leads from the CT secondaries to the relay are approximately 10 feet in length. For ground CT requirements, SafeGear HD 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 HD switchgear utilizes VIY-60 potential transformers. For 15 kV applications, SafeGear HD uses ABB VIZ-11 and VIZ-75 PTs. All PTs are available in wye-wye, open delta, line to line and line to ground configurations.

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

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 Circuit Current (rms)	kA	50, 63		
Rated Frequency	Hz	50, 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 C37.20.2-1999 metal-clad standard.

\*\* 4000A is forced-air cooled.

# General Overview

## SafeGear® HD

### Available accessories

SafeGear HD switchgear is available with the following accessories:

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

### Testing

SafeGear HD 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 (HI-POT) 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 transformer

Factory witness testing is also available on request.

### Options

- Installation, operation and maintenance manual by CD or printed
- Mechanical options
  - Tin plated bus
  - Mimic bus
  - Cable supports
  - Mechanical trip on breaker doors
  - IR windows (IRISS or Fluke)
  - Channel sills
- Electrical options
  - Separate or common pull-out fuse block or molded case circuit breaker trip and close coil protection
  - Maximum 20% spare terminal blocks per row
  - 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 HD Descriptive Bulletin	1VAL108002-DB
SafeGear HD Flyer	1VAL108003-FL
Installation, Operation and Maintenance Manual for SafeGear HD	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	1VAL108001-AP
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 15k VA single-phase require a draw-out fuse unit with stationary mounted CPT.
- 3000 A and 4000 A must be located in their own frame with a 57-inch instrument compartment located above the breaker.

# Construction

## Doors

SafeGear HD front doors consist of the breaker compartment, auxiliary unit compartments and LV compartments. These doors are provided with a single handle, multi-point latch as standard. 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 HD product are used to access the high voltage cable compartments. These doors are available as split doors (top compartment/bottom compartment) hinged and bolted. Hinged doors are provided with left-hand hinges (when facing the door). Right-hand hinged doors are optional.

All front and rear doors are constructed using 11-gauge painted steel.

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 a viewing window 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.



# Compartment types

## Circuit breaker compartment

### Circuit breaker compartments

SafeGear HD circuit breaker compartments are designed for maximum operator safety by providing two 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 feature of the switchgear. These features make SafeGear HD 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 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 the primary or 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.

**Note:** Terminal blocks normally covered by grounded metal barrier have been removed in this photo

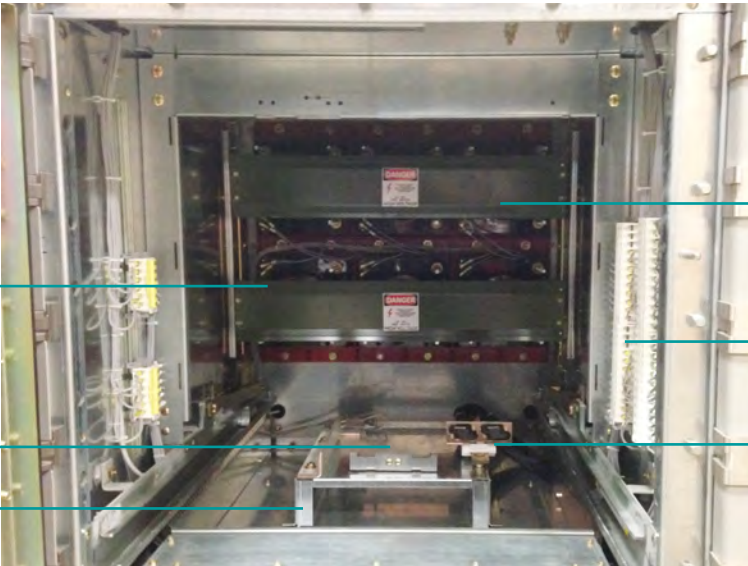


### Secondary disconnect system

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 the 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 security.





# Compartment types

## Auxiliary modules

### 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 racking mechanism which allows for closed door racking 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.

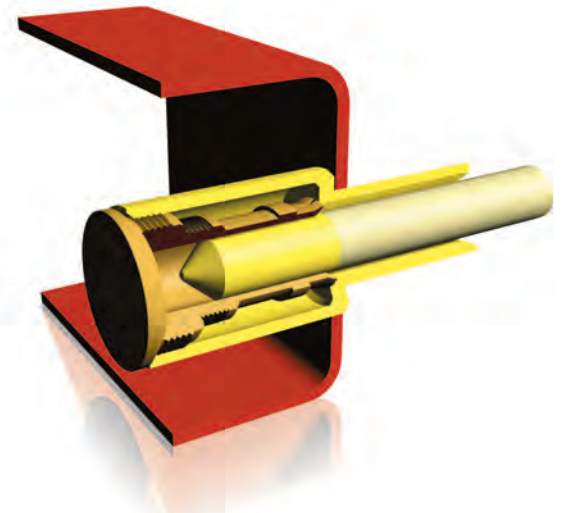
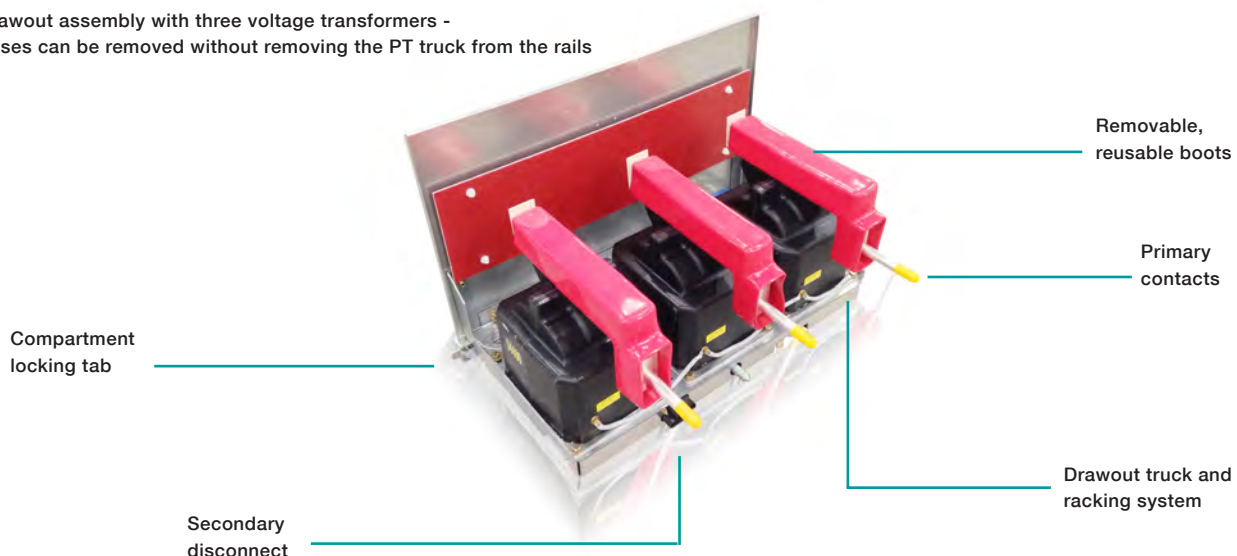
All primary auxiliary compartments, including potential transformers, control power transformers and draw-out fuse compartments, use arc-quenching Delrin® technology for primary contact assemblies (Delrin® is a registered trademark of DuPont). A Delrin® tipped conductor probe is inserted into a Delrin® 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 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.

**PT drawout assembly with three voltage transformers - the fuses can be removed without removing the PT truck from the rails**



Delrin primary probe and recessed contact assembly

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.

# Compartment types

## Instrument compartment

### Instrument compartment

ABB mounts all protection and control devices in a dedicated low voltage module. Each low voltage instrument module is completely isolated and segregated from high-voltage components which ensures the safety of operations and maintenance personnel while they work on control and auxiliary circuits. The LV wiring pans are designed to be removeable and customizable.

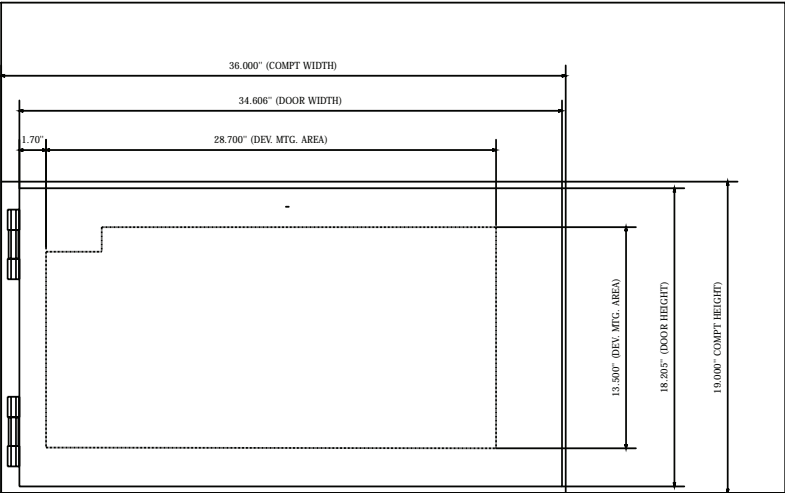
Plastic enclosed wireways are used to provide protection for the wiring, as well as a neat and organized appearance. This allows for easy additions of wiring, should they be needed.

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.

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



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

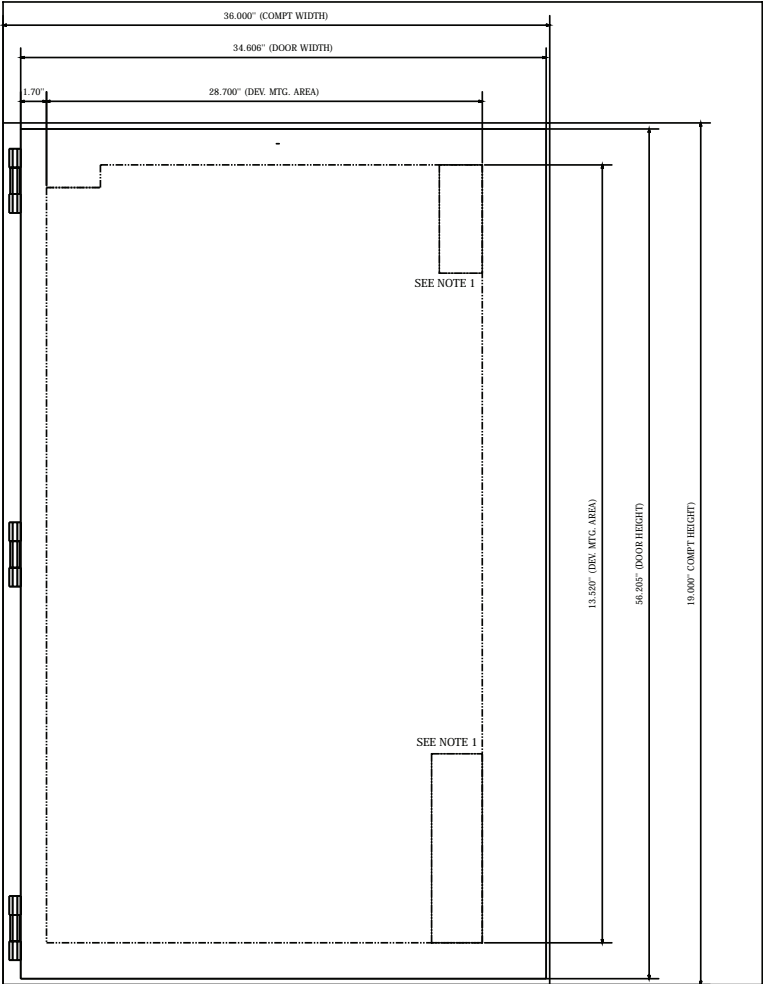


LVC DOOR PANEL 19"



# Compartment types

## Instrument compartment



LVC DOOR PANEL 57"

# 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.

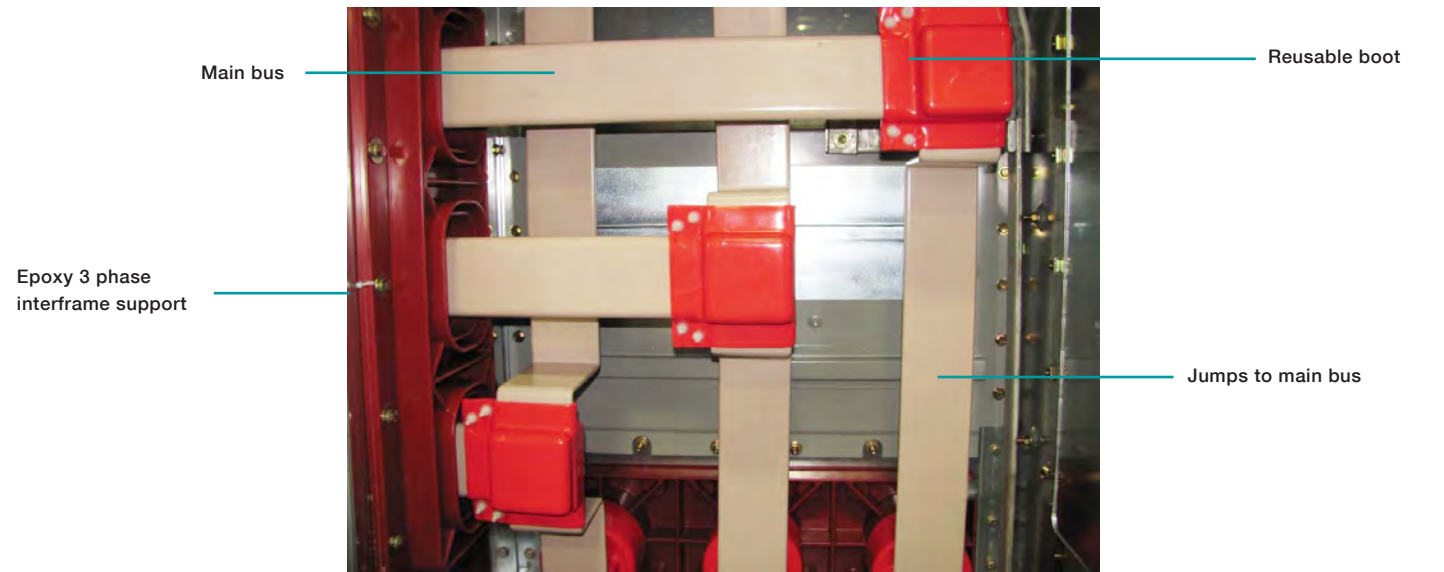
The bus is epoxy insulated with an advance powder coat system that eliminates voids and other potential defects, resulting in maximum integrity of the insulation system. Removable, reusable boots are provided at each joint to simplify access and maintenance.

Insulating standoffs rigidly support the bus. This includes 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 epoxy for all ratings.

SafeGear HD arc-resistant metal-clad switchgear design certifications are based on epoxy primary bus supports. Epoxy is standard for standoff bus insulator supports, primary breaker bushings and interframe main bus supports. Separate drawings are available to indicate the position and dimensions of the epoxy compartment-mounted primary contact supports, epoxy inter-frame horizontal bus supports, and standoff insulators. If porcelain bus supports and insulators are needed, contact factory.

Characteristic	Epoxy specification
Flexural Strength, MPA	120 - 150
Tensile Strength, MPA	70 – 90
Impact Strength, KJ/m2	10 – 15
Thermal Class	F
Dielectric Strength (Short Time), kV/mm	> 23

Continuous current	Rating	Quantity/phase	Size
1200 A	63 kA	1	.75" x 4"
2000 A	63 kA	1	.75" x 4"
3000 A	63 kA	2	.75" x 4"
4000 A	63 kA	2	.5" x 6"



# Compartment types

## Cable compartment

The design of the cable compartments for SafeGear HD 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 or roof bushings.

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

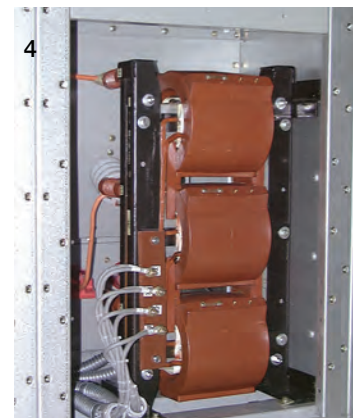
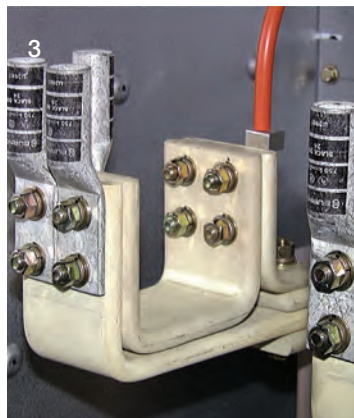
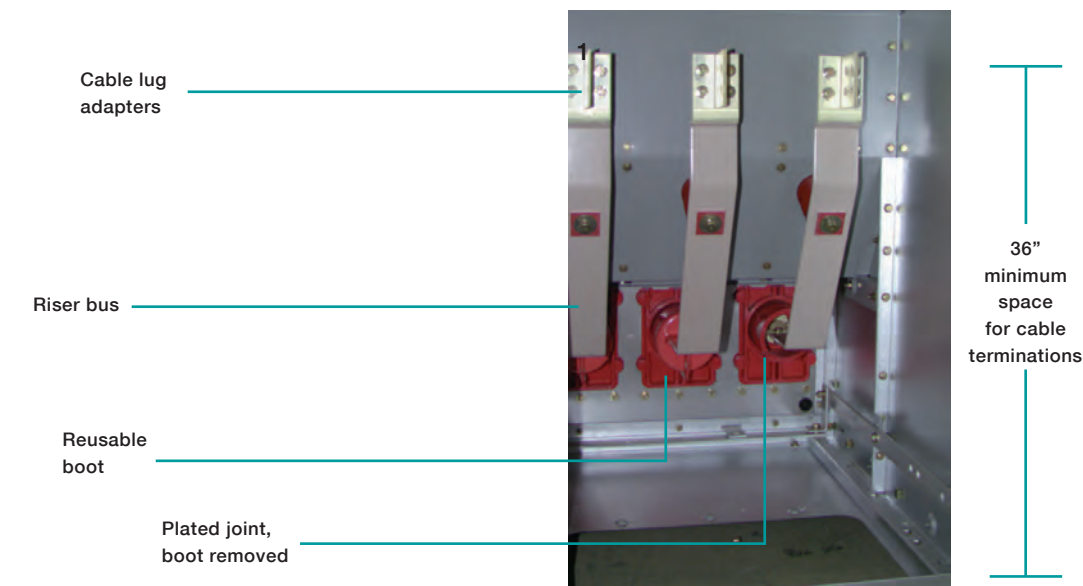
Cable compartments are available with optional readily accessible zero sequence current transformers, surge arrestors and capacitor and ground studs on the bus risers. When a draw-out fuse compartment is installed in the front of the switchgear, the

rear cable compartment offers room for a large three-phase floor-mounted control power transformer up to 75 kVA.

The 112-inch depth of SafeGear HD provides ample space for various cable terminations and protection monitoring and control devices as needed.

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 HD 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.

1 Cable compartment (main bus - cover installed) | Various application designs in cable compartments: 2 Surge arrestors | 3 Connection of up to eight cables per phase (three cable lugs shown) | 4 Large fixed-mount CPT up to 75 kVA 3-phase or 50 kVA single-phase



# Arc chamber and plenum

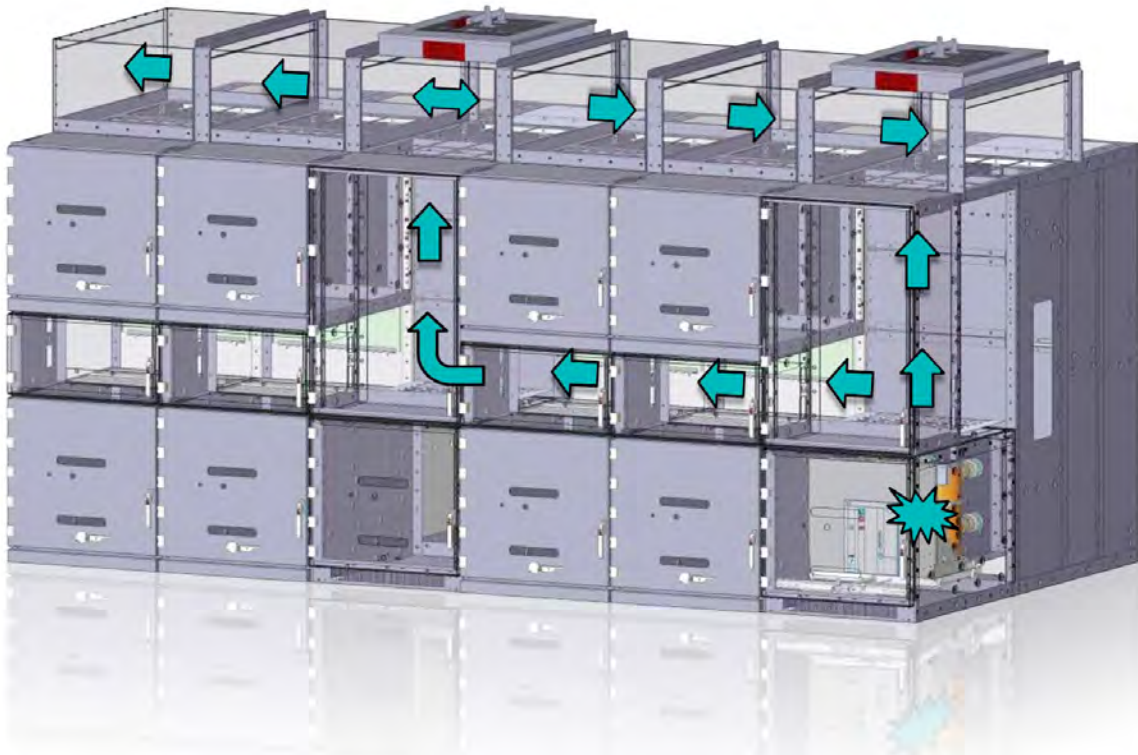
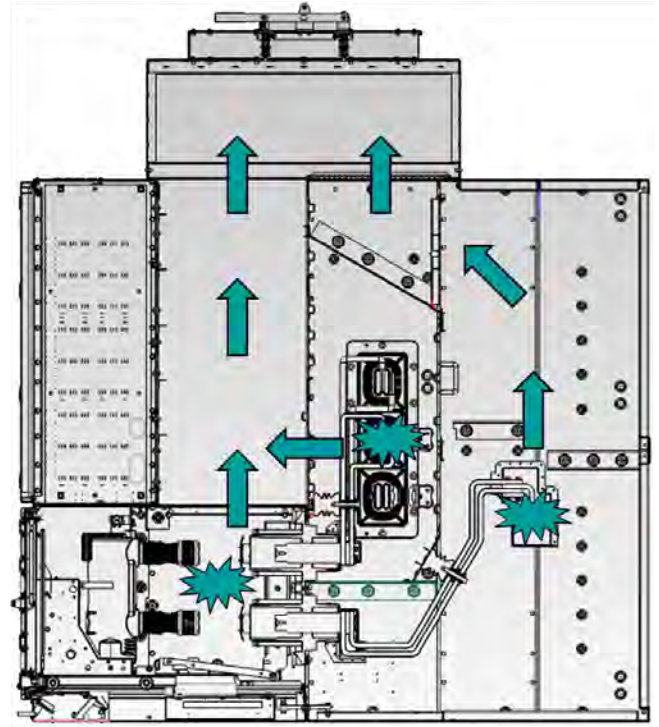
A system of chambers inside the switchgear lineup serves as an exhaust system which vents gases away from personnel and the affected cubicle in the case of an arc fault. Vents and flaps are located inside the chamber system which leads to a top-mounted plenum on the enclosure. Once inside the top-mounted plenum, the gases and pressure are directed to an area outside the building and away from personnel. The plenum sections feature external flanges for ease of bolting sections together at assembly and 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 Application Guide, 1VAL108001-AP, 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 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.



# 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 92" depth.

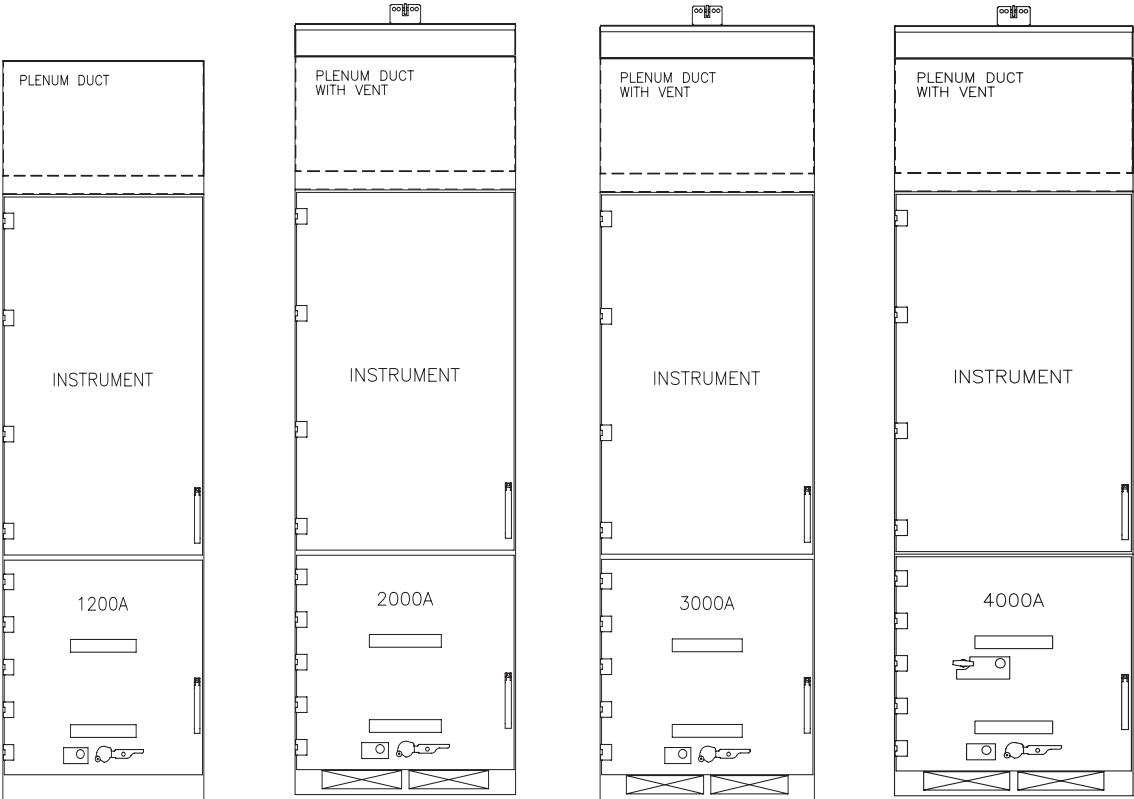
### Dimensions

Frame	Width (in)	Height with plenum (in)	Depth (in)
2000/3000/4000 A frames	36	129.5	112
All other frames	36	116	112

### Options

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

\* Refer to page 23 for floorplan





# Available frame types

## Two-high breaker 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.

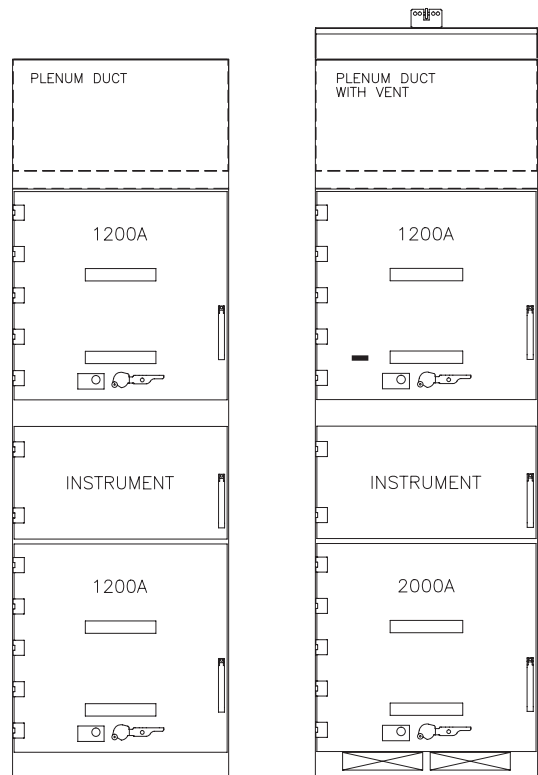
Cable termination information		
Cable size	# of Terms single pad per phase	GCT option
#2 AWG	4	BYZ-S
#4 AWG	4	BYZ-S
500 MCM	4	BYZ-S
750 MCM	4	BYZ-L
1000 MCM (2-hole)	2	BYZ-S
(1000 MCM 4-hole)	1	BYZ-S

Dimensions			
Frame	Width (in)	Height with plenum (in)	Depth (in)
2000 A frames	36	129.5	112
All other frames	36	116	112

### Options

- Ground CTs
- Surge arrestors
  - Distribution
  - Intermediate
- Surge capacitor (or arrestors, one or the other)
- Ground studs
- Space heaters
- Cable supports

\* Refer to page 22 for floorplan



# 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.

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 92-inch depth.

### Notes:

1. See page 25 for floorplan
2. CPT=control power transformer

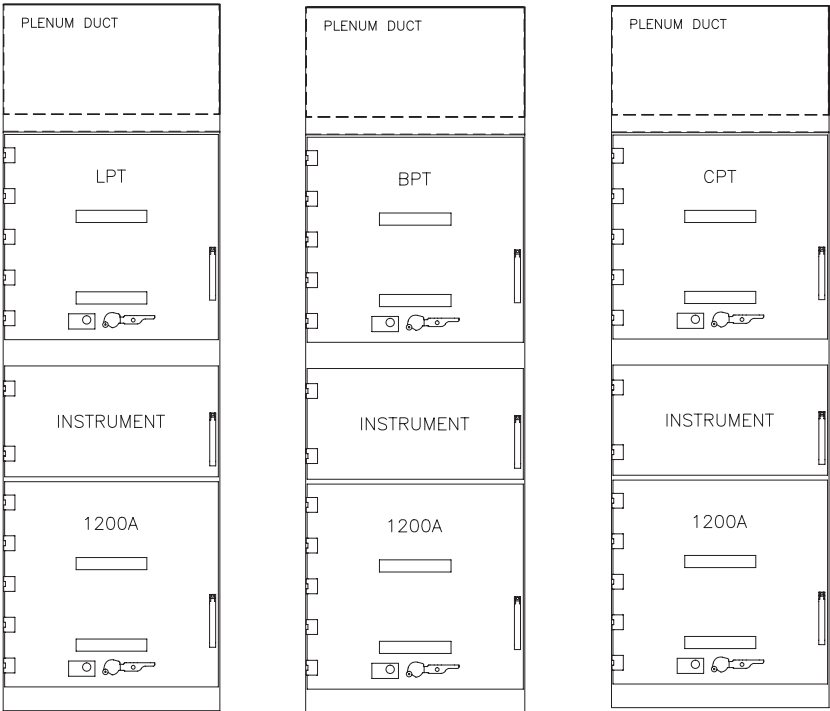
Dimensions			
Frame	Width (in)	Height with plenum (in)	Depth (in)
2000 A frames	36	129.5	112
All other frames	36	116	112

### Options

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

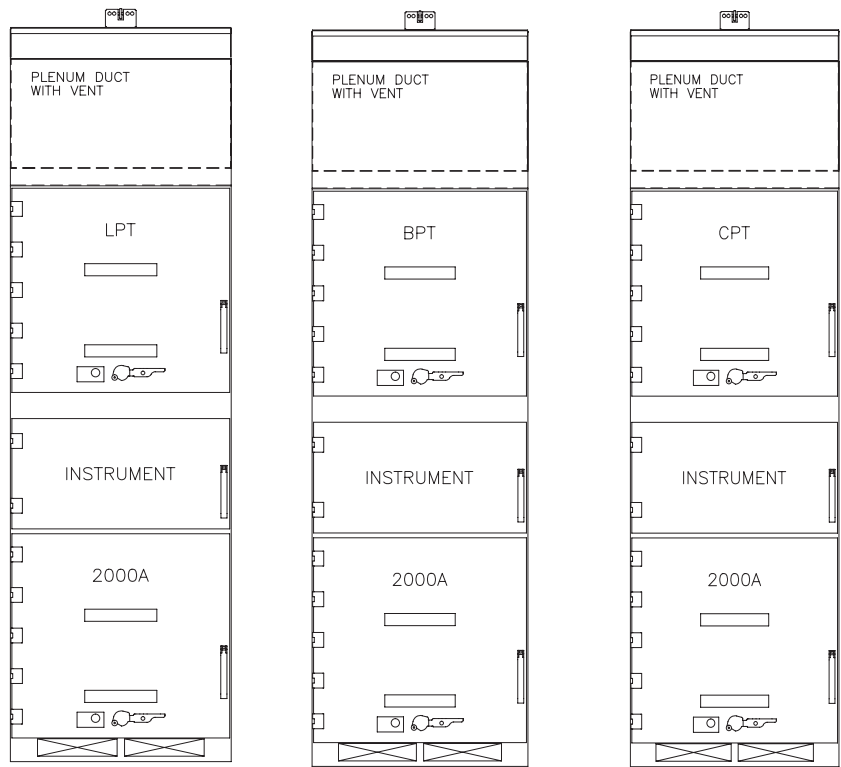
3. LVC=low voltage compartment/instrument compartment
4. PT=potential transformer
5. DOF=drawout fuse

### Breaker below

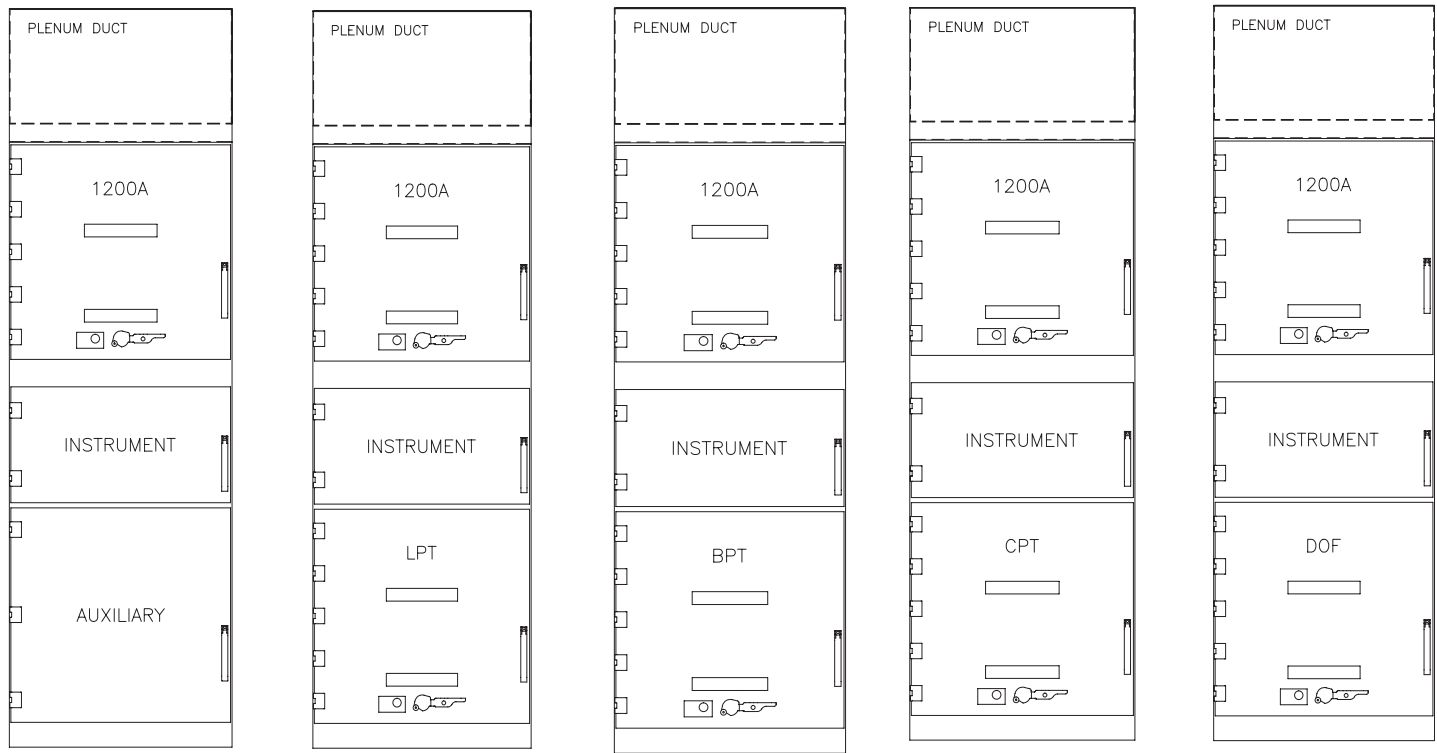


# Available frame types

## Breaker below



## Breaker above





# Available frame types

## Auxiliary frames

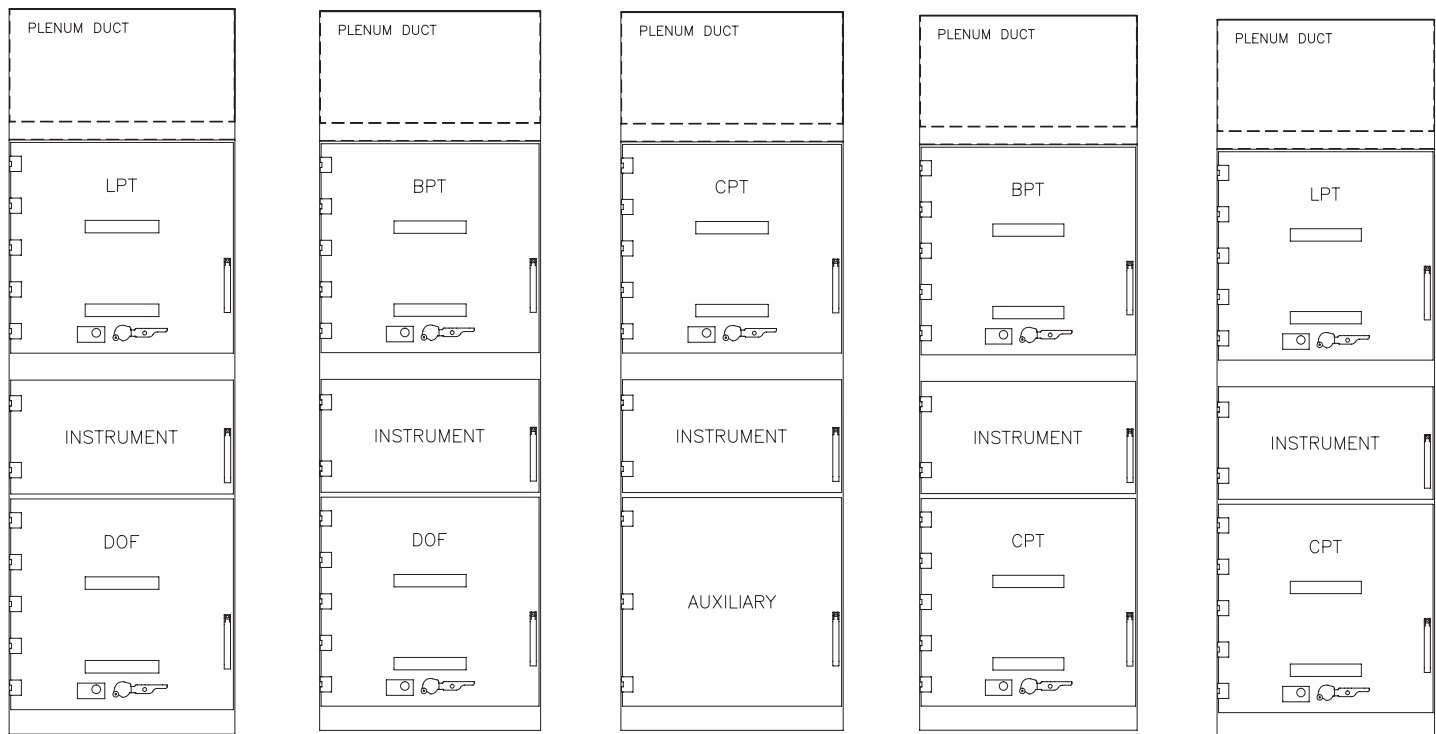
### Description

The two-high auxiliary frame consists of one or two 38-inch compartments with a 19-inch or 57-inch instrument compartment for one or two auxiliary devices in a single frame.

Dimensions			
Frame	Width (in)	Height with plenum (in)	Depth (in)
All frames	36	116	112

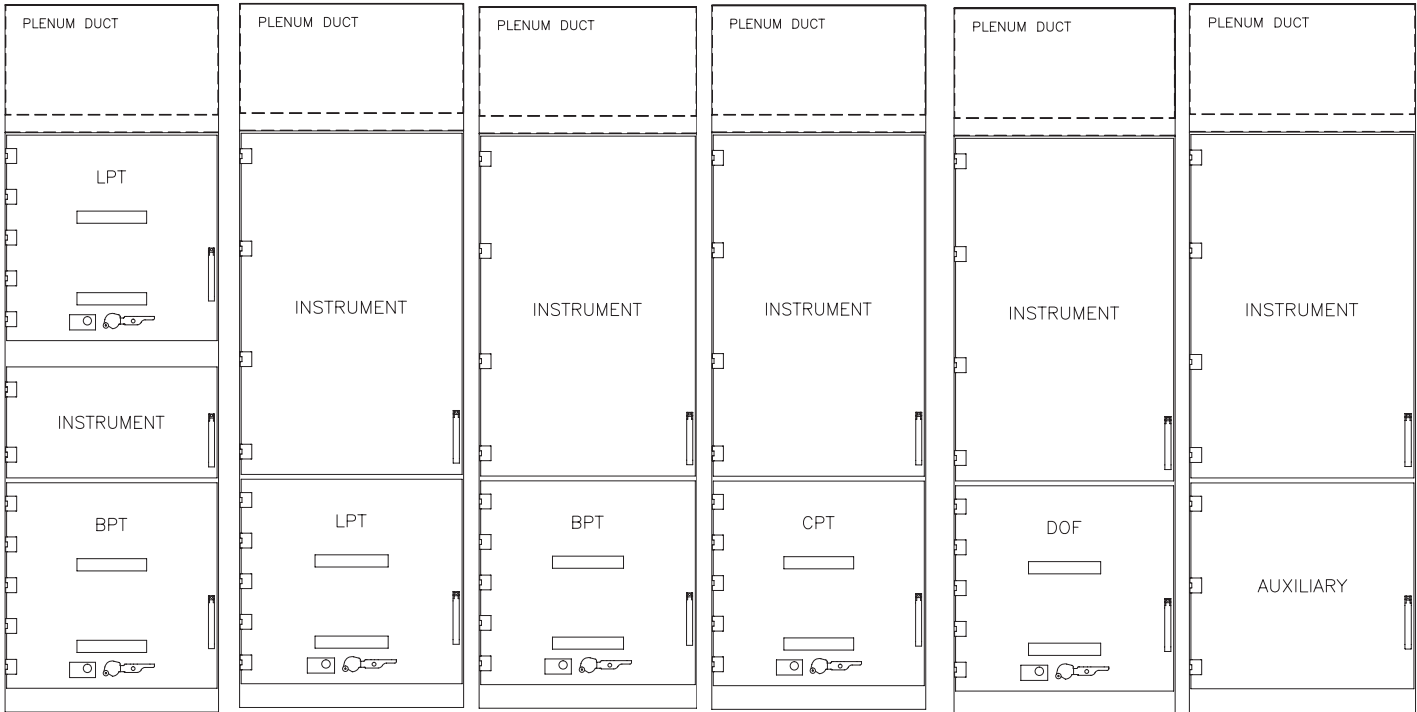
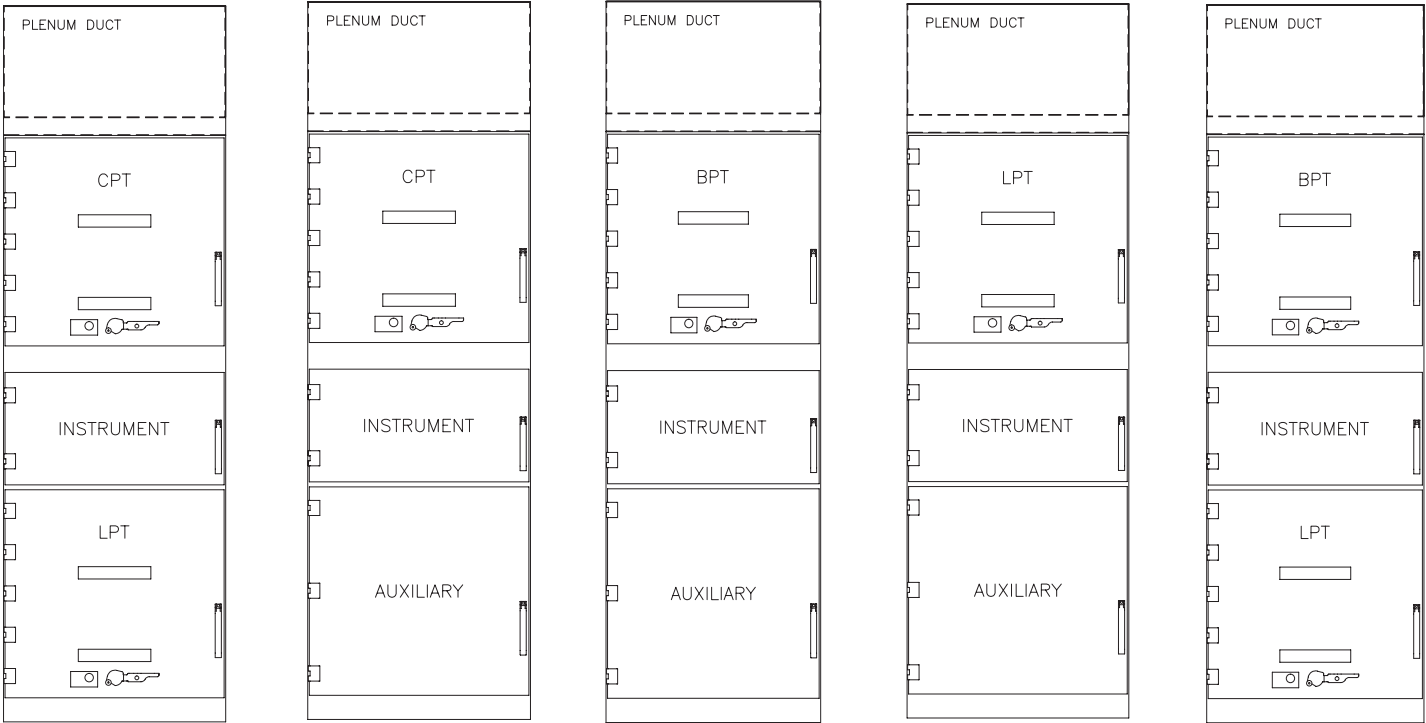
### Options

- Space heaters



# Available frame types

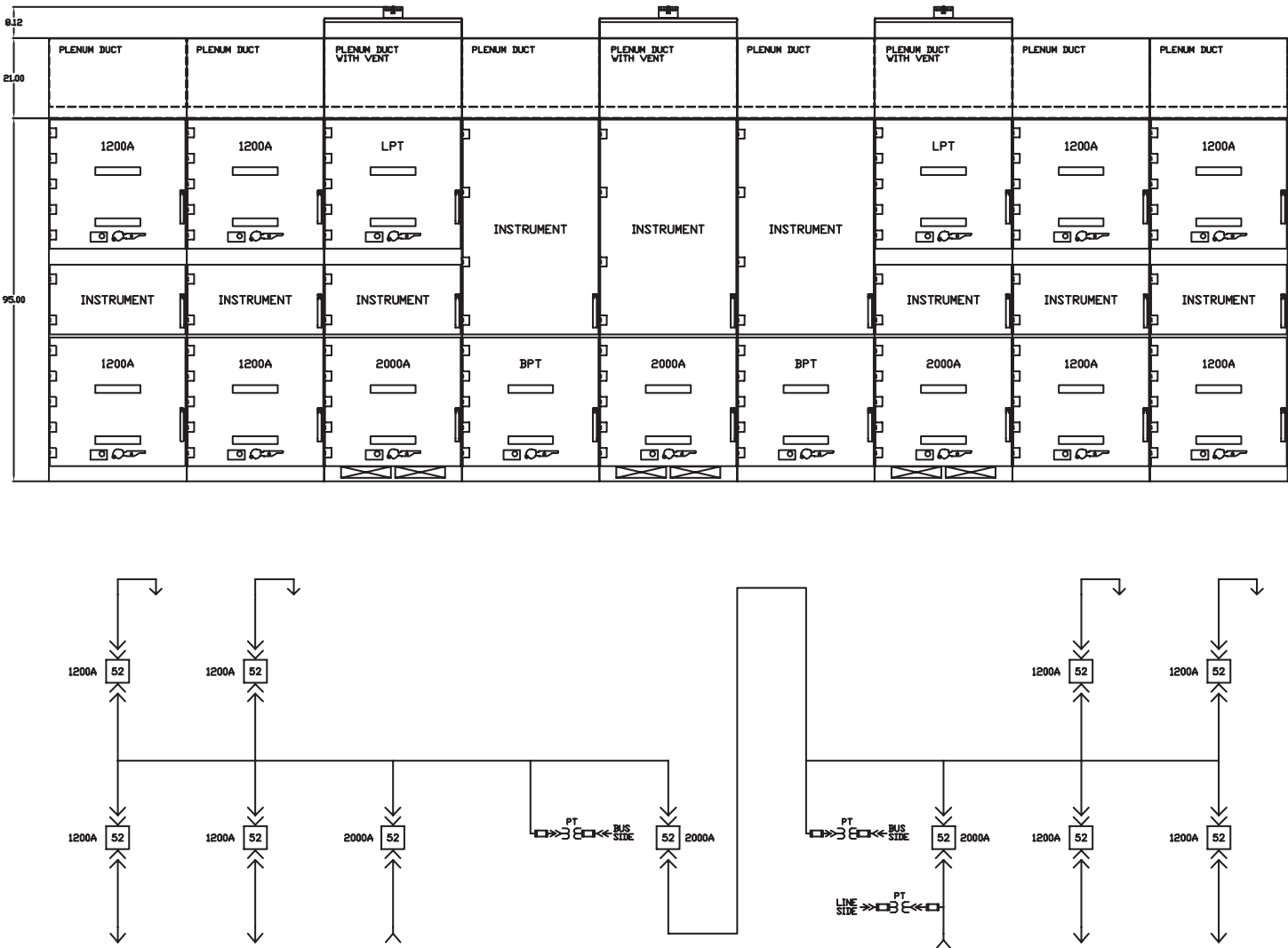
## Auxiliary frames



# Typical arrangements

## Main-Tie-Main - 2000 A/1200 A

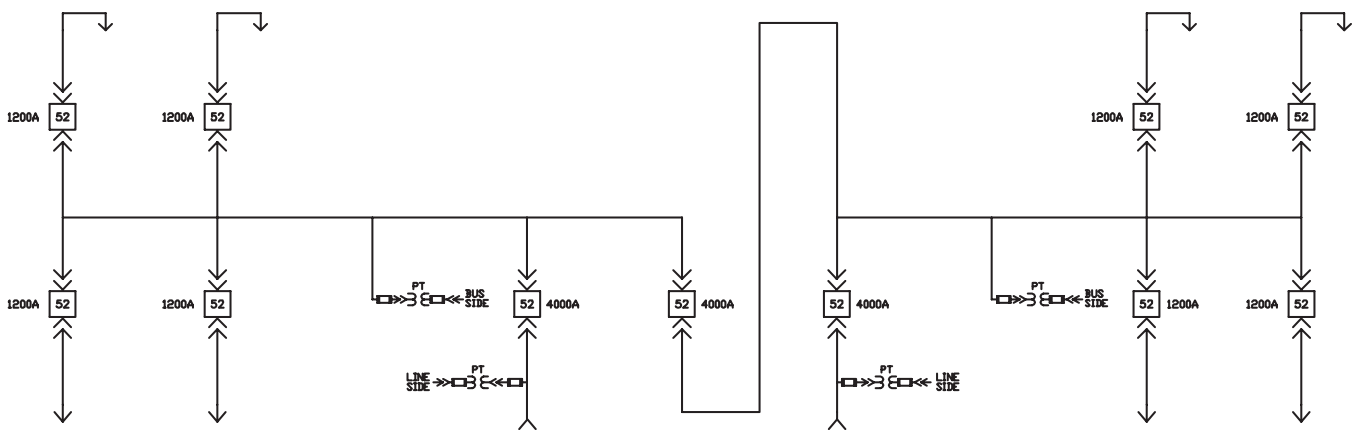
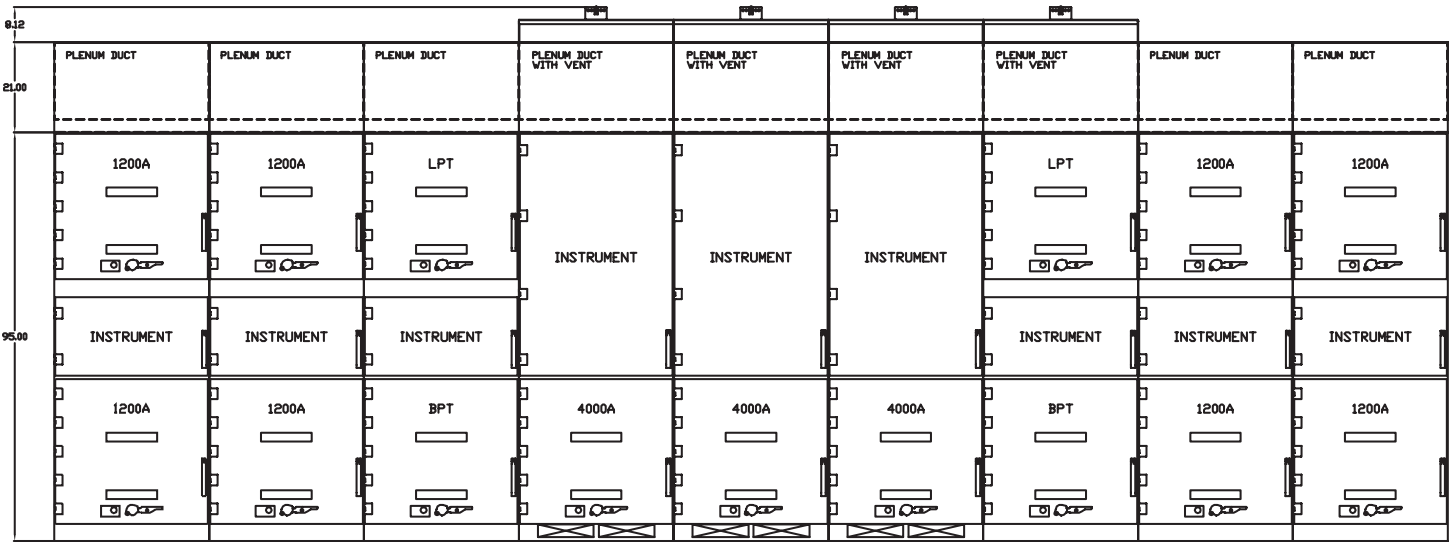
Arrangements are the same for for 5 kV, 8.25 kV and 15 kV.



# Typical arrangements

## Main-Tie-Main - 3000 A/4000 A

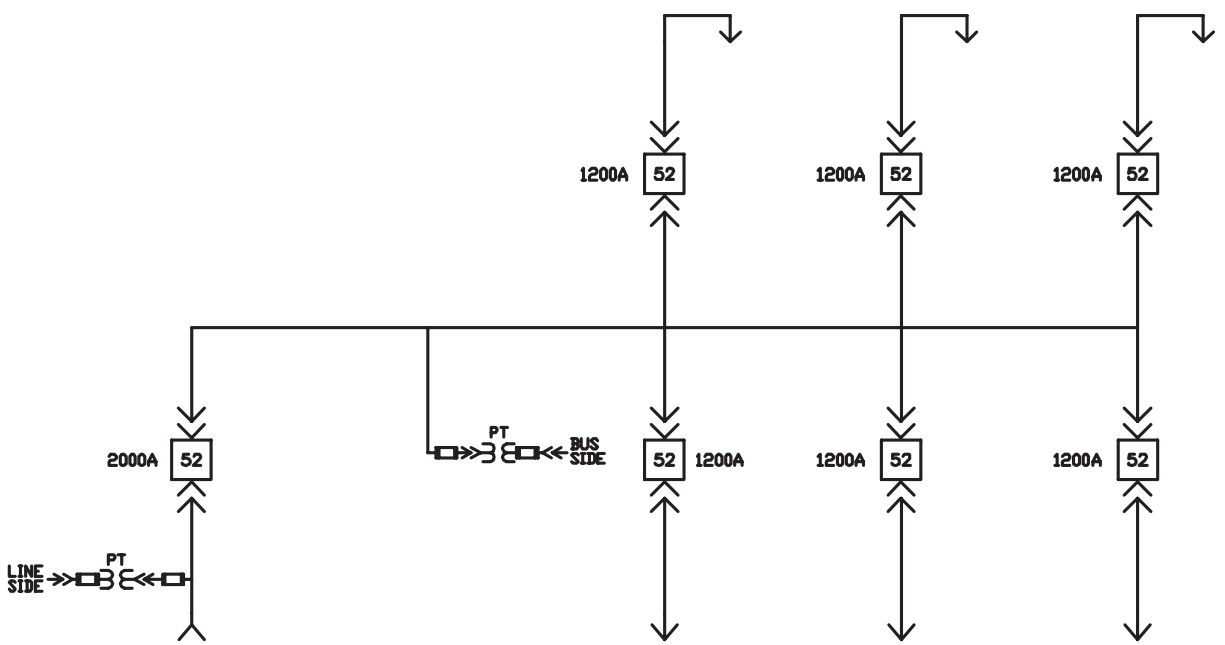
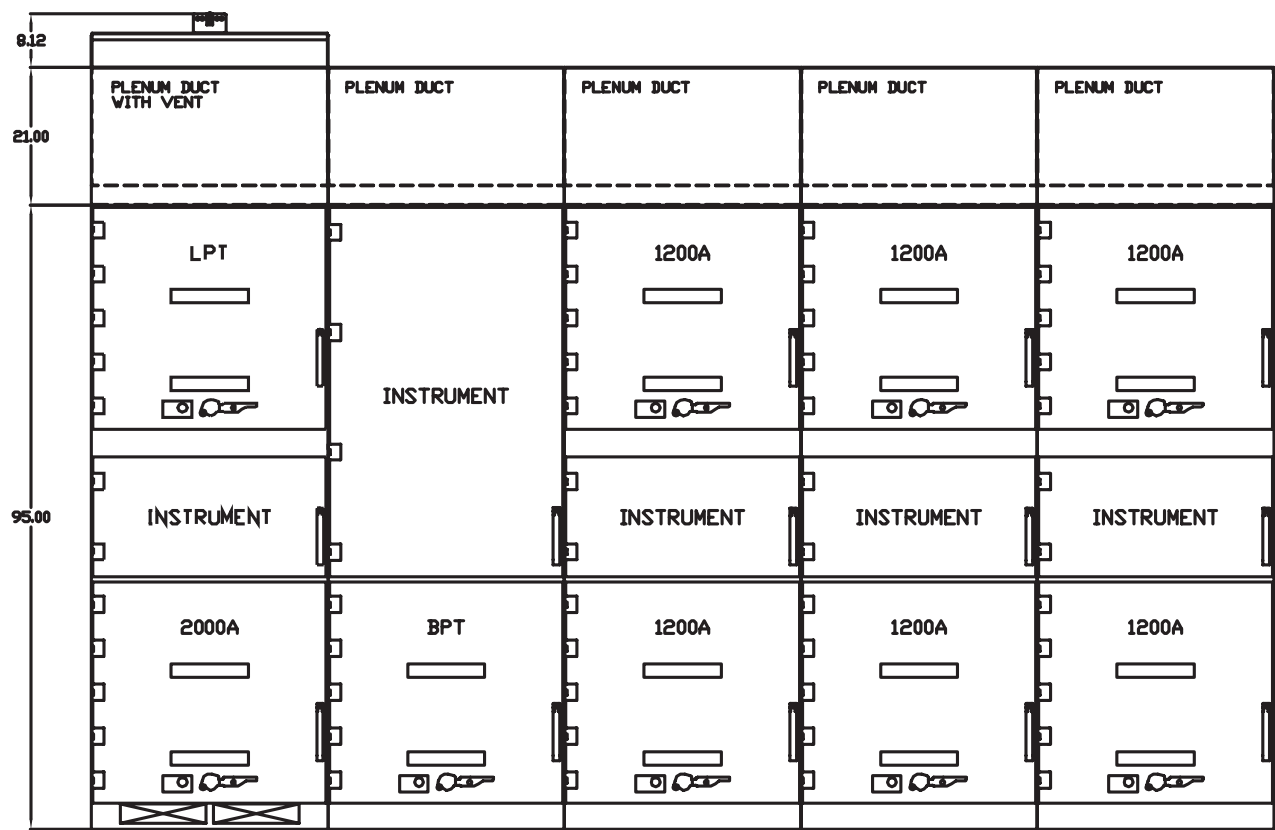
Arrangements are the same for for 5 kV, 8.25 kV and 15 kV.



# Typical arrangements

## Main with feeders - 2000 A/1200 A

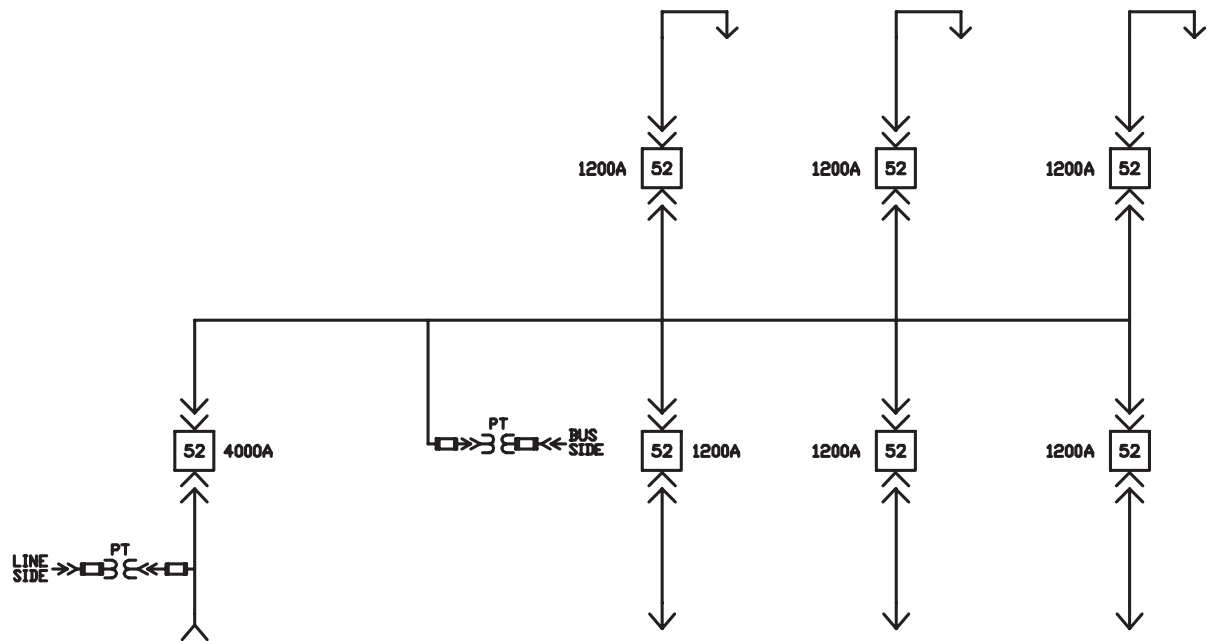
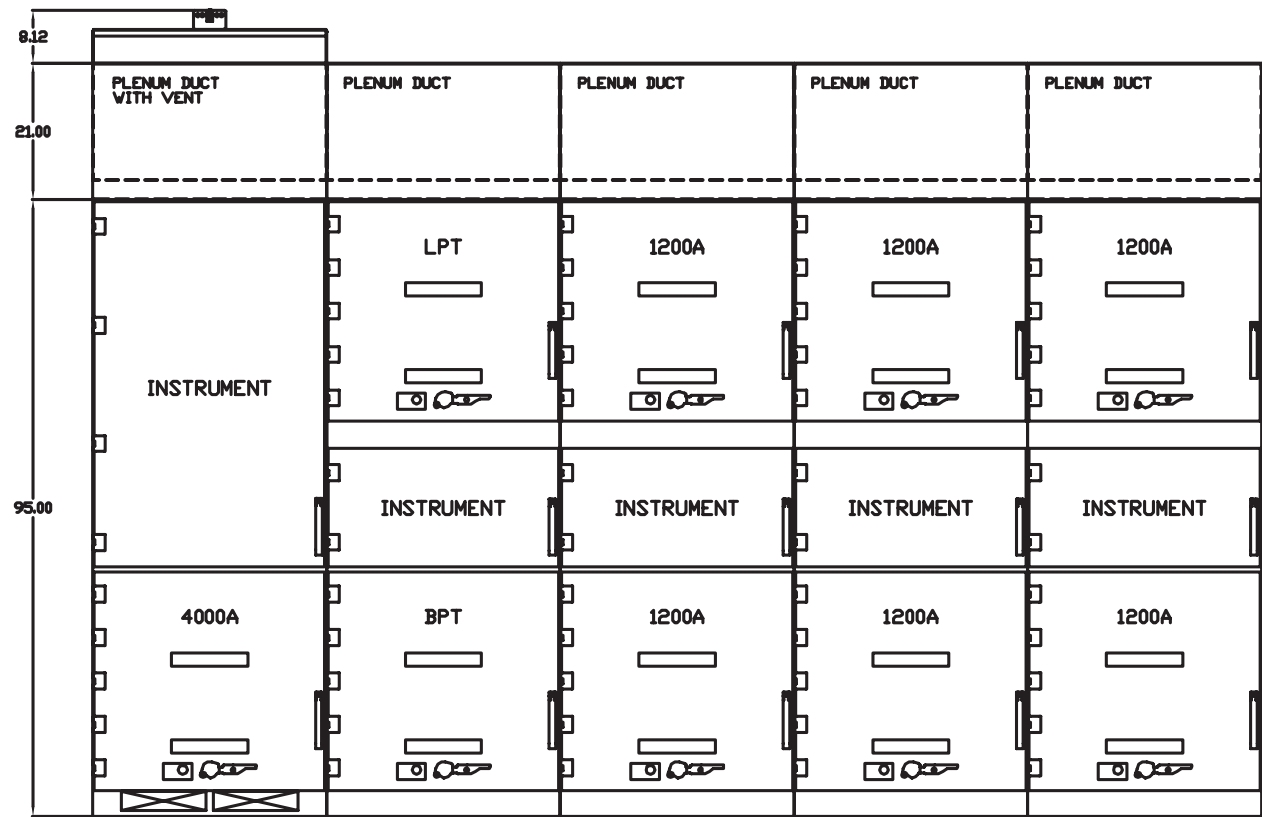
Arrangements are the same for for 5 kV, 8.25 kV and 15 kV.



# Typical arrangements

## Main with feeders - 3000 A/4000 A

Arrangements are the same for for 5 kV, 8.25 kV and 15 kV.

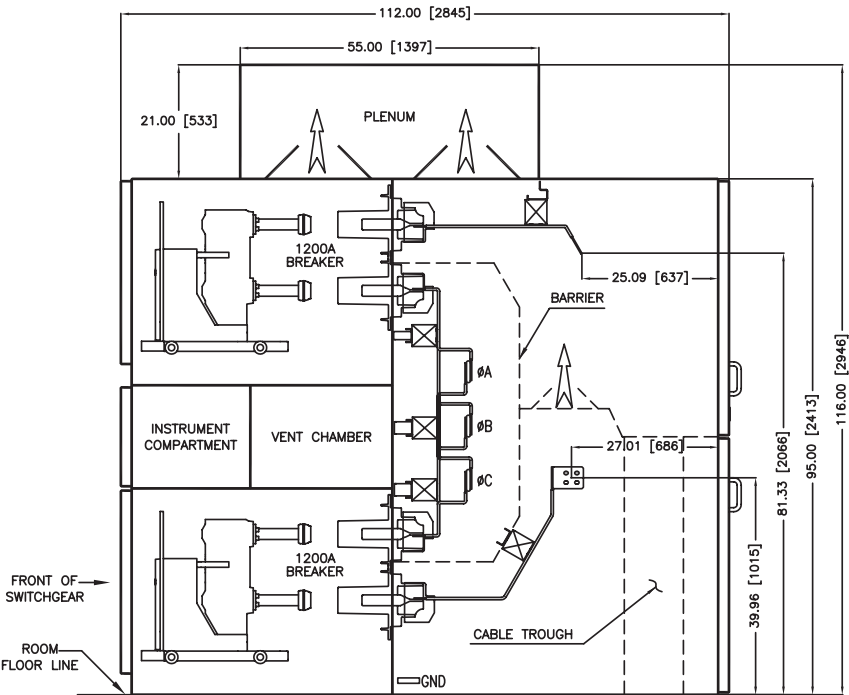


# Civil engineering details

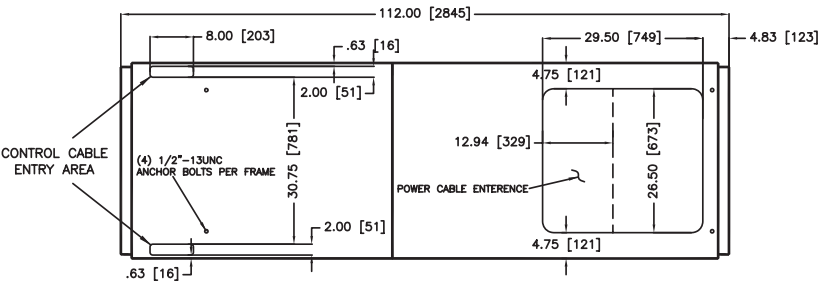
## Typical side views, floor plans and clearances

### SafeGear HD switchgear two-high frames

Circuit breaker: 1200 A/1200 A



SIDE SECTION



FLOOR PLAN

Circuit breaker: 3000 A



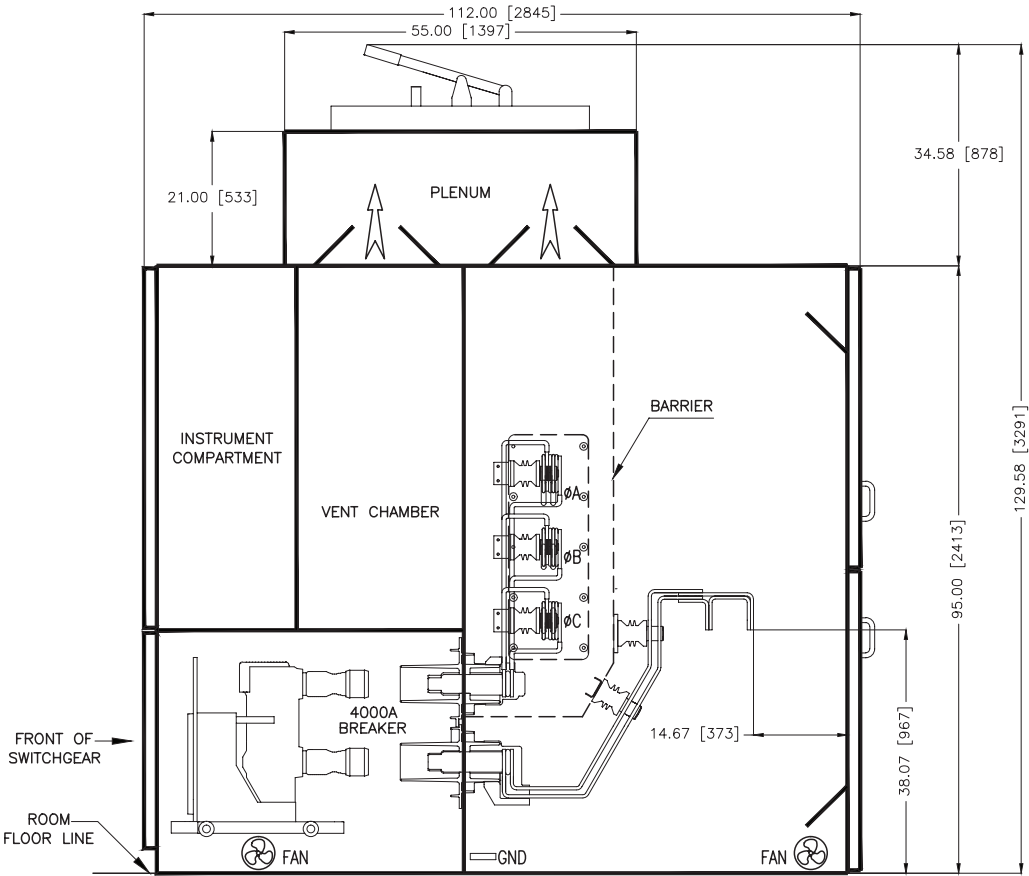


# Civil engineering details

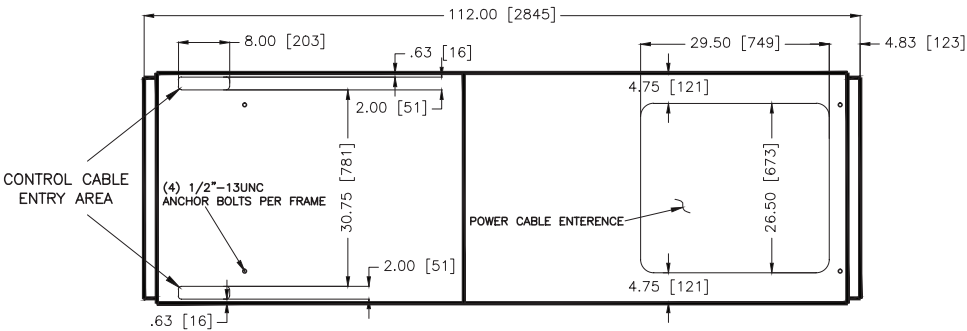
## Typical side views, floor plans and clearances

### SafeGear HD switchgear one-high frames

Circuit breaker: 4000 A



SIDE SECTION



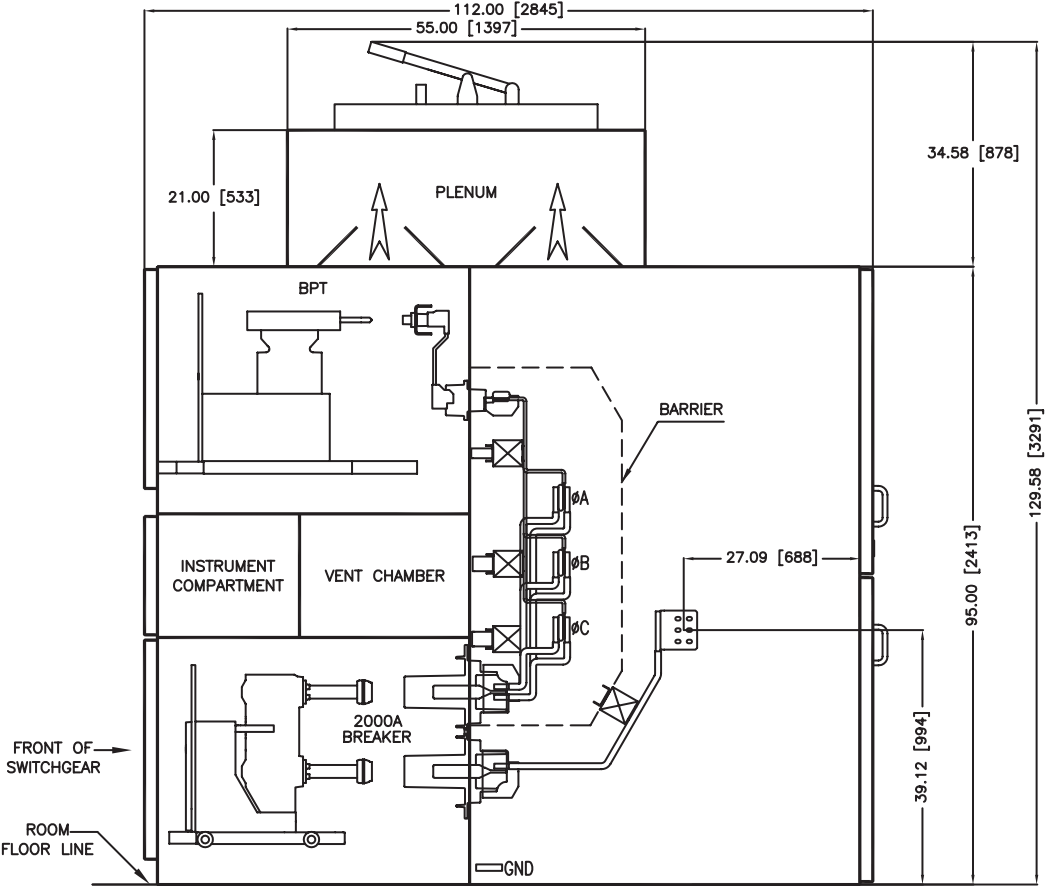
FLOOR PLAN

# Civil engineering details

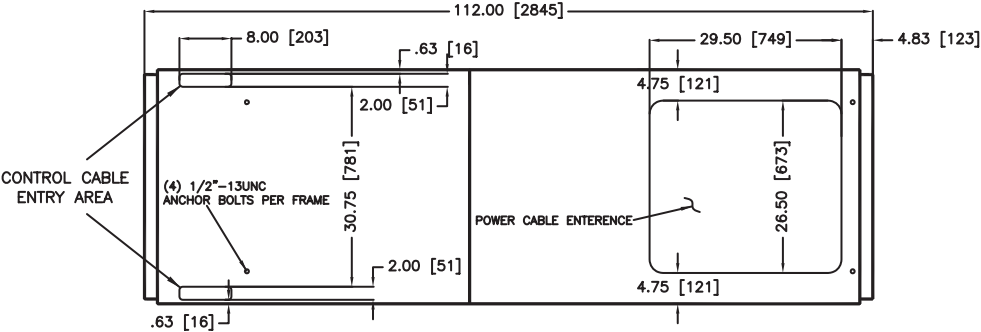
## Typical side views, floor plans and clearances

### SafeGear HD switchgear breaker and auxiliary frames

Circuit breaker: 2000 A



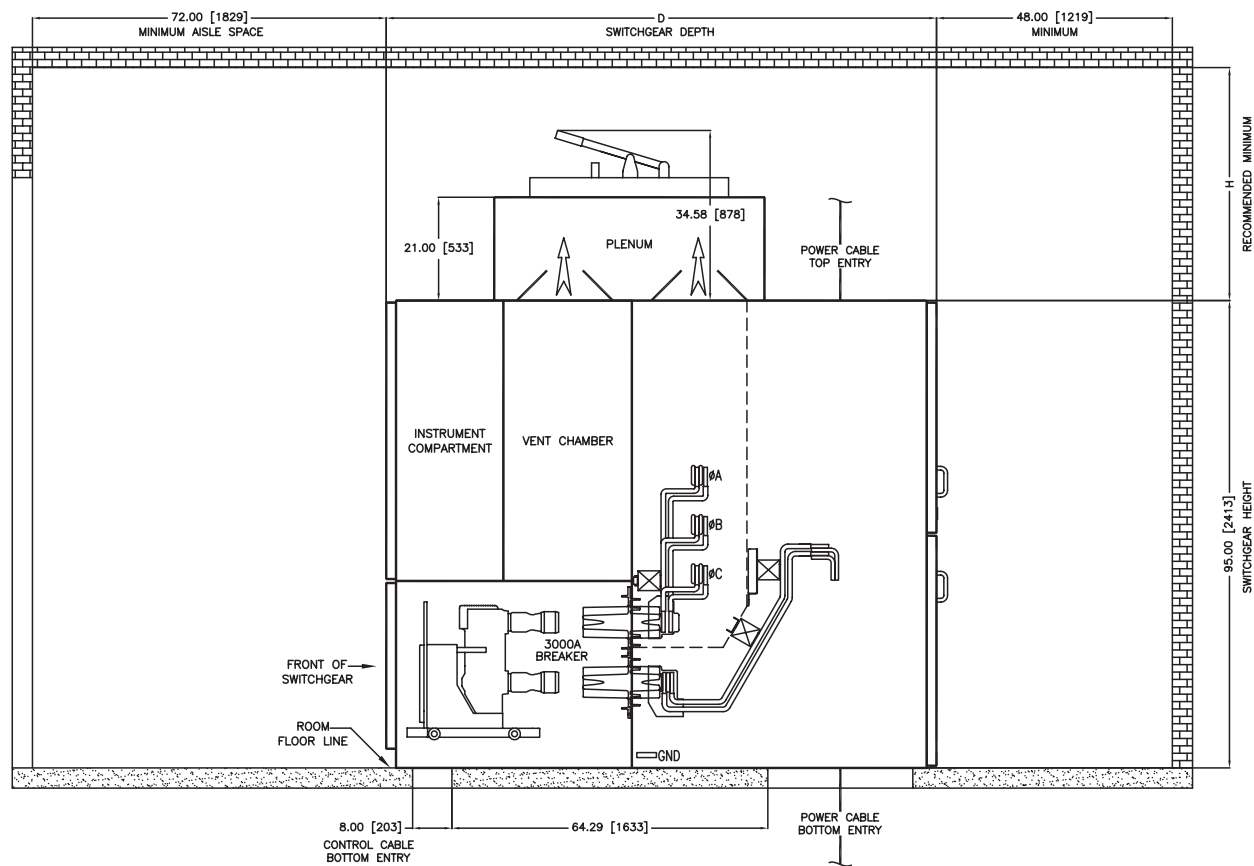
SIDE SECTION



FLOOR PLAN

# Civil engineering details

## Typical side views, floor plans and clearances



Typical civil engineering dimensions - inches (mm)	
	Depth (D)
SafeGear HD	112 (2845)

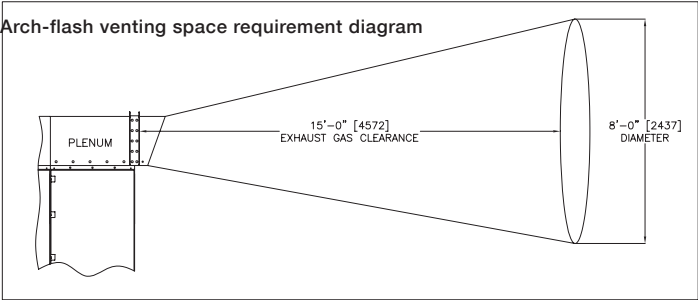
### Dimension H:

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



# 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 HD 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.

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.

Basic frame configuration	Circuit breaker (rating)	Weight	
		lbs	kg
One circuit breaker	1200	4550	2068
	2000	4915	2234
	3000	5550	2523
Two circuit breakers	1200/1200	6380	2900
	1200	5305	2411
One circuit breaker, one VT	2000	5675	2580
One circuit breaker, one CPT	1200	5330	2423
	2000	5700	2591

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



Technical guide

ADVAC™

5/15 kV ANSI spring mechanism vacuum  
circuit breaker

Power and productivity  
for a better world™



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# ADVAC breaker

## General overview

The ADVAC breaker is a spring mechanism breaker with an easy to maintain design. Fully compliant with IEEE Standards C37.04, C37.06 and C37.09, the ADVAC breaker is a great fit for many applications.

Featuring a modular design surrounding the EL-mechanism for breakers 50 kA and below and the ABB classic mechanism for 63 kA. ADVAC breakers are among the most reliable breakers on the market.

### Features

- Mechanical operations counter
- Optional roll-on-floor design
- Breaker status open or closed indicator
- Mechanical anti-pump device
- Spring charge status
- Built-in manual charge handle (50 kA and below)



### Available ADVAC breaker ratings

Voltage class	Nominal voltages	Continuous current	Short circuit/withstand (2 sec)	Close and latch	BIL (lightning impulse withstand)	Low frequency withstand (Hi-Pot)
kV	kV	A	kA, rms	kA, peak	kV, crest	kV, rms
5	2.4, 4.16, 4.8	1200, 2000, 3000	25	65	60	19
			31.5	82		
			40	104		
			50	130		
			63	164		
8.25	4.8, 6.9, 7.2	1200, 2000, 3000	40	104	95	36
15	6.9, 7.2, 8.4, 11, 12, 12.47, 13.2, 13.8, 14.4	1200, 2000, 3000	25	65	95	36
			31.5	82		
			40	104		
			50	130		
			63	164		

# ADVAC breaker

## Capacitor bank switch ratings

Voltage class	Continuous current	Short circuit current	Capacitor switching ratings	
kV	A	kA	Type	Notes
5	1200	25	C2	630 A back to back capacitor bank
		31.5	C2	25 A rated cable charging
		40	C2	25 A rated cable charging
		50	C2	1200 A back to back capacitor bank
		63	C1	1770 A back to back capacitor bank
	2000	25	C2	25 A rated cable charging
		31.5	C2	25 A rated cable charging
		40	C2	1200 A back to back capacitor bank
		50	C2	1200 A back to back capacitor bank
		63	C1	1770 A back to back capacitor bank
	3000	25	C2	1200 A back to back capacitor bank
		31.5	C2	1200 A back to back capacitor bank
		40	C2	1200 A back to back capacitor bank
		50	C2	1200 A back to back capacitor bank
		63	C1	1770 A back to back capacitor bank
8.25	1200	40	C2	1200 A back to back capacitor bank
	2000	40	C2	1200 A back to back capacitor bank
	3000	40	C2	1200 A back to back capacitor bank
15	1200	25	C2	630 A back to back capacitor bank
		31.5	C2	25 A rated cable charging
		40	C2	1200 A back to back capacitor bank
		50	C2	1030 A back to back rated cable charging
		63	C1	1770 A back to back capacitor bank
	2000	25	C2	25 A rated cable charging
		31.5	C2	25 A rated cable charging
		40	C2	1200 A back to back capacitor bank
		50	C2	1030 A back to back rated cable charging
		63	C1	1770 A back to back capacitor bank
	3000	25	C2	1200 A back to back capacitor bank
		31.5	C2	1200 A back to back capacitor bank
		40	C2	1200 A back to back capacitor bank
		50	C2	1030 A back to back rated cable charging
		63	C1	1770 A back to back capacitor bank



# ADVAC breaker

## Timing characteristics

Total interrupting time consists of opening time plus the time required for arc interruption. Total interrupt time is 50 ms or less for three cycle breakers and 83 ms or less for five cycle breakers.

Voltage class	Continuous current	Short circuit current	Interrupt time	Closing time
kV	A	kA	Cycles	ms
5	1200	25	3	30-60
		31.5	3	30-60
		40	5	50-80
		50	5	50-80
		63	3	45-80
	2000	25	3	30-60
		31.5	3	30-60
		40	3	50-80
		50	5	50-80
		63	3	45-80
	3000	25	3	50-80
		31.5	3	50-80
		40	3	50-80
		50	5	50-80
		63	3	45-80
8.25	1200	40	3	50-80
	2000	40	3	50-80
	3000	40	3	50-80
15	1200	25	3	30-60
		31.5	3	30-60
		40	3	50-80
		50	3	50-80
		63	3	45-80
	2000	25	3	30-60
		31.5	3	30-60
		40	3	50-80
		50	3	50-80
		63	3	45-80
	3000	25	3	50-80
		31.5	3	50-80
		40	3	50-80
		50	3	50-80
		63	3	45-80

# ADVAC breaker

## Mechanical endurance ratings

Voltage class	Continuous current	Short circuit current	No load mechanical operations
kV	A	kA	
5	1200	25	10000
		31.5	10000
		40	5000
		50	5000
		63	2000
	2000	25	10000
		31.5	10000
		40	5000
		50	5000
		63	2000
	3000	25	5000
		31.5	5000
		40	5000
		50	5000
		63	2000
8.25	1200	40	5000
	2000	40	5000
	3000	40	5000
15	1200	25	10000
		31.5	10000
		40	5000
		50	5000
		63	2000
	2000	25	10000
		31.5	10000
		40	5000
		50	5000
		63	2000
	3000	25	5000
		31.5	5000
		40	5000
		50	5000
		63	2000

# ADVAC breaker

## Dimensions and weight

Voltage class	Continuous current	Short circuit current	Height	Width	Depth	Weight
kV	A	kA	in/mm	in/mm	in/mm	lb/kg
5	1200	25	28	28	27	298
		31.5	28	28	27	298
		40	28	28	27	364
		50	30	28	27	419
		63	30	28	31	573
	2000	25	28	28	27	364
		31.5	28	28	27	364
		40	28	28	27	364
		50	30	28	27	441
		63	30	28	31	573
	3000	25	28	28	27	419
		31.5	28	28	27	419
		40	28	28	27	419
		50	30	28	27	463
		63	30	28	31	650
8.25	1200	40	28	28	27	364
	2000	40	28	28	27	397
	3000	40	28	28	27	419
15	1200	25	28	28	27	298
		31.5	28	28	27	298
		40	28	28	27	364
		50	30	28	27	419
		63	30	28	31	573
	2000	25	28	28	27	364
		31.5	28	28	27	364
		40	28	28	27	364
		50	30	28	27	441
		63	30	28	31	573
	3000	25	28	28	27	419
		31.5	28	28	27	419
		40	28	28	27	419
		50	30	28	27	463
		63	30	28	31	650

# ADVAC breaker

## Construction - 50 kA and below

### EL-mechanism

The EL-mechanism is used in many breakers across ABB's portfolio, thereby reducing required spare parts inventory. By using the EL-mechanism, the ADVAC breaker maintains a lightweight, modular design that is easy to maintain in the case of normal maintenance or repair.

The EL-mechanism also features a mechanical anti-pump device to eliminate reliance on electrical anti-pump devices

By utilizing a modular design featuring the EL-mechanism, the ADVAC breaker has a quick change trip/close coil and charge motor design that makes repair of these commonly repaired parts easy.

For breaker rebuilds or repairs, the entire EL-mechanism can be removed and replaced in under an hour.

### Vacuum interrupters

ABB vacuum interrupters (VIs) are embedded in a solid insulation material to protect the VIs from collecting dust or moisture and from accidental bumps. The solid insulation also improves tracking resistance making ABB circuit breakers one of the lightest available in the market. Because of the embedded design, these vacuum interrupters are maintenance free for the life of the VI.

### Smart coils

ADVAC breakers feature smart coils with on-board microprocessors that monitor for coil continuity, over-current and over temperature scenarios and provide a more efficient response than standard coils. Options for a second open coil or under-voltage coil are also available.

### Breaker racking truck

ABB's breaker racking truck for switchgear is integral to the breaker itself in lieu of being inside the switchgear breaker cell. Rated for 180 foot-pounds of torque, the breaker racking truck exceeds the industry standard of 50-60 foot-pounds by a factor of 3 thereby greatly reducing the possibility of an over-torque condition.

The breaker racking truck is rated for 1000 rack in-rack out operations, exceeding the ANSI Standard of 500 operations.

#### 1 EL-mechanism | 2 Vacuum interrupters

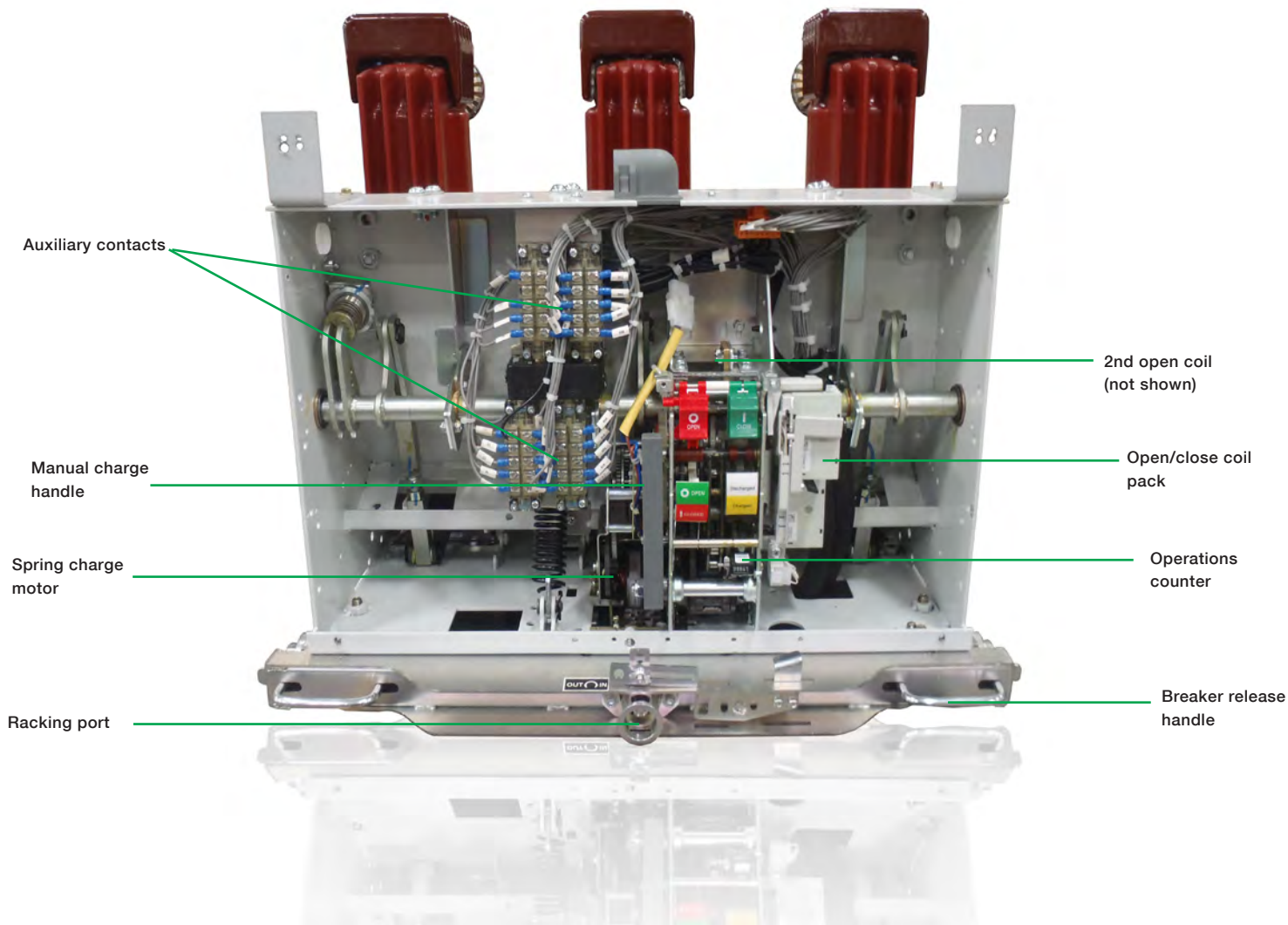
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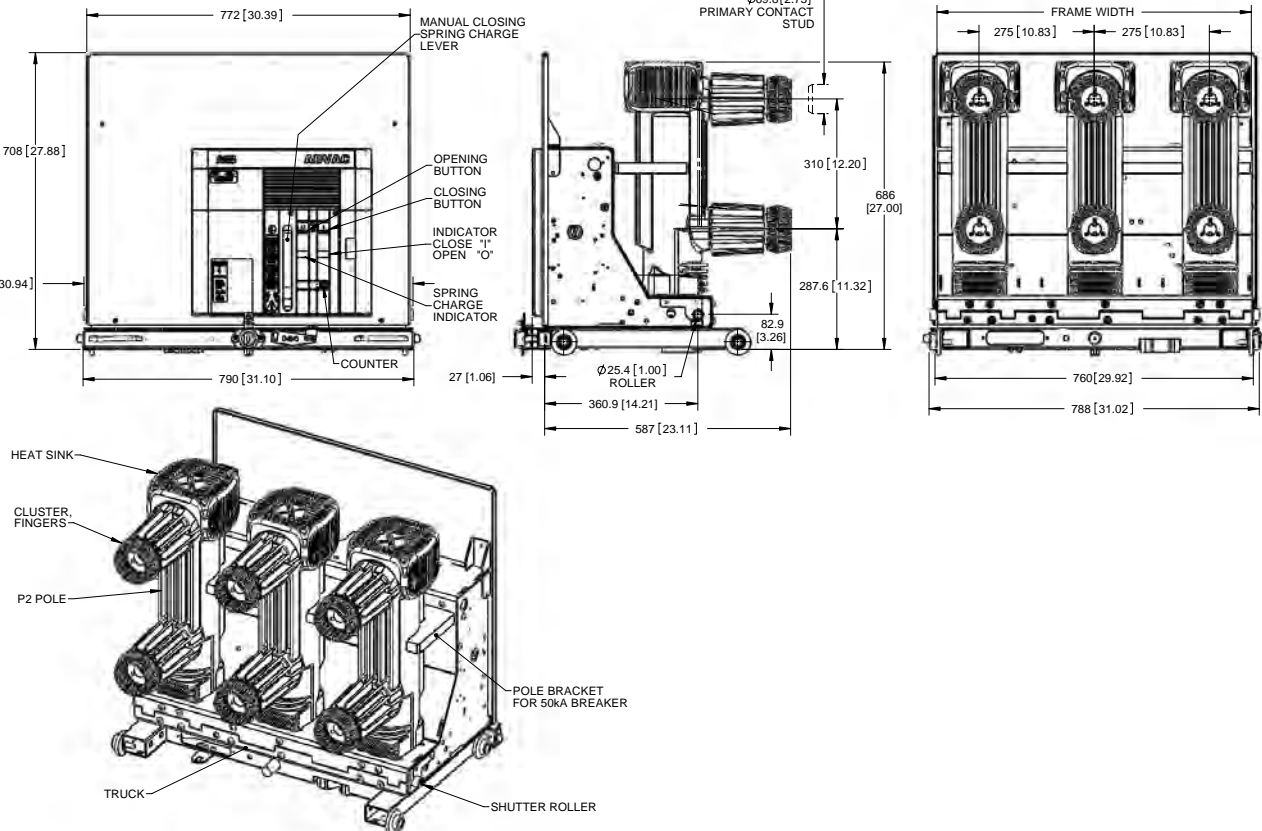
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ADVAC breaker  
Internal diagram - 50 kA and below



## Outline drawing - 50 kA and below



## Schematic drawing - 50 kA and below



# ADVAC breaker

## Power requirements - 50 kA and below

Tripping (-MO1 & -MO2) coils	Nominal control power voltage					
	24 Vdc	48 Vdc	125 Vdc	250 Vdc	120 Vac	240 Vac
-MO1 launch current	8.5 A	4.5 A	2.0 A	1.0 A	2.0 A	1.0 A
-MO1 launch duration	100 ms	100 ms	100 ms	100 ms	100 ms	100 ms
-MO1 hold current	250 mA	150 mA	50 mA	50 mA	50 mA	50 mA
-MO2 launch current	8.5 A	4.5 A	2.0 A	1.0 A	2.0 A	1.0 A
-MO2 launch duration	100 ms	100 ms	100 ms	100 ms	100 ms	100 ms
-MO2 hold current	250 mA	150 mA	50 mA	50 mA	50 mA	50 mA
Operating range	14 - 28 Vdc	28 - 56 Vdc	70 - 140 Vdc	140 - 280 Vdc	104 - 127 Vac	208 - 254 Vac
1 min Low freq. withstand	1500 V	1500 V	1500 V	1500 V	1500 V	1500 V

Closing (-MC) coils	Nominal control power voltage					
	24 Vdc	48 Vdc	125 Vdc	250 Vdc	120 Vac	240 Vac
-MC launch current	5.45 A	4.5 A	2.0 A	1.0 A	2.0 A	1.0 A
-MC launch duration	150 ms	150 ms	150 ms	150 ms	150 ms	150 ms
-MC hold current	750 mA	150 mA	50 mA	50 mA	50 mA	50 mA
Operating range	18-28 Vdc	36 - 56 Vdc	100 - 140 Vdc	200 - 280 Vdc	104 - 127 Vac	208 - 254 Vac
1 min Low freq. withstand	1500 V	1500 V	1500 V	1500 V	1500 V	1500 V

UnderVoltage (-MU) coil	Nominal control power voltage					
	24 Vdc	48 Vdc	125 Vdc	250 Vdc	120 Vac	240 Vac
-MU launch current	8.5 A	4.5 A	2.0 A	1.0 A	2.0 A	1.0 A
-MU launch duration	100 ms	100 ms	100 ms	100 ms	100 ms	100 ms
-MU hold current	250 mA	150 mA	50 mA	50 mA	50 mA	50 mA
-MU dropout (trip)	8 - 17 Vdc	17 - 34 Vdc	44 - 88 Vdc	88 - 175 Vdc	42 - 84 Vac	84 - 168 Vac
-MU reset	20 - 26 Vdc	41 - 53 Vdc	106 - 138 Vdc	213 - 275 Vdc	102 - 132 Vac	204 - 264 Vac
Operating time	30 ms	30 ms	30 ms	30 ms	30 ms	30 ms
1 min Low freq. withstand	1500 V	1500 V	1500 V	1500 V	1500 V	1500 V

Spring charging motor	Nominal control power voltage					
	24 Vdc	48 Vdc	125 Vdc	250 Vdc	120 Vac	240 Vac
Motor ( $\leq$ 40 kA) inrush amps	2.5 A	12.5 A	5.0 A	2.5 A	5.0 A	2.5 A
Motor ( $\leq$ 40 kA) inrush duration	0.2 sec	0.2 sec	0.2 sec	0.2 sec	0.2 sec	0.2 sec
Motor ( $\leq$ 40 kA) run amps	8.37 A	4.5 A	2.0 A	1.0 A	2.0 A	1.0 A
Motor ( $\leq$ 40 kA) run time	6-7 s	6 - 7 s	6 - 7 s	6 - 7 s	6 - 7 s	6 - 7 s
Motor (50 kA) inrush amps	37.5 A	19.0 A	7.5 A	4.0 A	7.5 A	4.0 A
Motor (50 kA) inrush duration	0.2 s	0.2 sec	0.2 sec	0.2 sec	0.2 sec	0.2 sec
Motor (50 kA) run amps	14.58 A	7.5 A	3.0 A	1.5 A	3.0 A	1.5 A
Motor (50 kA) run time	6-7 s	6 - 7 s	6 - 7 s	6 - 7 s	6 - 7 s	6 - 7 s
Operating range	18-28- Vdc	36 - 56 Vdc	100 - 140 Vdc	200 - 280 Vdc	104 - 127 Vac	208 - 254 Vac
1 min Low freq. withstand	1500 V	1500 V	1500 V	1500 V	1500 V	1500 V

Auxilliary contacts	Nominal control power voltage					
	24 Vdc	48 Vdc	125 Vdc	250 Vdc	120 Vac	240 Vac
Rated carrying current	10 A	10 A	10 A	10 A	10 A	10 A
Rated breaking current	10 A	7.6 A	4.4 A	1.8 A	2.6 A	2.3 A
Maximum breaking current	12 A	10 A	6 A	0 A	26 A	23 A



# ADVAC breaker

## Construction - 63 kA

### Classic mechanism

The ADVAC classic mechanism 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. The unique ADVAC mechanism uses a single toroidal spring mounted on a drive shaft to rotate the shaft in the same direction during opening and closing. The spring can be charged manually via the chain drive and ratchet wheel, or electrically by the spring charging gear motor.

### Assembled poles

ABB assembled poles use an epoxy resin material to surround a vacuum interrupter in lieu of the embedded design of the 50 kA and below ADVAC breakers. The vacuum interrupters and associated assemblies are located inside of the epoxy resin housing.

### Breaker racking truck

ABB's breaker racking truck for switchgear is integral to the breaker itself in lieu of being inside the switchgear breaker cell. Rated for 180 foot-pounds of torque, the breaker racking truck exceeds the industry standard of 50-60 foot-pounds by a factor of 3 thereby greatly reducing the possibility of an over-torque condition.

The breaker racking truck is rated for 1000 rack in-rack out operations, exceeding the ANSI Standard of 500 operations.

1 Breaker lift truck | 2 ADVAC 63 kA

1



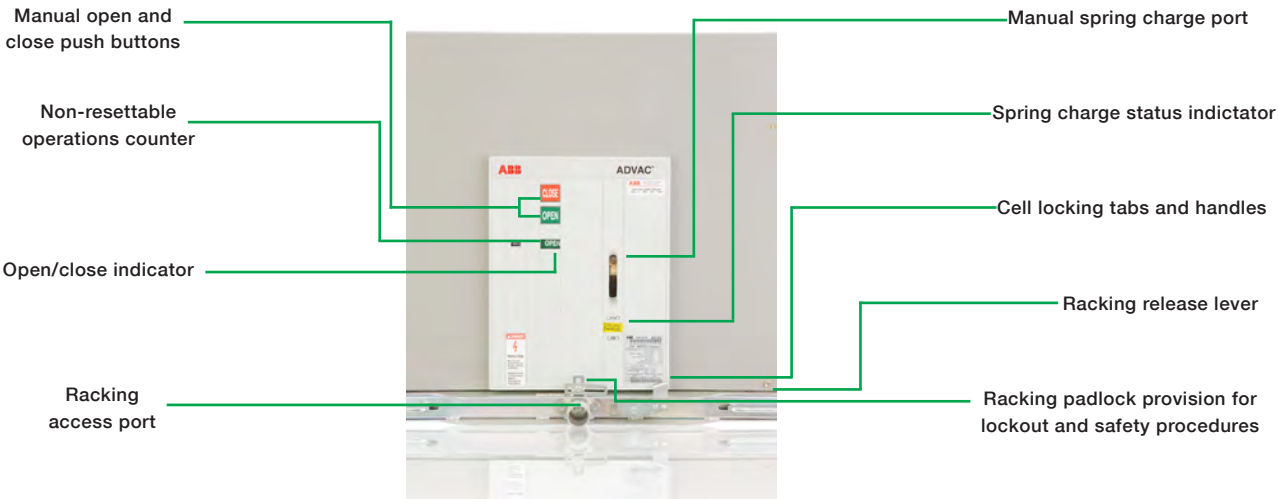
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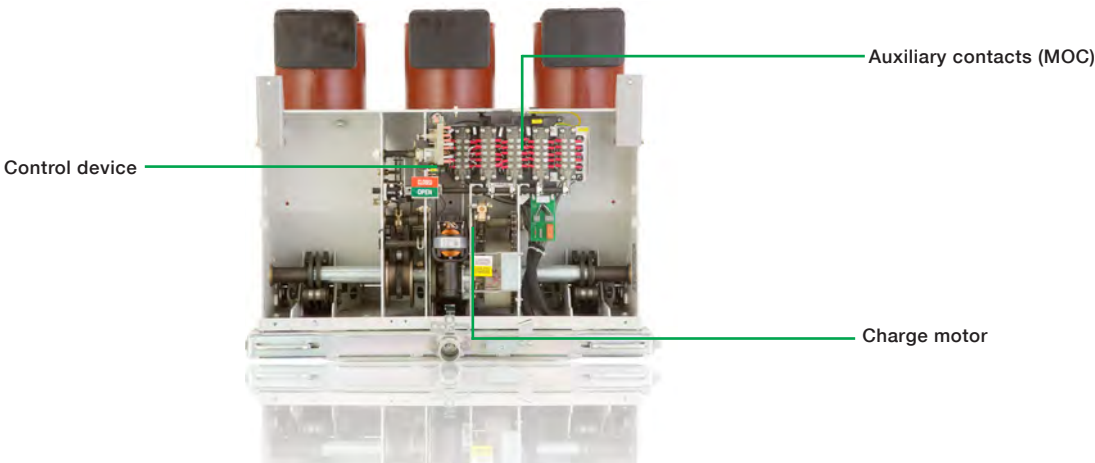
# ADVAC breaker

## Internal diagram - 63 kA

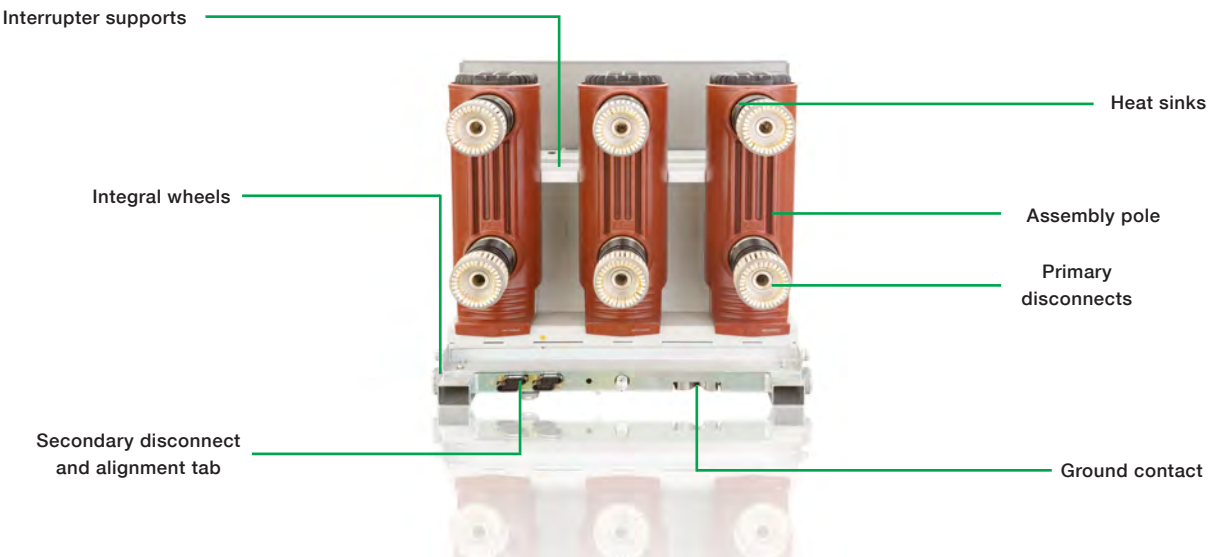
Front view of ADVAC circuit breaker



ADVAC circuit breaker with front panel removed

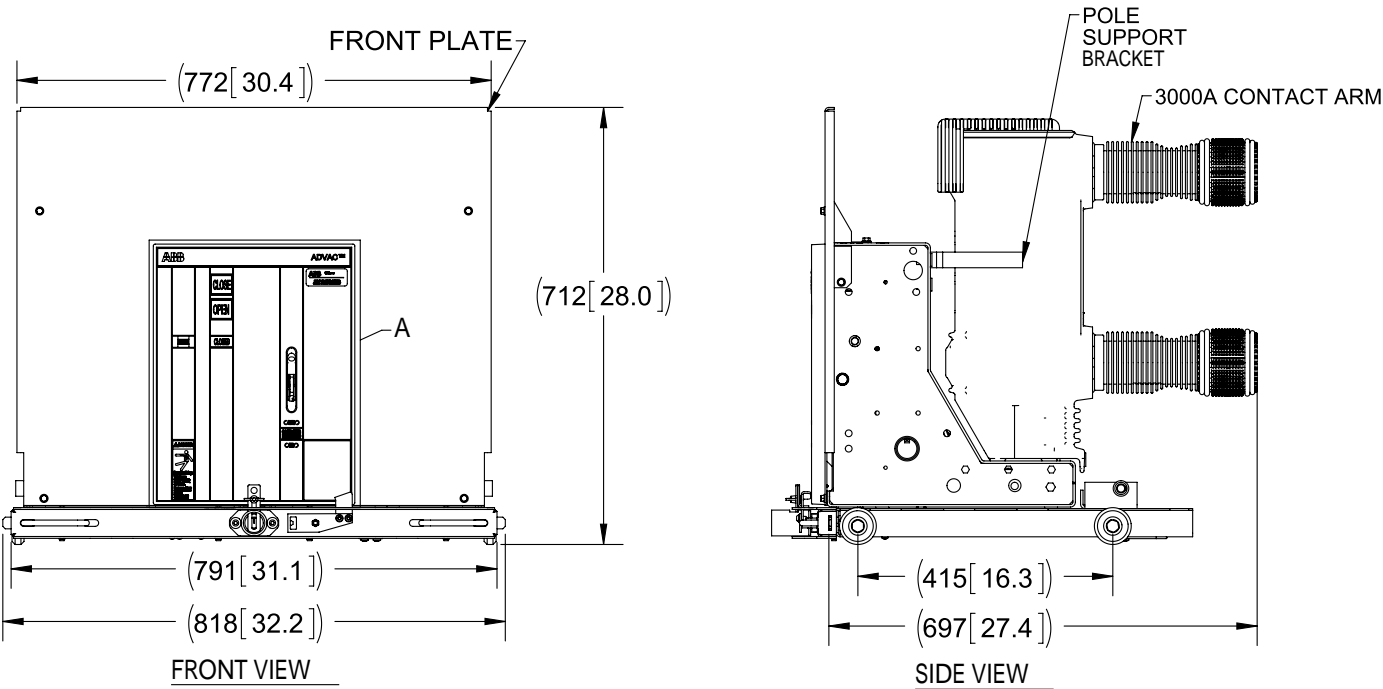
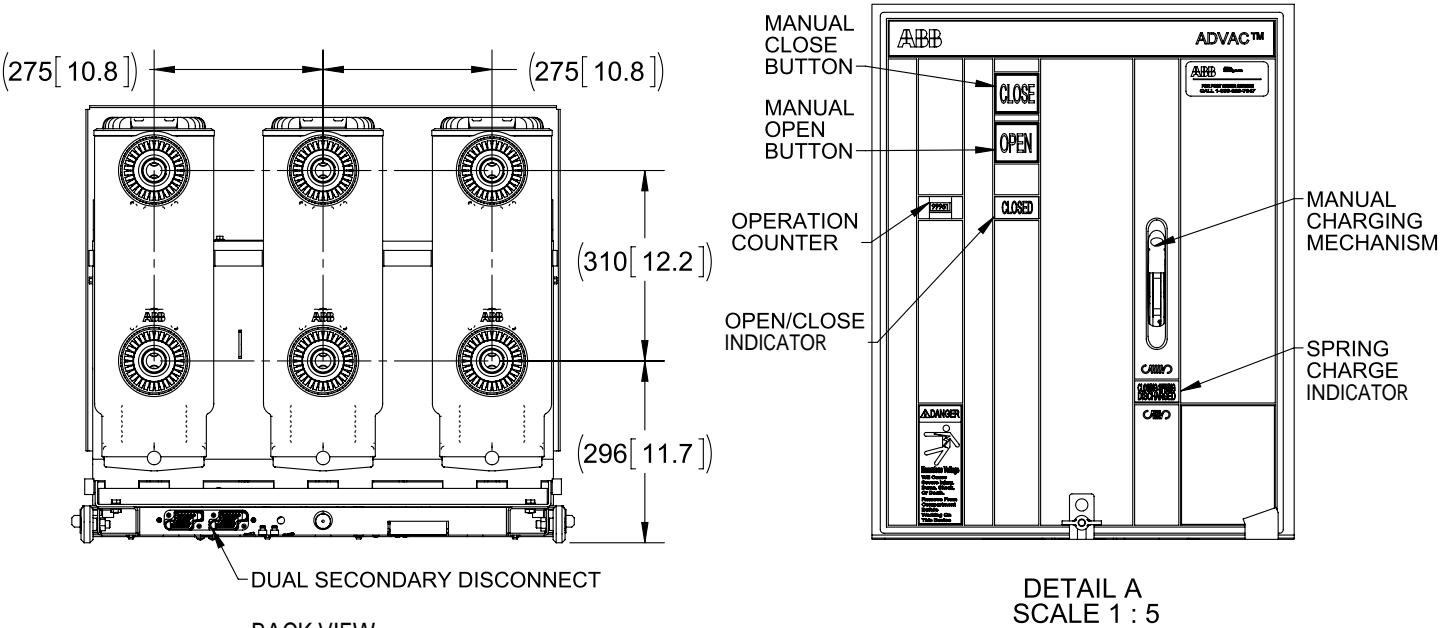


Rear view of ADVAC circuit breaker



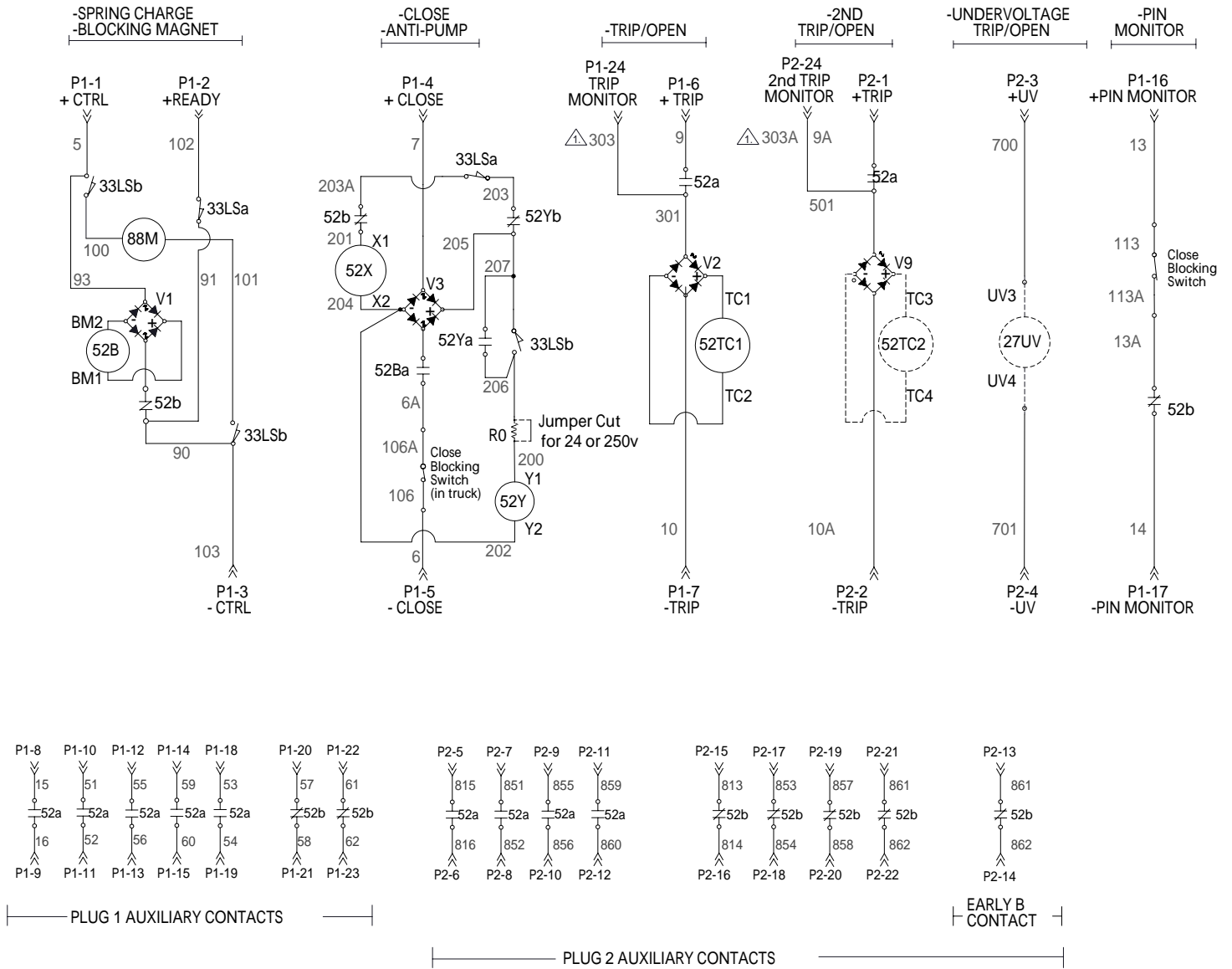
# ADVAC breaker

## Outline drawing - 63 kA



## ADVAC breaker

### Schematic drawing - 63 kA



# ADVAC breaker

## Power requirements - 63 kA

### Trip/close coil

Parameter	DC	AC
Operating voltage	48-125-250 VDC	120-240VAC
Operating limits	70-110% of operating voltage	70-110% of operating voltage
Power on inrush	200 W	200 VA
Inrush duration	100 ms	100 ms
Continuous power	5 W	5 VA
Insulation voltage	2000 V 50Hz (1 min)	2000 V 50Hz (1 min)

### Undervoltage coil

Parameter	DC	AC
Operating voltage	-48-125-250 VDC	120-240VAC24
Operating limits	CB opening: 35-70% of operating voltage CB closing: 85-110% of operating voltage	CB opening: 35-70% of operating voltage CB closing: 85-110% of operating voltage
Power on inrush	200 W	200 VA
Inrush duration	100 ms	100 ms
Continuous power	5 W	5 VA
Insulation voltage	2000 V 50Hz (1 min)	2000 V 50Hz (1 min)

### Charge motor

Parameter	DC	AC
Operating voltage	-48-125-250 VDC	120-240VAC24
Operating limits	85-110% of operating voltage	85-110% of operating voltage
Power on inrush	Less than or equal to 40 kA: 600W Greater than 40kA: 900W	Less than or equal to 40 kA: 600 VA Greater than 40kA: 900 VA
Rated power	Less than or equal to 40 kA: 200 W Greater than 40kA: 350 W	Less than or equal to 40 kA: 200 VA Greater than 40kA: 350 VA
Charging time	6-7 s	6-7 s
Insulation voltage	2000 V 50Hz (1 min)	2000 V 50Hz (1 min)

### Auxiliary switch ratings

UN	Timing	Rated current (A)	Breaking capacity (A)
220 VAC		2.5	25
24 VDC	1 ms	10	12
	15 ms	10	12
	50 ms	8	10
	200 ms	6	7.7
60 VDC	1 ms	8	10
	15 ms	6	8
	50 ms	5	6
	200 ms	4	5.4
110 VDC	1 ms	6	8
	15 ms	4	5
	50 ms	2	4.6
	200 ms	1	2.2
220 VDC	1 ms	1.5	2
	15 ms	1	1.4
	50 ms	0.75	1.2
		0.5	1



Technical guide

AMVAC™

5/15/27 kV ANSI magnetic mechanism  
vacuum circuit breaker

Power and productivity  
for a better world™



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# AMVAC breaker

## General overview

The AMVAC breaker is a magnetically actuated and latched breaker capable of a high number of operations due to its simplified design. Fully compliant with IEEE Standards C37.04, C37.06 and C37.09, the AMVAC breaker is a great fit for many applications.

### Features

- Mechanical operations counter
- Optional roll-on-floor design
- Open, closed, ready/not ready lights and pushbuttons
- Maintenance-free magnetic actuator



### Available AMVAC breaker ratings

Voltage class	Nominal voltages	Continuous current	Short circuit/withstand (2 sec)	Close and latch	BIL (lightning impulse withstand)	Low frequency withstand (Hi-Pot)
kV	kV	A	kA, rms	kA, peak	kV, crest	kV, rms
5	2.4, 4.16, 4.8	1200, 2000, 3000	25	65	60	19
			31.5	82		
			40	104		
			50	130		
8.25	4.8, 6.9, 7.2	1200, 2000, 3000	40	104	95	36
15	6.9, 7.2, 8.4, 11, 12, 12.47, 13.2, 13.8, 14.4	1200, 2000, 3000	25	65	95	36
			31.5	82		
			40	104		
			50	130		
27	20.78, 21.6, 22.86, 23, 23.9, 24.94	1200, 2000	16	42	125	60
			25	65		



# AMVAC breaker

## Construction

### Magnetic actuator

Introduced in 1997, the bi-stable magnetic actuator is used in many ABB products, including the AMVAC breaker. Due to its simple design, no maintenance on the actuator is necessary for the lifetime of the product.

The magnetic actuator operates on the principle of shifting magnetic flux and is latched into one of the stable positions by rare-earth magnets which require no power.

### Vacuum interrupters

ABB vacuum interrupters (VIs) are embedded in a solid insulation material to protect the VIs from collecting dust or moisture and from accidental bumps. The solid insulation also improves tracking resistance making ABB circuit breakers some of the lightest available in the market. Because of the embedded design, these vacuum interrupters are maintenance-free for the life of the VI.

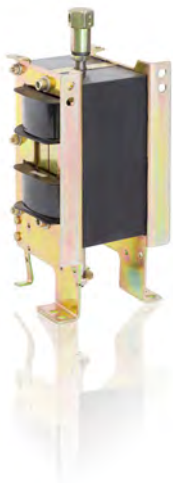
### On-board capacitors

The on-board capacitors of the AMVAC breaker deliver the current needed for creation of magnetic fields within the mechanism thereby eliminating current draw and voltage drop from the battery bank for the substation.

For more information on the maintenance of the capacitors, please see the AMVAC Installation, Operation and Maintenance Manual.

1 Magnetic actuator | 2 Vacuum interrupters | 3 On-board capacitors

1



2



3



# AMVAC breaker

## Construction

### Electronic control board

The electronic control board technology for the AMVAC breaker provides improved reliability due to its self-monitoring functions and features. Featuring coil monitoring, sensor monitoring, optional under-voltage trip and optional energy failure trip, the AMVAC breaker is customizable for any application.

By managing the 45 ms current limited pulse delivered to the mechanism by the on-board capacitors, the electronic control board eliminates one cause of common failures in typical spring mechanism breakers – the burning of trip and close coils.

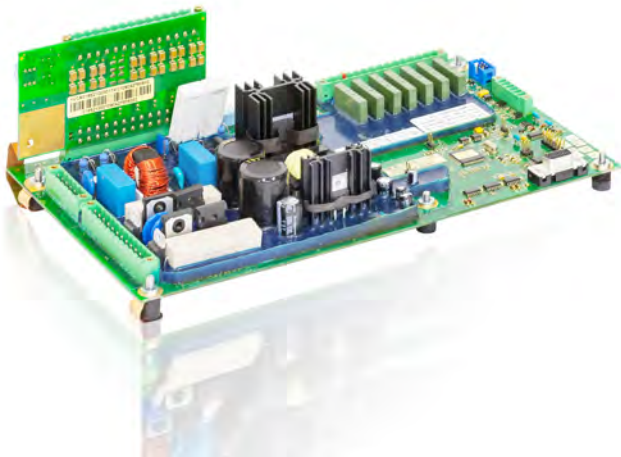
### Breaker racking truck

ABB's breaker racking truck for switchgear is integral to the breaker itself in lieu of being inside the switchgear breaker cell. Rated for 180 foot-pounds of torque, the breaker racking truck exceeds the industry standard of 50-60 foot-pounds by a factor of three, greatly reducing the possibility of an over-torque condition.

The breaker racking truck is rated for 1000 rack in-rack out operations, exceeding the ANSI Standard of 500 operations.

1 Electronic control board| 2 Breaker lift truck

1



2



# AMVAC breaker

## Capacitor bank switch ratings

Voltage class	Continuous current	Short circuit current	Capacitor switching ratings	
kV	A	kA	Type	Notes
5	1200	25	C0	25 A cable charging
		31.5	C0	25 A cable charging
		40	C0	25 A cable charging
		50	C0	630 A back to back capacitor bank
	2000	25	C0	25 A cable charging
		31.5	C0	25 A cable charging
		40	C0	630 A back to back capacitor bank
		50	C0	630 A back to back capacitor bank
	3000	25	C1	630 A back to back capacitor bank
		31.5	C1	630 A back to back capacitor bank
		40	C1	630 A back to back capacitor bank
		50	C1	630 A back to back capacitor bank
8.25	1200	40	C1	630 A back to back capacitor bank
	2000	40	C1	630 A back to back capacitor bank
	3000	40	C1	630 A back to back capacitor bank
15	1200	25	C0	25 A cable charging
		31.5		25 A cable charging
		40	C1	630 A back to back capacitor bank
		50	C1	1000 A back to back capacitor bank
	2000	25		25 A cable charging
		31.5		25 A cable charging
		40	C1	630 A back to back capacitor bank
		50	C1	1000 A back to back capacitor bank
	3000	25	C1	630 A back to back capacitor bank
		31.5	C1	630 A back to back capacitor bank
		40	C1	630 A back to back capacitor bank
		50	C1	1000 A back to back capacitor bank
27	1200	16	BTB	400 A back to back capacitor bank
		25	BTB	400 A back to back capacitor bank
	2000	16	BTB	400 A back to back capacitor bank
		25	BTB	400 A back to back capacitor bank

# AMVAC breaker

## Timing characteristics

Total interrupting time consists of opening time plus the time required for arc interruption. Total interrupt time is 50 ms or less for three cycle breakers and 83 ms or less for five cycle breakers.

Voltage class	Continuous current	Short circuit current	Interrupt time	Closing time
kV	A	kA	Cycles	ms
5	1200	25	3	45-60
		31.5	3	45-60
		40	5	45-60
		50	5	45-60
	2000	25	3	45-60
		31.5	3	45-60
		40	3	45-60
		50	5	45-60
	3000	25	3	45-60
		31.5	3	45-60
		40	3	45-60
		50	5	45-60
8.25	1200	40	3	45-60
	2000	40	3	45-60
	3000	40	3	45-60
15	1200	25	3	45-60
		31.5	3	45-60
		40	3	45-60
		50	3	45-60
	2000	25	3	45-60
		31.5	3	45-60
		40	3	45-60
		50	3	45-60
	3000	25	3	45-60
		31.5	3	45-60
		40	3	45-60
		50	3	45-60
27	1200	16	3	45-60
		25	3	45-60
	2000	16	3	45-60
		25	3	45-60

# AMVAC breaker

## Mechanical endurance ratings

Voltage class	Continuous current	Short circuit current	No load mechanical operations
kV	A	kA	
5	1200	25	10000
		31.5	10000
		40	5000
		50	5000
	2000	25	10000
		31.5	10000
		40	5000
		50	5000
	3000	25	5000
		31.5	5000
		40	5000
		50	5000
8.25	1200	40	5000
	2000	40	5000
	3000	40	5000
15	1200	25	10000
		31.5	10000
		40	5000
		50	5000
	2000	25	10000
		31.5	10000
		40	5000
		50	5000
	3000	25	5000
		31.5	5000
		40	5000
		50	5000
27	1200	16	5000
		25	5000
	2000	16	5000
			5000

# AMVAC breaker

## Dimensions and weight

Voltage class	Continuous current	Short circuit current	Height	Width	Depth	Weight
kV	A	kA	in	in	in	lb
5	1200	25	28	31	27	334
		31.5	28	31	27	334
		40	28	31	27	410
		50	28	31	27	410
	2000	25	28	31	27	419
		31.5	28	31	27	419
		40	28	31	27	419
		50	28	31	27	419
	3000	25	28	31	27	459
		31.5	28	31	27	459
		40	28	31	27	459
		50	28	31	27	459
8.25	1200	40	28	31	27	410
	2000	40	28	31	27	419
	3000	40	28	31	27	459
15	1200	25	28	31	27	334
		31.5	28	31	27	334
		40	28	31	27	410
		50	28	31	27	430
	2000	25	28	31	27	419
		31.5	28	31	27	419
		40	28	31	27	419
		50	28	31	27	430
	3000	25	28	31	27	459
		31.5	28	31	27	459
		40	28	31	27	459
		50	28	31	27	481
27	1200	16	30	31	27	410
		25	30	31	27	410
	2000	16	30	31	27	419
			30	31	27	419

# AMVAC breaker

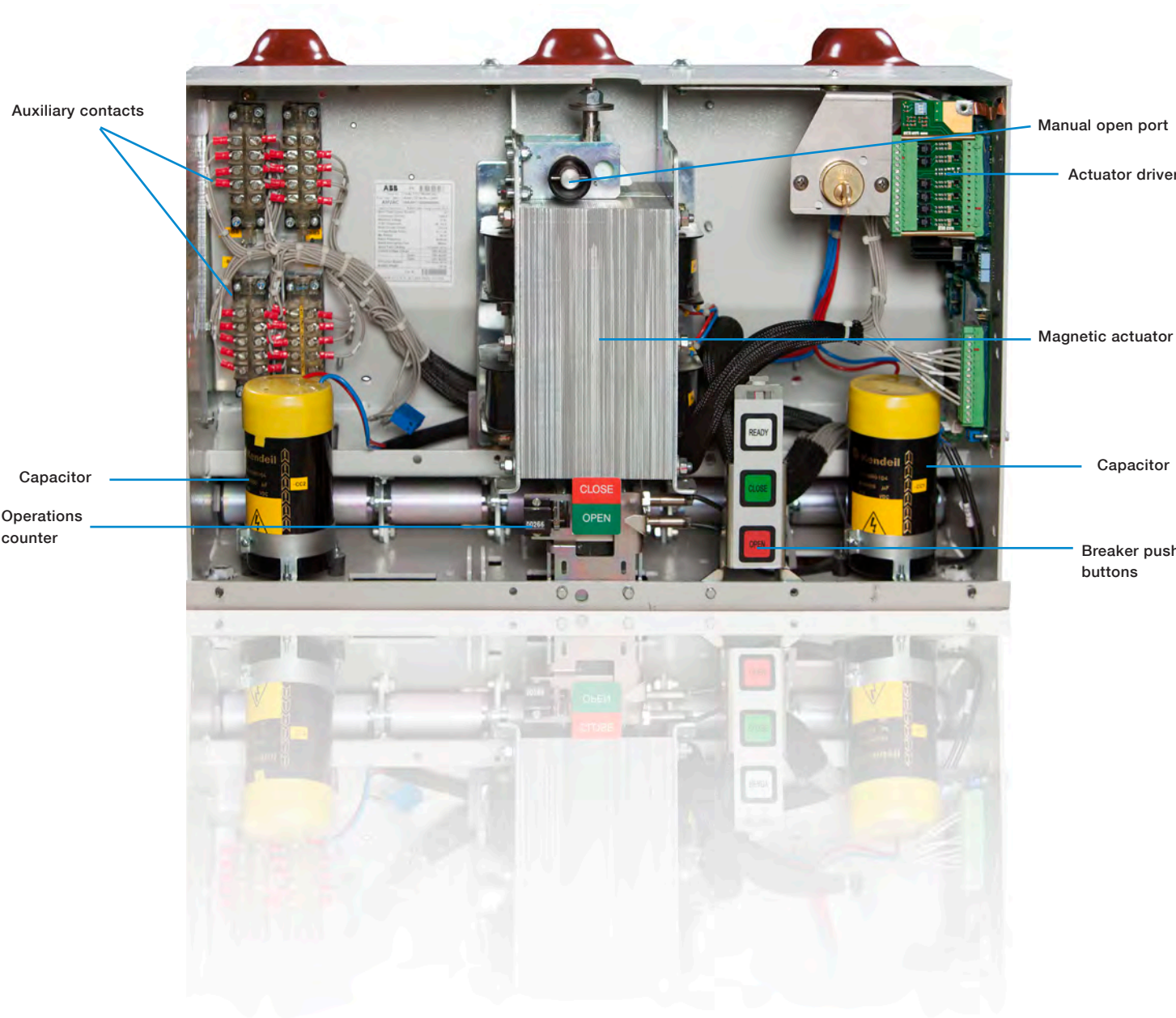
## Power requirements and auxiliary switch ratings

Power requirements	
	Actuator driver
Standby	10 W
Capacitor charging	100 W
Trip/close	0.25 W

Auxilliary contacts	Nominal control power voltage					
	24 Vdc	48 Vdc	125 Vdc	250 Vdc	120 Vac	240 Vac
Rated carrying current	10 A	10 A	10 A	10 A	10 A	10 A
Rated breaking current	10 A	7.6 A	4.4 A	1.8 A	2.6 A	2.3 A
Maximum breaking current	12 A	10 A	6 A	0 A	26 A	23 A

# AMVAC breaker

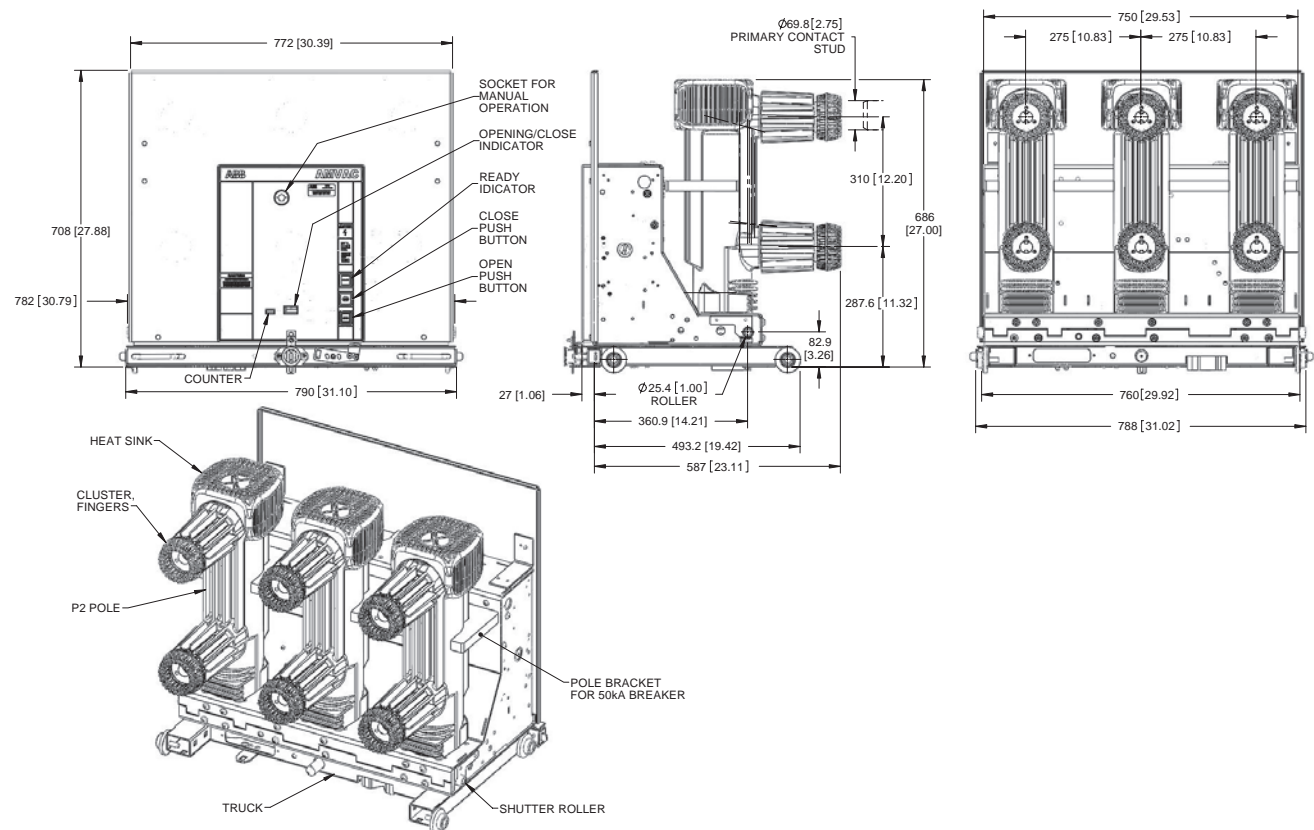
## Internal diagram





# AMVAC breaker

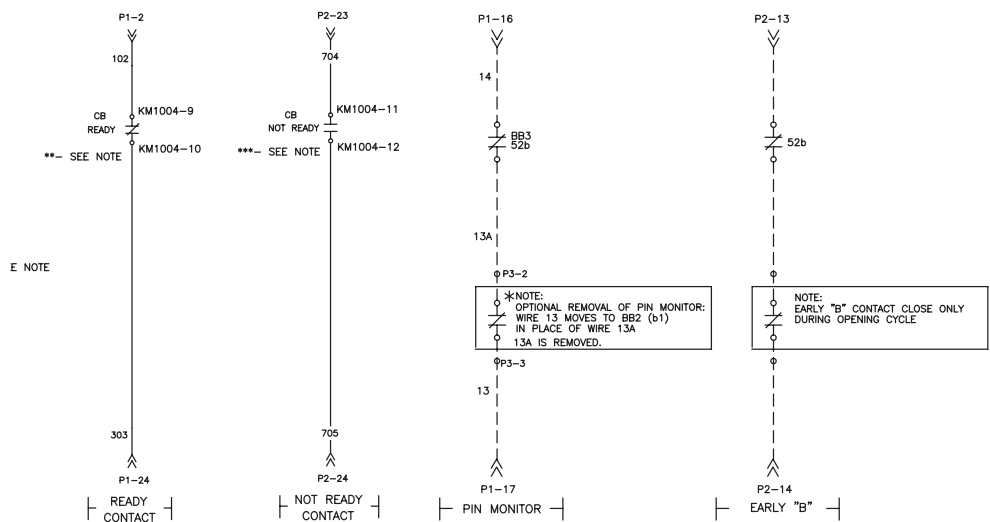
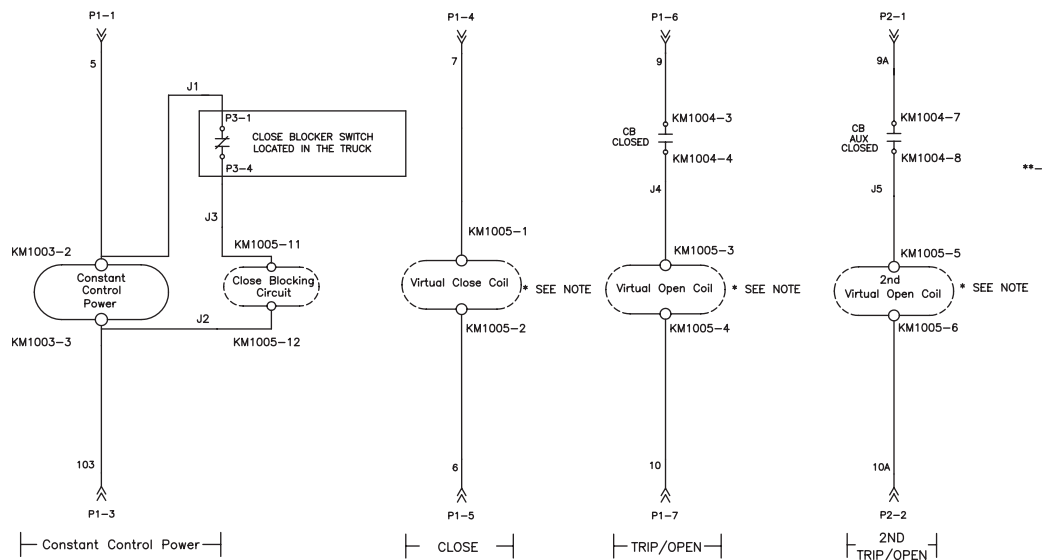
## Outline drawing



# AMVAC breaker

## Schematic drawing

AMVAC circuit breakers are supplied with dual secondary disconnects, which includes 9 normally open “a” contacts and 8 normally closed “b” contacts.





Technical guide

# Vmax/A™

## 5/15 kV ANSI/IEC spring mechanism vacuum circuit breaker

Power and productivity  
for a better world™



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# Vmax/A circuit breaker

## General overview

### Vmax/A ANSI circuit breaker

Compliant with IEEE C37.04, C37.09, the Vmax/A is a reliable, light-weight, and flexible breaker used in the ReliaGear ND platform. The Vmax/A breaker features a modular, easy to maintain design with only a single screw to remove the smart coil assembly and the spring charge motor. Using this design, maintenance time on breakers is greatly reduced - lowering maintenance costs and limiting employees' exposure to the switchgear, thereby increasing personnel safety.

The Vmax/A breaker's lightweight design, with optional roll-on-the-floor wheels, provides direct roll-in access to lower breaker cubicles without the use of a lift truck for convenient removal and insertion of breaker elements.



### Vmax/A breaker ratings

Voltage (kV)	Main bus	Isc (kA)	Interrupt	Close & latch	BiL	Low frequency withstand
5	1200	25	25	65	60	19
		31.5	31.5	82	60	19
	2000	25	25	65	60	19
		31.5	31.5	82	60	19
15	1200	25	25	65	95	36
		31.5	31.5	82	95	36
	2000	25	25	65	95	36
		31.5	31.5	82	95	36

# Vmax/A circuit breaker

## Ratings tables

### Timing characteristics

Voltage (kV)	Continuous current (A)	Short circuit current (kA)	Interrupt time (cycles)	Closing time (cycles)
5	1200	25	3	5
		31.5	3	5
	2000	25	3	5
		31.5	3	5
15	1200	25	3	5
		31.5	3	5
	2000	25	3	5
		31.5	3	5

Total interrupting time consists of opening time plus the time required for arc interruption. Total interrupt time is 50 ms or less for 3 cycle breakers and 83 ms or less for 5 cycle breakers.

### Mechanical endurance ratings

Parameter	5 kV	15 kV
No load mechanical operations	10,000	10,000
Operations between servicing	2,000	2,000

### Dimensions and weights

Voltage (kV)	Continuous current (A)	Short circuit current (kA)	Height (in/mm)	Width (in/mm)	Depth (in/mm)	Weight (lb/kg)
5	1200	25	26.07/662.2	19.37/492	26.05/662	215.6/98
		31.5	26.07/662.2	19.37/492	26.05/662	215.6/98
	2000	25	26.07/662.2	19.37/492	26.05/662	215.6/98
		31.5	26.07/662.2	19.37/492	26.05/662	215.6/98
15	1200	25	26.07/662.2	19.37/492	26.05/662	215.6/98
		31.5	26.07/662.2	19.37/492	26.05/662	215.6/98
	2000	25	26.07/662.2	19.37/492	26.05/662	215.6/98
		31.5	26.07/662.2	19.37/492	26.05/662	215.6/98

# Vmax/A circuit breaker

## Power requirements

Tripping (-MO1 & -MO2) coils	Nominal control power voltage					
	24 Vdc	48 Vdc	125 Vdc	250 Vdc	120 Vac	240 Vac
-MO1 launch current	8.5 A	4.5 A	2.0 A	1.0 A	2.0 A	1.0 A
-MO1 launch duration	100 ms	100 ms	100 ms	100 ms	100 ms	100 ms
-MO1 hold current	250 mA	150 mA	50 mA	50 mA	50 mA	50 mA
-MO2 launch current	8.5 A	4.5 A	2.0 A	1.0 A	2.0 A	1.0 A
-MO2 launch duration	100 ms	100 ms	100 ms	100 ms	100 ms	100 ms
-MO2 hold current	250 mA	150 mA	50 mA	50 mA	50 mA	50 mA
Operating range	14 - 28 Vdc	28 - 56 Vdc	70 - 140 Vdc	140 - 280 Vdc	104 - 127 Vac	208 - 254 Vac
1 min Low freq. withstand	1500 V	1500 V	1500 V	1500 V	1500 V	1500 V

Closing (-MC) coils	Nominal control power voltage					
	24 Vdc	48 Vdc	125 Vdc	250 Vdc	120 Vac	240 Vac
-MC launch current	5.45 A	4.5 A	2.0 A	1.0 A	2.0 A	1.0 A
-MC launch duration	150 ms	150 ms	150 ms	150 ms	150 ms	150 ms
-MC hold current	750 mA	150 mA	50 mA	50 mA	50 mA	50 mA
Operating range	18-28 Vdc	36 - 56 Vdc	100 - 140 Vdc	200 - 280 Vdc	104 - 127 Vac	208 - 254 Vac
1 min Low freq. withstand	1500 V	1500 V	1500 V	1500 V	1500 V	1500 V

UnderVoltage (-MU) coil	Nominal control power voltage					
	24 Vdc	48 Vdc	125 Vdc	250 Vdc	120 Vac	240 Vac
-MU launch current	8.5 A	4.5 A	2.0 A	1.0 A	2.0 A	1.0 A
-MU launch duration	100 ms	100 ms	100 ms	100 ms	100 ms	100 ms
-MU hold current	250 mA	150 mA	50 mA	50 mA	50 mA	50 mA
-MU dropout (trip)	8 - 17 Vdc	17 - 34 Vdc	44 - 88 Vdc	88 - 175 Vdc	42 - 84 Vac	84 - 168 Vac
-MU reset	20 - 26 Vdc	41 - 53 Vdc	106 - 138 Vdc	213 - 275 Vdc	102 - 132 Vac	204 - 264 Vac
Operating time	30 ms	30 ms	30 ms	30 ms	30 ms	30 ms
1 min Low freq. withstand	1500 V	1500 V	1500 V	1500 V	1500 V	1500 V

Spring charging motor	Nominal control power voltage					
	24 Vdc	48 Vdc	125 Vdc	250 Vdc	120 Vac	240 Vac
Motor ( $\leq$ 40 kA) inrush amps	2.5 A	12.5 A	5.0 A	2.5 A	5.0 A	2.5 A
Motor ( $\leq$ 40 kA) inrush duration	0.2 sec	0.2 sec	0.2 sec	0.2 sec	0.2 sec	0.2 sec
Motor ( $\leq$ 40 kA) run amps	8.37 A	4.5 A	2.0 A	1.0 A	2.0 A	1.0 A
Motor ( $\leq$ 40 kA) run time	6-7 s	6 - 7 s	6 - 7 s	6 - 7 s	6 - 7 s	6 - 7 s
Motor (50 kA) inrush amps	37.5 A	19.0 A	7.5 A	4.0 A	7.5 A	4.0 A
Motor (50 kA) inrush duration	0.2 s	0.2 sec	0.2 sec	0.2 sec	0.2 sec	0.2 sec
Motor (50 kA) run amps	14.58 A	7.5 A	3.0 A	1.5 A	3.0 A	1.5 A
Motor (50 kA) run time	6-7 s	6 - 7 s	6 - 7 s	6 - 7 s	6 - 7 s	6 - 7 s
Operating range	18-28- Vdc	36 - 56 Vdc	100 - 140 Vdc	200 - 280 Vdc	104 - 127 Vac	208 - 254 Vac
1 min Low freq. withstand	1500 V	1500 V	1500 V	1500 V	1500 V	1500 V

Auxiliary switch ratings - wiping contact rotary switch	
UN	Rate current (A)
24 VDC	20
48 VDC	20
100 DVC	15
250 VDC	8

# Vmax/A circuit breaker

## Construction

### EL-mechanism

The EL-mechanism is used in many breakers across ABB's portfolio, thereby reducing required spare parts inventory. By using the EL-mechanism, the ADVAC breaker maintains a lightweight, modular design that is easy to maintain in the case of normal maintenance or repair.

The EL-mechanism also features a mechanical anti-pump device to eliminate reliance on electrical anti-pump devices

By utilizing a modular design featuring the EL-mechanism, the ADVAC breaker has a quick change trip/close coil and charge motor design that makes repair of these commonly repaired parts easy.

For breaker rebuilds or repairs, the entire EL-mechanism can be removed and replaced in under an hour.

### Smart coils

ADVAC breakers feature smart coils with on-board microprocessors that monitor for coil continuity, over-current and over temperature scenarios and provide a more efficient response than standard coils. Options for a second open coil or under-voltage coil are also available.

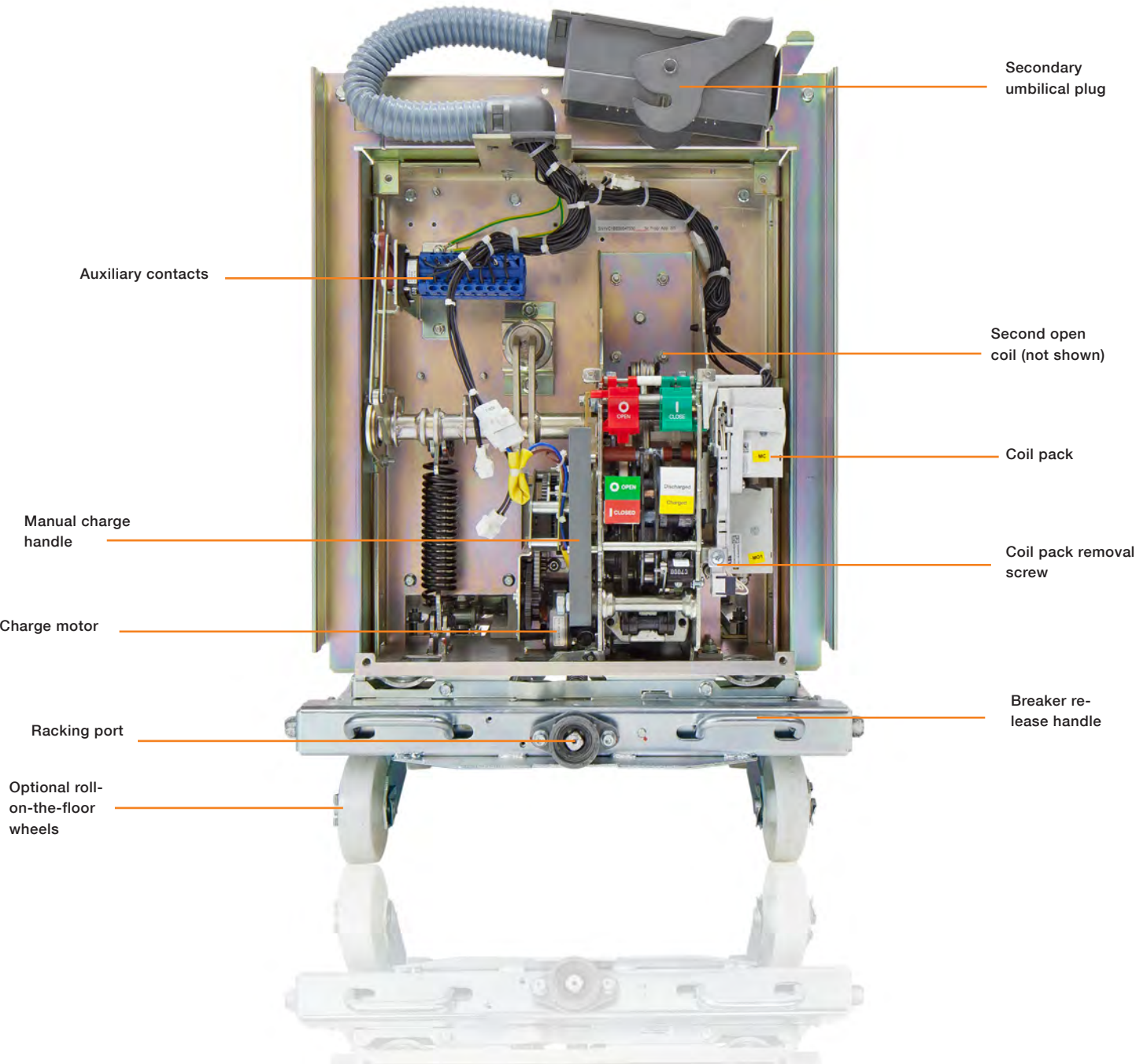


EL-mechanism



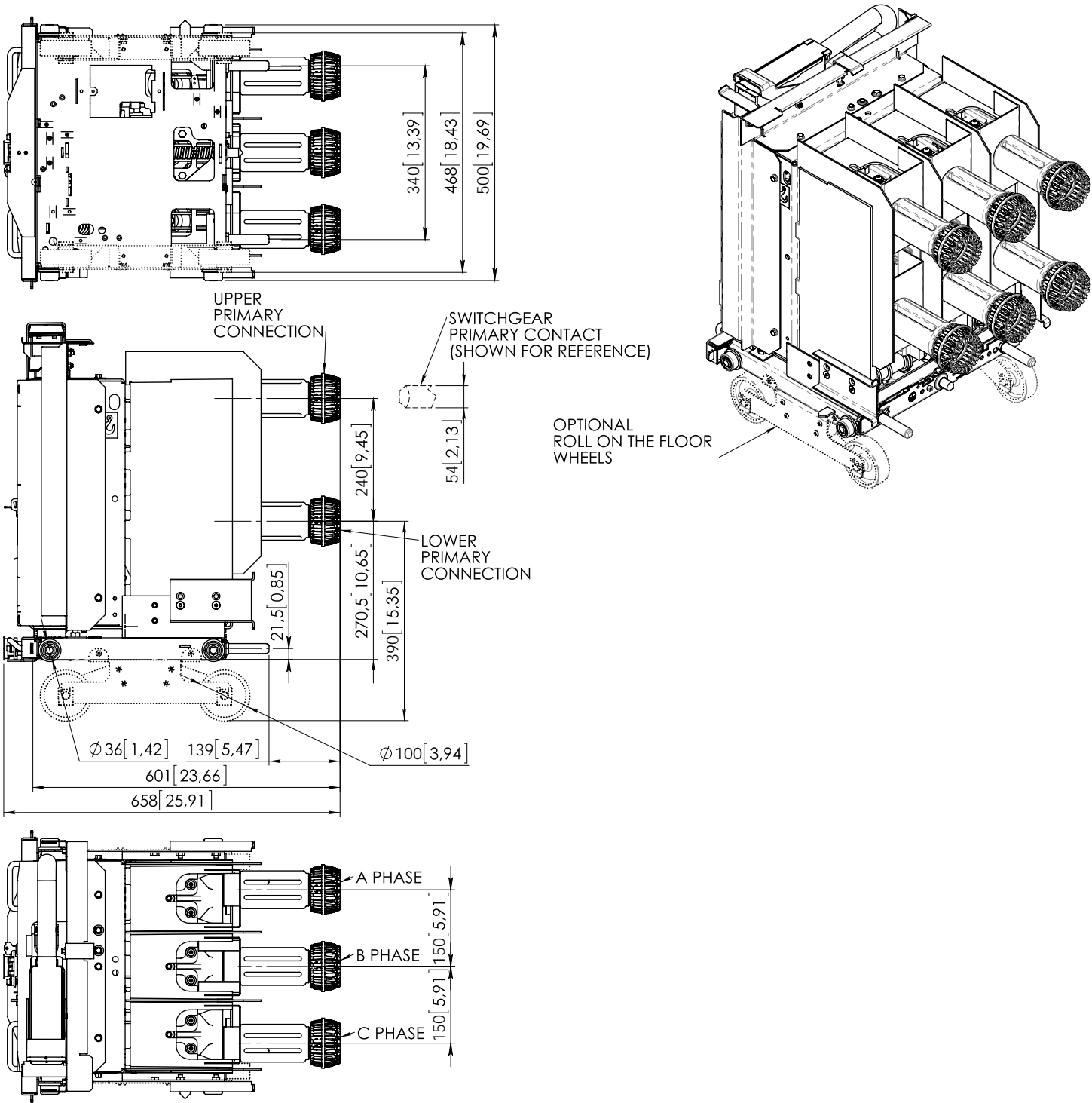
# Vmax/A circuit breaker

## Internal diagram



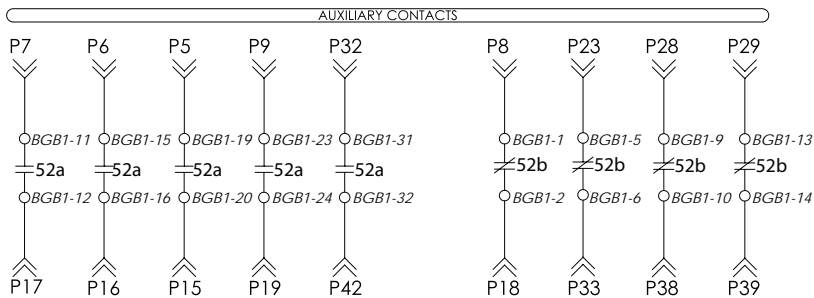
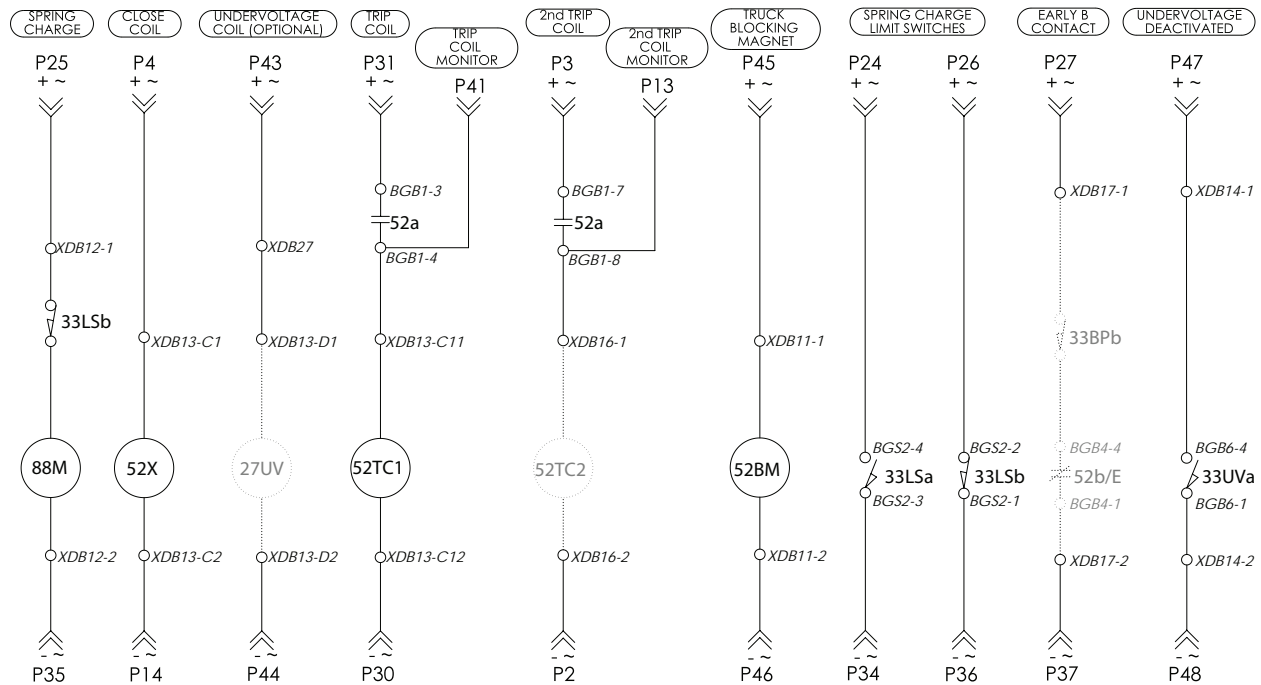
# Vmax/A circuit breaker

## Outline drawing



# Vmax/A circuit breaker

## Schematic drawing



- NOTES:
- 1.) SECOND TRIP/OPEN AND UNDERVOLTAGE ARE OPTIONAL AS ADDITIONAL COILS WIRING TO PLUG IS STANDARD.
  - 2.) SCHEMATIC SHOWS BREAKER IN OPEN AND CHARGED CONDITION  
52a IS OPEN WHEN BREAKER IS OPEN  
52b IS CLOSED WHEN BREAKER IS OPEN  
33LSa IS OPEN WHEN BREAKER IS DISCHARGED  
33LSb IS CLOSED WHEN BREAKER IS DISCHARGED
  - 3.) 88M: CHARGING MOTOR  
52X: CLOSE COIL  
52TC1: TRIP COIL  
52TC2: 2ND TRIP COIL (OPTIONAL)  
52BM: TRUCK BLOCKING MAGNET  
27UV: UNDERVOLTAGE (OPTIONAL)  
33LS: CLOSING SPRING CHARGE LIMIT SWITCH  
33BP: EARLY B MANUAL PUSHBUTTON BYPASS  
52a, 52b: AUXILIARY CONTACTS
- : CUSTOMER SWITCHGEAR CONNECTION  
—: ELECTRICAL CONNECTION  
.....: OPTIONAL CONNECTIONS
- 4) 52b/E: EARLY B CONTACT: CLOSING BY MECHANICAL INTERFACE TO THE MAIN SHAFT, CONTACT CLOSING MOMENTARILY AT THE BEGINNING OF THE OPENING OF THE BREAKER.  
5) REF: 2RGA024891P0001



Technical and application guide

# Switchgear Components and accessories

Power and productivity  
for a better world™



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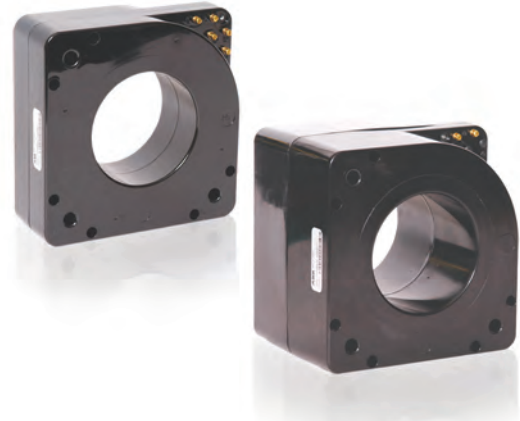
# Instrument transformers

## Current transformers - SAB-1, SAB-1D, SAB 2, SAB 2D

### 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 (SABs) are 3.5 inches deep, and up to four of these CTs can be installed for each phase (two on each bushing).

High accuracy CTs (SAB-Ds) 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.



Primary ampere rating	IEEE metering accuracy					IEEE	Style number
	B-0.1	B-0.2	B-0.5	B-0.9	B-1.8	Relaying accuracy	
SAB-1 (5.25" window)							
50	2.4	4.8	-	-	-	C10	923A329G01
75	1.2	2.4	4.8	-	-	C10	923A329G02
100	1.2	2.4	4.8	-	-	C20	923A329G03
150	0.6	0.6	1.2	2.4	4.8	C20	923A329G04
200	0.3	0.3	0.6	1.2	2.4	C50	923A329G05
250	0.3	0.3	0.6	1.2	1.2	C50	923A329G06
300	0.3	0.3	0.3	1.2	1.2	C50	923A329G07
400	0.3	0.3	0.3	0.3	0.6	C100	923A329G08
500	0.3	0.3	0.3	0.3	0.6	C100	923A329G09
600	0.3	0.3	0.3	0.3	0.3	C100	923A329G10
800	0.3	0.3	0.3	0.3	0.3	C100	923A329G11
1000	0.3	0.3	0.3	0.3	0.3	C100	923A329G12
1200	0.3	0.3	0.3	0.3	0.3	C200	923A329G13
1500	0.3	0.3	0.3	0.3	0.3	C200	923A329G14
2000	0.3	0.3	0.3	0.3	0.3	C200	923A329G15
2500	0.3	0.3	0.3	0.3	0.3	C400	923A329G16
3000	0.3	0.3	0.3	0.3	0.3	C400	923A329G17
4000	0.3	0.3	0.3	0.3	0.3	C400	923A329G18
5000	0.3	0.3	0.3	0.3	0.3	C400	923A329G19
Multi-ratio, IEEE, 5 terminals							
600	0.3	0.3	0.3	0.3	0.6	C100	923A329G20
1200	0.3	0.3	0.3	0.3	0.3	C200	923A329G21
2000	0.3	0.3	0.3	0.3	0.3	C200	923A329G22
3000	0.3	0.3	0.3	0.3	0.3	C400	923A329G23
4000	0.3	0.3	0.3	0.3	0.3	C400	923A329G24
5000	0.3	0.3	0.3	0.3	0.3	C400	923A329G25

Primary ampere rating	IEEE metering accuracy					IEEE	Style number
	B-0.1	B-0.2	B-0.5	B-0.9	B-1.8	Relaying accuracy	
SAB-1D (5.25" window)							
50	2.4	4.8	-	-	-	C20	923A331G01
75	1.2	2.4	4.8	-	-	C20	923A331G02
100	0.6	1.2	2.4	-	-	C50	923A331G03
150	0.3	0.6	1.2	4.8	4.8	C50	923A331G04
200	0.3	0.6	1.2	1.2	2.4	C100	923A331G05
250	0.3	0.3	0.6	1.2	2.4	C100	923A331G06
300	0.3	0.3	0.3	0.6	1.2	C100	923A331G07
400	0.3	0.3	0.3	0.6	1.2	C200	923A331G08
500	0.3	0.3	0.3	0.3	0.6	C200	923A331G09
600	0.3	0.3	0.3	0.3	0.3	C200	923A331G10
800	0.3	0.3	0.3	0.3	0.3	C200	923A331G11
1000	0.3	0.3	0.3	0.3	0.3	C200	923A331G12
1200	0.3	0.3	0.3	0.3	0.3	C400	923A331G13
1500	0.3	0.3	0.3	0.3	0.3	C400	923A331G14
2000	0.3	0.3	0.3	0.3	0.3	C400	923A331G15
2500	0.3	0.3	0.3	0.3	0.3	C800	923A331G16
3000	0.3	0.3	0.3	0.3	0.3	C800	923A331G17
4000	0.3	0.3	0.3	0.3	0.3	C800	923A331G18
5000	0.3	0.3	0.3	0.3	0.3	C800	923A331G25
Multi-Ratio, IEEE, 5 Terminals							
600	0.3	0.3	0.3	0.3	0.3	C200	923A331G19
1200	0.3	0.3	0.3	0.3	0.3	C400	923A331G20
2000	0.3	0.3	0.3	0.3	0.3	C800	923A331G21
3000	0.3	0.3	0.3	0.3	0.3	C800	923A331G22
4000	0.3	0.3	0.3	0.3	0.3	C800	923A331G23
5000	0.3	0.3	0.3	0.3	0.3	C800	923A331G24

# Instrument transformers

## Current transformers - SAB-1, SAB-1D, SAB 2, SAB 2D

Primary ampere rating	IEEE metering accuracy					IEEE	Style number
	B-0.1	B-0.2	B-0.5	B-0.9	B-1.8	Relaying accuracy	
SAB-2 (6.5" window)							
1500	0.3	0.3	0.3	0.3	0.6	C200	923A330G01
2000	0.3	0.3	0.3	0.3	0.3	C200	923A330G02
2500	0.3	0.3	0.3	0.3	0.3	C200	923A330G03
3000	0.3	0.3	0.3	0.3	0.3	C200	923A330G04
4000	0.3	0.3	0.3	0.3	0.3	C200	923A330G05
5000	0.3	0.3	0.3	0.3	0.3	C200	923A330G06
Multi-ratio, IEEE, 5 terminals							
2000	0.3	0.3	0.3	0.3	0.3	C200	923A330G07
3000	0.3	0.3	0.3	0.3	0.3	C200	923A330G08
4000	0.3	0.3	0.3	0.3	0.3	C200	923A330G09
5000	0.3	0.3	0.3	0.3	0.3	C200	923A330G10

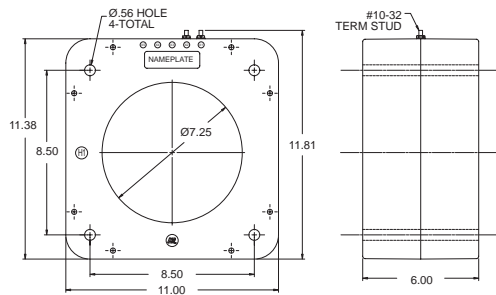
Primary ampere rating	IEEE metering accuracy					IEEE	Style number
	B-0.1	B-0.2	B-0.5	B-0.9	B-1.8	Relaying accuracy	
SAB-2D (6.5" window)							
1500	0.3	0.3	0.3	0.3	0.6	C400	923A332G01
2000	0.3	0.3	0.3	0.3	0.3	C400	923A332G02
2500	0.3	0.3	0.3	0.3	0.3	C400	923A332G03
3000	0.3	0.3	0.3	0.3	0.3	C400	923A332G04
4000	0.3	0.3	0.3	0.3	0.3	C400	923A332G05
5000	0.3	0.3	0.3	0.3	0.3	C400	923A332G06
Multi-ratio, IEEE, 5 terminals							
2000	0.3	0.3	0.3	0.3	0.3	C400	923A332G07
3000	0.3	0.3	0.3	0.3	0.3	C400	923A332G08
4000	0.3	0.3	0.3	0.3	0.3	C400	923A332G09
5000	0.3	0.3	0.3	0.3	0.3	C400	923A332G10

# Instrument transformers

## Current transformers - BYZ-S, BYZ-O, BYZ-L

### BYZ-S

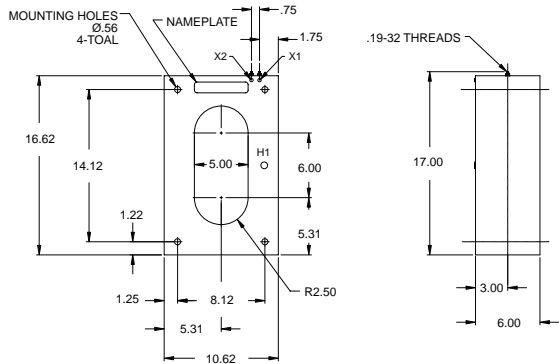
- 600 V indoor
- 10 kV BIL
- 60 Hz
- Mechanical rating: 180 x Normal



Primary current rating	Relaying accuracy	Thermal rating (x Normal, 1 sec)	Window diameter (in)	Weight (lb)
50	C10	100	7.25	52
100	C20	100	7.25	52

### BYZ-O

- 600 V indoor
- 10 kV BIL
- 60 Hz



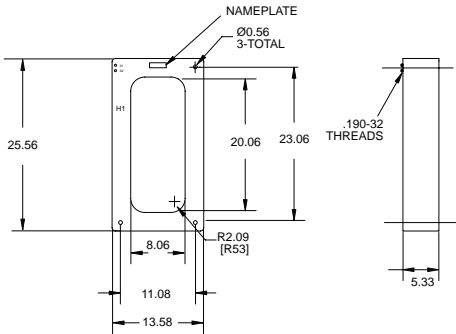
Primary current rating	Relaying accuracy	Thermal rating (x Normal, 1 sec)	Window diameter (in)	Weight (lb)
50	C20	100	5 x 10 oval	110
100	C50	100	5 x 10 oval	110



# Instrument transformers

## Current transformers - BYZ-S, BYZ-O, BYZ-L

- BYZ-L**
- 600 V indoor
  - 10 kV BIL
  - 60 Hz
  - Mechancial rating 180 x normal



Primary current rating	Relaying accuracy	Thermal rating (x Normal, 1 sec)	Window opening (in)	Weight (lb)
50	C10	100	8.06 x 20.06	150
75	C20	100	8.06 x 20.06	150
100	C30	100	8.06 x 20.06	150
150	C50	100	8.06 x 20.06	150
200	C50	100	8.06 x 20.06	150
300	C100	100	8.06 x 20.06	150
400	C100	100	8.06 x 20.06	150
500	C200	100	8.06 x 20.06	150

# Instrument transformers

## Potential transformers - VIY-60, VIZ-75, VIZ-11



PTs 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.

### Three phase, 60 Hz, 208/120 V secondary, 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	125	100:1, 120:1, 200:1	

1500 VA thermal at 30°C ambient  
1000 VA thermal at 55°C ambient

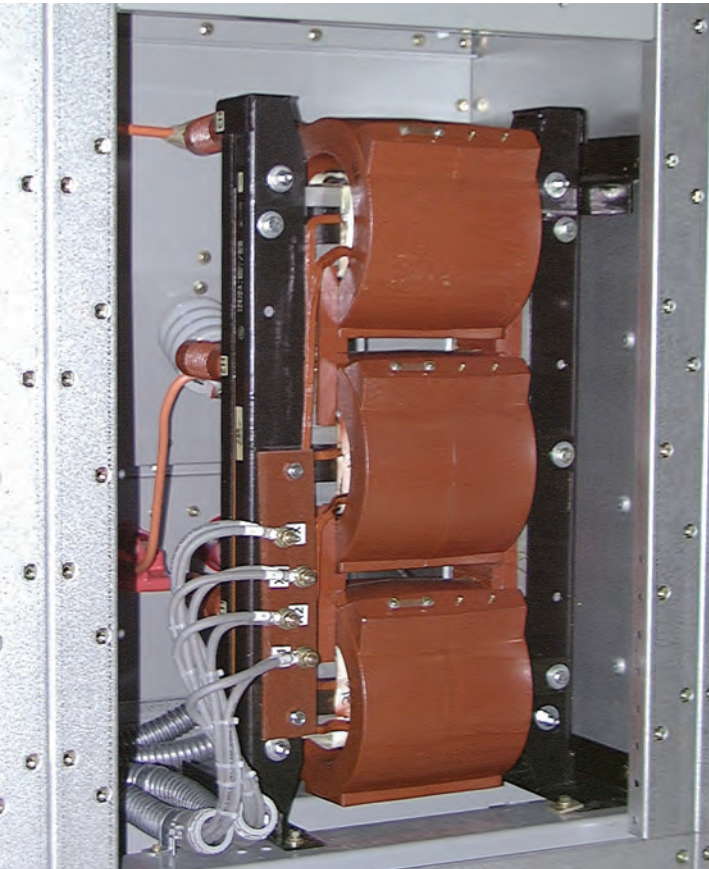
### PT Application Guide for Switchgear products

	5kV	8.25kV	15kV	27kV
Advance	VIY-60	VIZ-75/VIZ-11	VIZ-11	N/A
Advance 27	N/A	N/A	N/A	VIZ-12
SafeGear	VIY-60	VIZ-75/VIZ-11	VIZ-11	N/A
SafeGear HD	VIY-60	VIZ-75/VIZ-11	VIZ-11	N/A
ReliaGear ND	VIY-60	VIZ-75/VIZ-11	VIZ-11/TJC5*	N/A

\* In ReliaGear ND, VIZ-11 are used for open delta applications and TJC5 PTs are used for WYE-WYE configurations  
At all ratings, PT's are available in single phase, line-to-line or line-to-ground, and in 3-phase, open delta or wye-wye configurations.

# Instrument transformers

## Control power transformers



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
7200, 7620, 8320	95	3, 5, 10, 15, 25, 37.5, 50
12000, 12470, 13200, 13800	95	3, 5, 10, 15, 25, 37.5, 50
12000, 14400	125	3, 5, 10, 15, 25, 37.5, 50

Three phase, 60 Hz, 208/120 V secondary, epoxy - cast

Primary voltages	BIL kV	Available kVA
2400, 4160, 4800	60	9, 15, 30, 45
7200, 7620, 8320	95	9, 15, 30, 45
12000, 12470, 13200, 13800	95	9, 15, 30, 45

CPT application guide for switchgear products

	Drawout*	Fixed-1ph.	Fixed-3ph.
Advance	5, 10, 15kVA	25-50kVA	25-75kVA**
Advance 27	N/A	5-50kVA	N/A***
SafeGear	5, 10, 15kVA	25-50kVA	25-75kVA**
SafeGear HD	5, 10, 15kVA	25-50kVA	25-75kVA**
ReliaGear ND	5, 10, 15kVA	Contact Factory	Contact Factory

\* All CPT's in drawout unit are single phase only. Primary connections are standard phase-to-phase, with phase to ground optional

\*\* Maximum CPT size limited to CPT fuse drawout unit capacity

\*\*\* 3-phase CPT fuse drawout is available for remote mounted CPT's up to 75 kVA

# Accessories

## Lift truck, breaker test cabinet and test jumper

For maximum convenience, all withdrawable assemblies - circuit breakers, PTs, 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 PT and CPT/fuse drawouts.

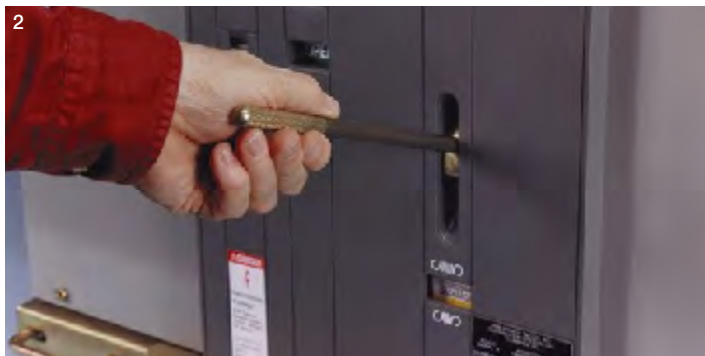
### Breaker test cabinet

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.

### 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.

1 Racking crank | 2 Charging handle (for 63 kA breakers only) | 3 Lift truck | 4 Test jumper | 5 Breaker test cabinet



# Accessories

## Advance and Safegear Ground and Test device (G&T)

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.

### Ground and Test device for SafeGear HD Safety, interlocking, insertion and withdrawal, and coordination features

#### Terminal sets barriers

The manual G&T device is equipped with a barrier designed to prevent access to the ungrounded terminal set. A padlocking (hasp) provision is provided as a secure means to prevent the barrier from being inadvertently moved and exposing the ungrounded terminal set.

#### Insertion and withdrawal

The device is able to be inserted and withdrawn from the circuit breaker compartment in the same manner as the circuit breaker, including use of the same lift truck and racking tools. The device is provided with a position indicator.

#### Coordination

The device is equipped with mechanical interlock that coordinates with the circuit breaker compartment. The device is blocked from being inserted into a circuit breaker compartment where the required ratings exceed those of the G&T device.

#### Grounding feature

The 15 kV manual G&T device is marketed for use with the ABB SafeGear HD platform. These devices are supplied when specified by the customer.

#### Terminal sets

The device features two terminal sets. One set is intended for grounding of the line side, and the other set for the load side. Only one set can be grounded at any time.

#### Grounding connection system

The device features a grounding connection system that operates with the use of grounding cables. The grounding cables and related hardware provided with the device satisfy the requirements of the design tests for the short time and momentary tests as required per IEEE C37.20.6.



#### Notes:

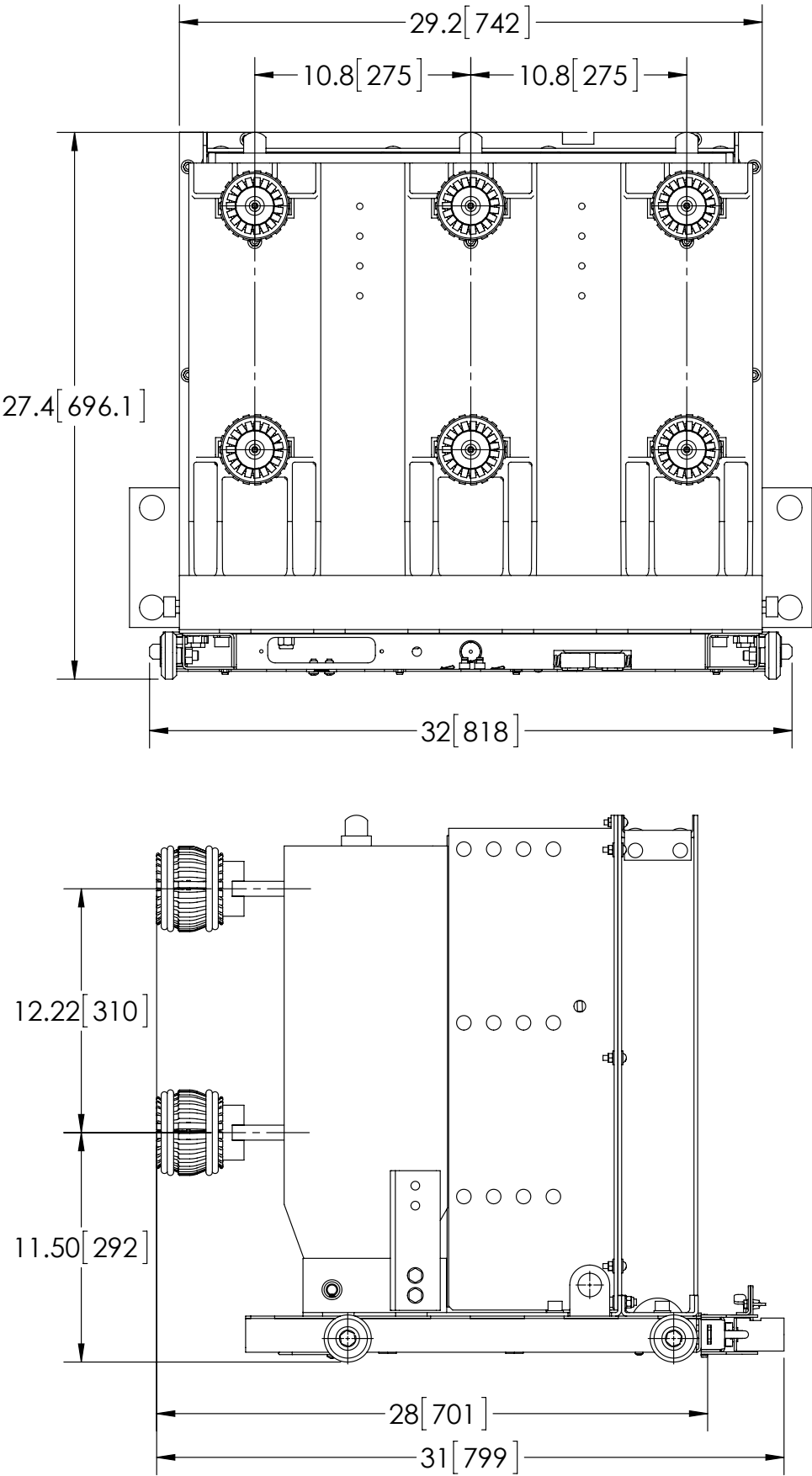
1. The device is for use with cells designed for ADVAC or AMVAC breakers.
2. Two sets of cables are furnished. The short set attaches to the lower terminal set, and the long set attaches to the upper terminal set.
3. This device is designed for use with only one set of cables attached to a terminal set 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.

#### Interrupting or closing capability

The ABB manual G&T device does not feature closing or interrupting. The device does not have a mechanism by which to open or close a circuit. 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.

Accessories

Ground and Test device (G&T) dimensions





# Accessories

## ReliaGear ND Ground and Test device (G&T)

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.

### Grounding feature

The 15 kV manual G&T device is for use with the ABB ReliaGear ND platform. These devices are supplied when specified by the customer.

### Insertion and withdrawal

The device is able to be inserted and withdrawn from the circuit breaker compartment in the same manner as the circuit breaker, including use of the same lift truck and racking tools. The device is provided with a position indicator.

### Coordination

The device is equipped with mechanical interlock that coordinates with the circuit breaker compartment. The device is blocked from being inserted into a circuit breaker compartment where the required ratings exceed those of the G&T device.

### Terminal sets

The device features two terminal sets. One set is intended for grounding of the line side, and the other set for the load side. Only one set can be grounded at any time.



### Notes:

1. The device is for use with cells designed for Vmax/A breakers.
2. Either the upper terminals are grounded through their cable set, or the lower terminals are grounded at any time.
3. 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.
4. Device cannot be stored in breaker compartments.

### Grounding connection system

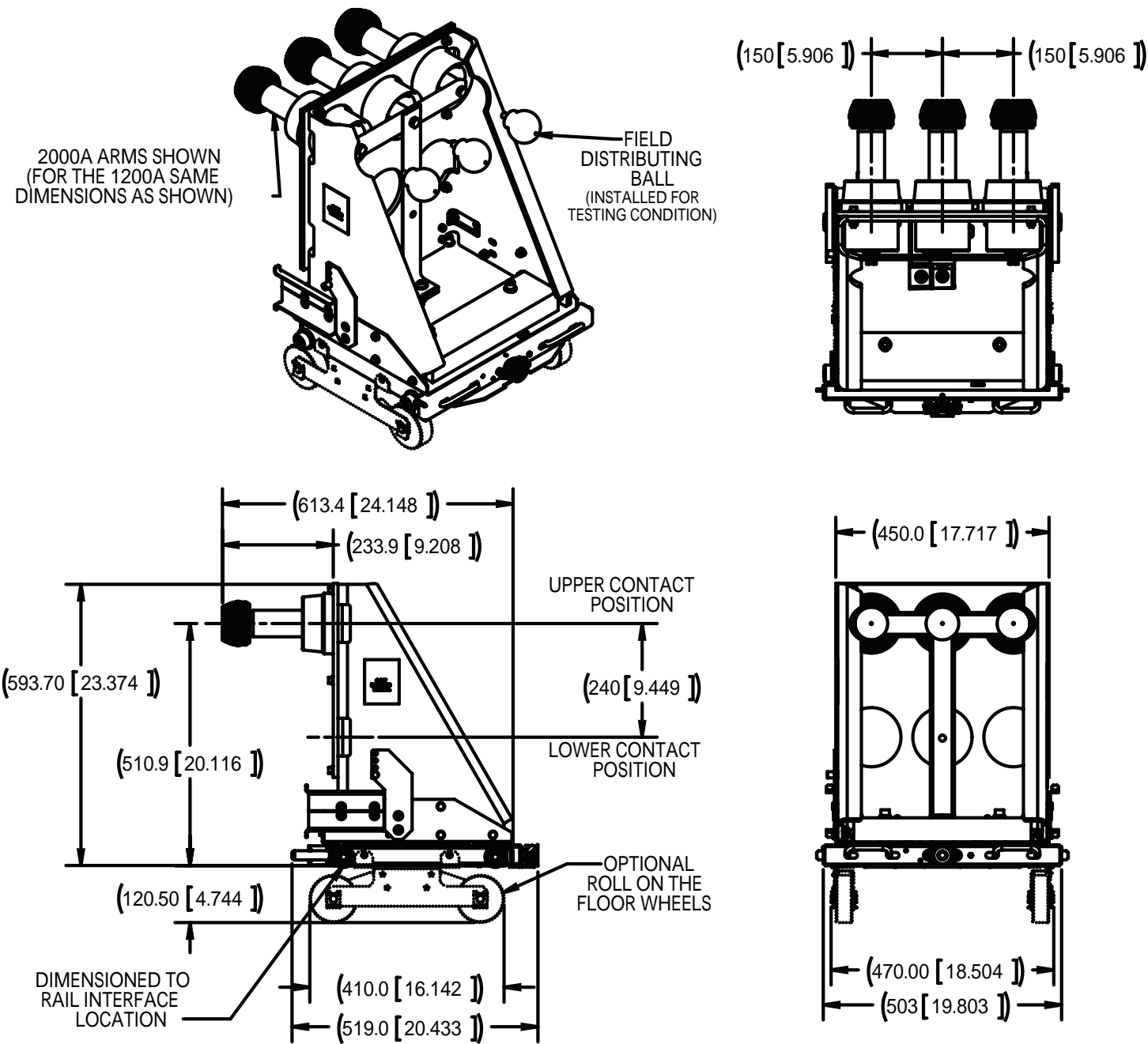
The device features a grounding connection system that operates with the use of grounding cables. The grounding cables and related hardware provided with the device satisfy the requirements of the design tests for the short time and momentary tests as required per IEEE C37.20.6.

### Interrupting or closing capability

The ABB manual G&T device does not feature closing or interrupting. The device does not have a mechanism by which to open or close a circuit. A single device can be used for both 1200 A and 2000 A compartments.

Accessories

ReliaGear ND Ground and Test device (G&T) dimensions





# SmartRack™ electrical remote racking device

The SmartRack™ electric remote racking device is intended to assist technicians with the process of racking ABB medium voltage circuit breakers and associated equipment. The main function of the device is to perform the racking operation with minimal manual interaction. This allows the operator of the device to maintain a significant distance between themselves and the circuit breaker while racking is performed as compared to the traditional hand-crank method of racking.

The SmartRack electric remote racking device is able to perform this complex task through the use of a programmable logic controller and servomotor. Throughout operation, the controller and motor are in constant communication allowing the device to accurately position a circuit breaker or other device in the switchgear cell. The racking device incorporates an actuator to operate the interlock lever which eliminates need for an additional unit to perform this task or for additional manual interaction.

### SmartRack Application Guide

The SmartRack remote racking device is designed to operate with the following devices.

	Breaker/ Contactor	G&T Device	PT Unit	CPT Unit	CPT Fuse Unit
Advance	X	X	X	X	X
Advance 27	X	X	X	X	X
SafeGear	X	X	X	X	X
SafeGear.HD	X	X	X	X	X
ReliaGear.ND	X	X	N/A	N/A	N/A
SafeGear MCC	X	N/A	N/A	N/A	N/A







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