Global Leader

ISO 9001 REGISTERED
MGMT.SYS.
RvA C024
DNV Certification B.V., The Netherlands

HVF & HAF

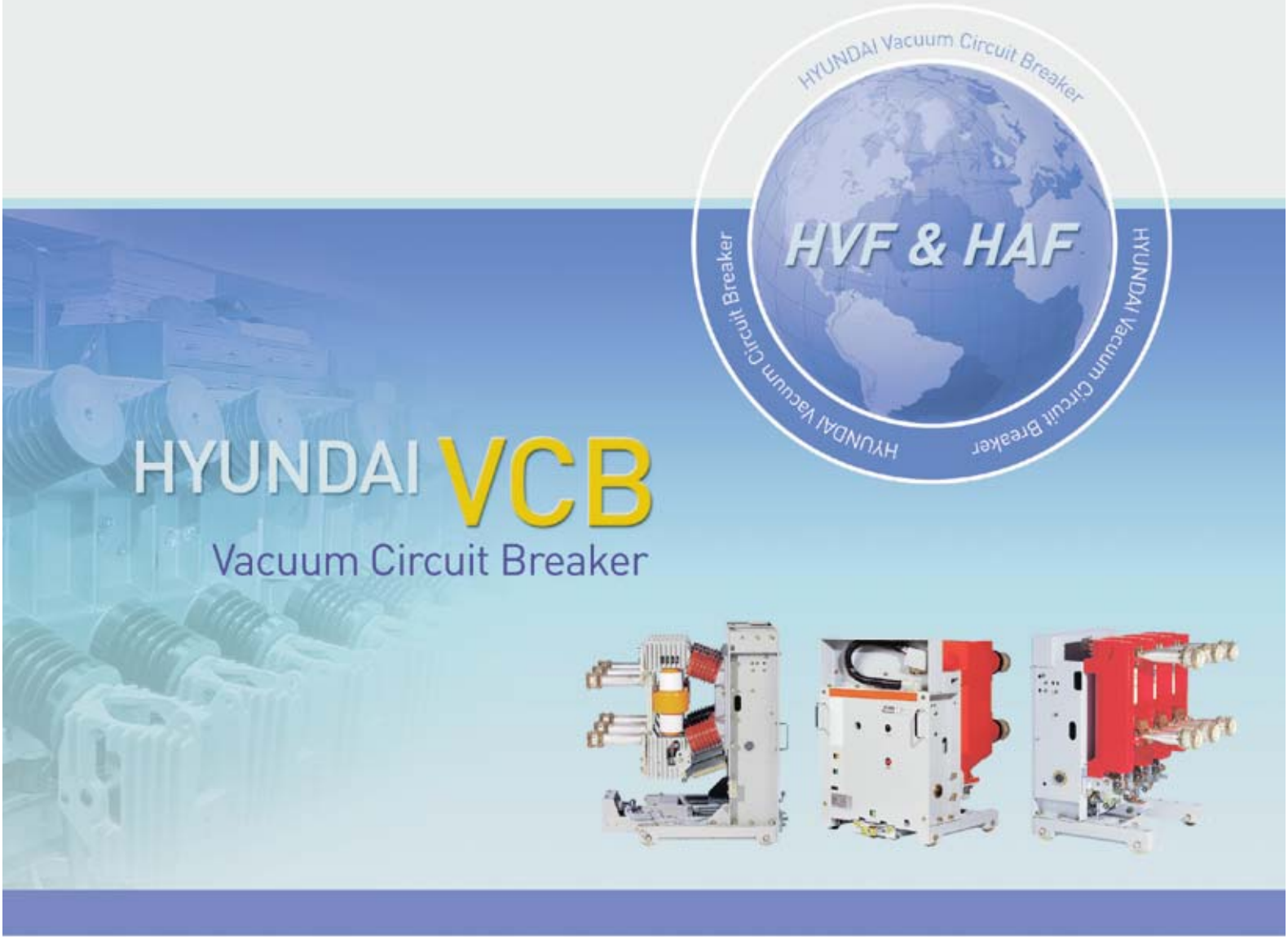
Vacuum Circuit Breaker

VCB

Vacuum
Circuit
Breaker

HYUNDAI
HEAVY INDUSTRIES CO.,LTD.

We build a better future!



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Description

HYUNDAI's HVF & HAF series vacuum circuit breakers are three-pole units designed for use in medium voltage indoor switchgears.

The breakers, including vacuum interrupters, are manufactured and fully tested according to IEC standards and other related standards by HYUNDAI in ISO 9001 certified facilities.

7.2 /12 kV,	up to 50 kA, up to 3150 A.
15 kV,	up to 40 kA, up to 3150 A.
24 kV,	up to 40 kA, up to 3150 A.
38 kV,	up to 40 kA, up to 3000 A.

Based on the advanced vacuum principle, the breakers retain high dielectric strength with only a small contact gap and have a greatly extended service life with maintenance-free features.

Greatly extended service lifetime

Rugged in construction with a minimum of moving parts, the HYUNDAI HVF & HAF vacuum circuit breaker operating mechanism features reduced maintenance requirements, providing a long life expectancy of 30,000 operations.

Because of the small amount of contact erosion, contact life is increased to 20,000 operations for the rated normal current.

Maintenance-free

The circuit breakers require little maintenance.

In fact, only the parts subject to normal wear and aging must be serviced to ensure fully reliable operation.

This involves simple jobs carried out by the customer's personnel with short servicing times and corresponding downtimes and also long operation periods between servicing.

Maintenance is confined to lubricating the operating mechanism.

The vacuum interrupters and their supports need not be serviced.

No contact degradation

Contact resistance is not effected significantly by switching operations and remains constant with the help of applied contact pressure.

Additionally, the contacts cannot be oxidized.

Moisture and contamination residues cannot form on contacts within the hermetically sealed vacuum interrupter.

As a result, contacts remain metallically clean, and dielectric strength at the open contact gap is kept in good condition.

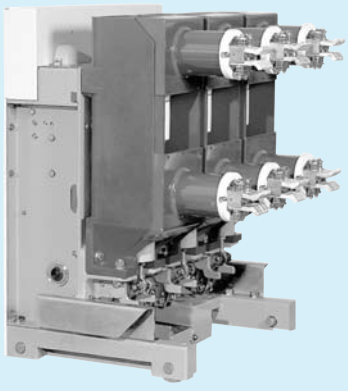


Fig. 1 HVF vacuum circuit breaker (12 kV 40 kA 1250 A)

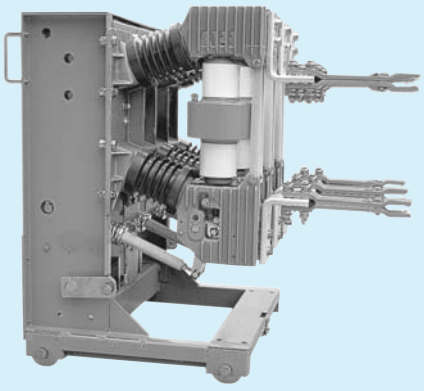


Fig. 2 HAF vacuum circuit breaker (7.2 kV 40 kA 1250 A)

Application

Applicable standards

HYUNDAI HVF & HAF vacuum circuit breakers fully meet all requirements of IEC publication 60056, and also of BS 5311, VDE 0670, ANSI C37 and ESB 150 for some types.

Rapid load transfer, synchronizing & operating duty

With its consistent short closing and opening times, the HYUNDAI HVF & HAF series is especially beneficial in load transfer from one circuit to another without interruption of service.

This high-speed operation synchronizes the systems so that they are parallel at the moment of contact closure.

According to the relevant standards and breaker types, tests were carried out for the following operating duties:

CO-15 S-CO
O-3 min-CO-3 min-CO
O-0.3 S-CO-3 min-CO (for auto-reclosing)

Switching of overhead transmission lines and cables

The relatively small capacitive currents of the overhead transmission lines and cables under no-load are safely interrupted without reignition and thus without overvoltage development.

Switching of capacitors

The vacuum circuit breakers are particularly suitable for switching capacitive circuits.

They are capable of switching capacitors up to the highest bank ratings without restrike and thus without overvoltages occurring.

Capacitive currents of up to 400 A can generally be interrupted.

When capacitors are connected in parallel, currents which have the same level as short-circuit currents can occur which, due to their high rate of rise, can cause damage to the system components.

Making currents up to a peak value of 10 kA is permissible.

Switching unloaded transformers

By using special contact materials, the chopping current of the vacuum circuit breakers is only 4 A to 5 A.

This means that no dangerous overvoltages arise when unloaded transformers are disconnected.

Switching of motors

HYUNDAI HVF & HAF vacuum circuit breakers can be used economically for controlling motors with their high number of switching operations at rated normal currents in conjunction with high-voltage motors.

If small high-voltage motors are shut down during start-up, switching surge may occur.

This affects high-voltage motors with a starting current of up to 600 A.

The level of these overvoltages can be reduced to safe values by means of surge limiters.

Interruption of short-circuit currents with very high rate of rise of TRV

The faults immediately behind transformers, generators, or current-limiting chokes may cause full short-circuit current development.

The rate of rise of transient recovery voltage is predictable up to 10 kV/μs or even higher when fault occurs behind chokes.

This hostile condition also can be easily handled by the vacuum circuit breakers.

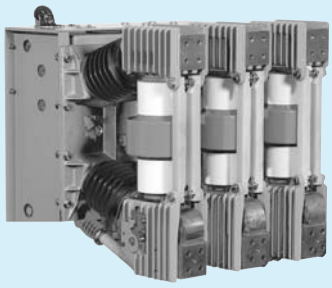


Fig. 3 HAF vacuum circuit breaker

Selection Guide

HVF Type (HVF□□□□①)

Rated Voltage (kV)	Rated Breaking Current (kA)	Impulse Withstand Voltage (kV)	Rated Curent (A)					Applied Standard
			630	1250	2000	2500	3150	
7.2	25	60	1041	1042	1044			IEC60056
	31.5		1051	1052	1054			
	40			1062	1064		1067	
12	25	75	2041	2042	2044			
	31.5	75 (95③)	2051	2052	2054	2056		
	40			2062	2064		2067	
	50			2072	2074		2077	
24	12.5	125	6011	6012				
	25		6041	6042	6044			
	31.5			6052	6054	6056		
	40	150		6062	6064		6067	
38	31.5	150 (170③)		7052	7054		7057	ANSI C37
	40			7062	7064		7067	

HAF Type (HAF□□□□-□①)

Rated Voltage (kV)	Rated Breaking Current (kA)	Impulse Withstand Voltage (kV)	Rated Curent (A)					Applied Standard	Previous Type No.②
			630	1250	2000	2500	3150		
4.76	50	60		1072	1074		1077	ANSI C37	-
7.2	25	60	1041	1042	1044			IEC 60056	3AF104 □
	31.5		1051	1052	1054	1056			3AF105 □
	40			1162	1164	1166	1167	IEC 60056 ESB 150	3AF116 □
	50			1172		1176	1177	IEC 60056	3AF117 □
12	25	75	1541	1542	1544			IEC 60056	3AF154 □
	31.5		1751	1752	1754	1756			3AF175 □
	40			1762	1764	1766	1767		3AF176 □
	50			1772		1776	1777		3AF177 □
15	25	95	2341	2342	2344	2346			3AF234 □
	31.5		2351	2352	2354	2356			3AF235 □
	40			2362	2364	2366	2367	IEC 60056 ANSI C37	3AF236 □
24	12.5	125	6111	6112				IEC 60056	3AF611 □
	16		6121	6122					3AF612 □
	20		6131	6132	6134				3AF613 □
	25		6141	6142	6144	6146		IEC 60056 ESB 150	3AF614 □

①Type no. suffix in the square "□" shall be listed as shown in the line of rated current.
②Type test report of 3AF type VCB which has been tested with previous type no. is still valid for HAF type.
③Impulse withstand voltage in "( )" is available on request.

Arc-quenching System

A metal-vapor arc discharge in the vacuum is initiated by the current to be interrupted as the contacts open.
A current flows through this metal-vapor plasma until the next zero transition.
The arc extinguishes in the vicinity of the current zero and the conductive metal-vapor condenses within a few microseconds on the metal surfaces.
As a result, the dielectric strength in the contact gap is rapidly rebuilt.

The rapid build-up of the dielectric strength at the contact gap enables the arc to be safely extinguished even if contact separation takes place shortly before a current zero transition.
The maximum arcing time for the last pole to clear is therefore only up to 15 ms.

The metal vapor arc discharge can only be maintained if a certain minimum current flows.
A current that does not attain this level can be chopped prior to current zero.

This chopping current must be kept to a minimum in order to prevent build-up of unduly high overvoltages when inductive circuits are switched.
The use of a special contact material of sintered CrCu ensures that current chopping is limited to 4-5 A.

The geometry and size of the contact are designed differently according to breaking current and interrupter type.

Radial magnetic field contact

The arc is constricted when large currents of more than 10 kA are interrupted.
To prevent local overheating of the contacts from the constricted arc, they are designed so that the arc does not stand still on one point of the contact surface.
The radial magnetic field caused by contact geometry keeps it travelling around the arcing ring of the contact piece.

Axial magnetic field contact

Axial magnetic field causes the arc not to be constricted even at high current value.
Therefore, the stress on the disc-shaped contact surfaces is uniform and any melting is avoided.

The arc for all conventional arc-quenching methods must be cooled even before the contacts have reached the minimum quenching distance and before the arc energy.
The arc drawn in the vacuum breaker, on the other hand, is not cooled since the metal vapor plasma is highly conductive and the resulting arc voltage only attains values between 20 V and 200 V.

For this reason and because of short arcing times, the arc energy developed in the breaker is very small.
This also accounts for the long electrical life of the vacuum breakers.

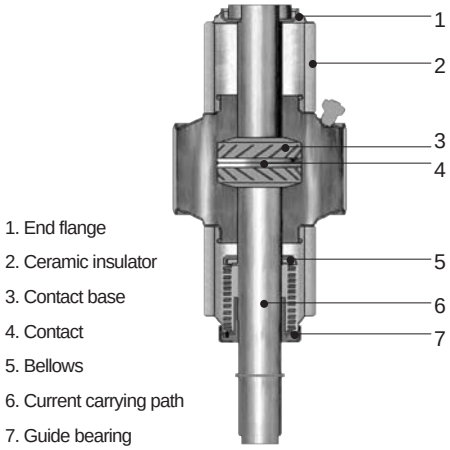


Fig. 4 Vacuum interrupter

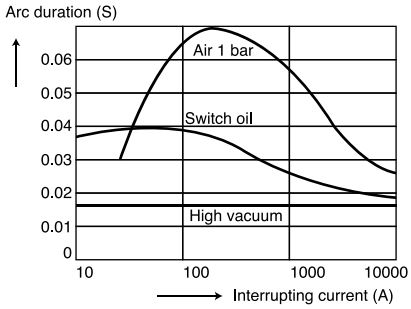


Fig. 5 Arc duration of various mediums

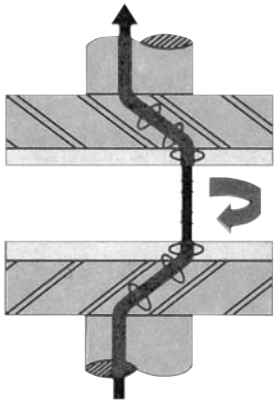


Fig. 6 Radial magnetic field contact arc

[Table 1] Arc voltage of various CB types.

Vacuum - Circuit Breaker:	:	20 ~ 200 V
SF_6 - Circuit Breaker	:	500 ~ 1000 V
Min. Oil - Circuit Breaker	:	1500 ~ 3000 V
Air - Circuit Breaker	:	1500 ~ 3000 V

Type & Rating

Ordering form for HVF Type

Please stipulate the complete ordering form as shown in below table.
Special design, which is not identified in the ordering form, shall be informed in advance.

HVF □ □ □ □ - □ □ □ □ □ □ - □ □ ■ ■

Basic order no. suffix ❶ ❷ ❸ ❹ ❺ ❻
Breaker (type no.)

❶ 1st order no. suffix (type of mounting).

- X A Fixed breaker without cradle
- E S Draw-out breaker with E-type cradle (nonmetallic partition without shutter)
- F S Draw-out breaker with F-type cradle (nonmetallic partition with shutter)
- H S Draw-out breaker with H-type cradle (metallic partition & bushing without shutter) IEC standard
- G S Draw-out breaker with G-type cradle (metallic partition & bushing with shutter) IEC standard
- C S Draw-out breaker with C-type cradle (metallic partition, bushing, auto jack, TOC, MOC & shutter without cell) ANSI standard
- M S Draw-out breaker with M-type cradle (metallic partition, bushing, auto jack, TOC, MOC & shutter with cell) ANSI standard

❷ 2nd order no. suffix (control voltage for motor).

1 DC24 V 2 DC48 V 3 DC60 V 4 DC110 V 5 DC125 V 6 DC220 V 7 AC110 V 9 AC220 V

❸ 3rd order no. suffix (control voltage for closing solenoid).

1 DC24 V 2 DC48 V 3 DC60 V 4 DC110 V 5 DC125 V 6 DC220 V 7 AC110 V 9 AC220 V

❹ 4th order no. suffix (control voltage for trip solenoid).

1 DC24 V 2 DC48 V 3 DC60 V 4 DC110 V 5 DC125 V 6 DC220 V 7 AC110 V 9 AC220 V

❺ 5th order no. suffix (aux. contacts & control jack).

- X Without control jack
- A Double control jack mounted on the breaker body, 4NO + 4NC
- B Double control jack mounted on the breaker body, 7NO + 7NC
- C Single control jack leaded out from the breaker body with a 0.8m cable, 4NO + 4NC
- D Double control jack leaded out from the breaker body with two 0.8m cables, 10NO +10NC

❻ 6th order no. suffix (position switch & others).

- R □ 2nd shunt release (□: order no. for control voltage as shown below)
- U □ Under voltage release (□: order no. for control voltage as shown below)
- L □ Lockout relay (□: order no. for control voltage as shown below)
- V □ Varistor module (□: order no. for varistor)
- P 0 Cam for position switch
- P 2 Position switch
- T 5 Opening time 50 ms required
- Z Z Special design or accessories

※ - Order no. for control voltage of 6th order no. suffix.

1 DC 24 V 2 DC48 V 3 DC60 V 4 DC110 V 5 DC125 V 6 DC220 V
7 AC110 V 9 AC220 V

- Detailed outline drawings will be submitted upon request.

Type & Rating

HVF VCB - 7.2 kV

Type No. ①		HVF 104□	HVF 105□	HVF 106□
Application standard		IEC60056		
Rated voltage (kV)		7.2		
Frequency (Hz)		50 / 60		
Rated current (A)		1 630 2 1250 4 2000	1 630 2 1250 4 2000	2 1250 4 2000 7 3150
Rated short-circuit breaking current (kA)		25	31.5	40
Rated short-circuit making current (kA)		65	82	104
Short-time withstand current for 3 sec		25	31.5	40
Operating duty		O-0.3 s-CO-3 min-CO		CO-15 s-CO
Power-frequency withstand voltage (kV, 1 min)		20		
Impulse withstand voltage (kV, 1.2 x 50μ s)		60		
Closing time (ms)		75		
Opening time (ms)		60(50②)		
Breaking time (cycles)		5		
Closing Operation	System	Motor Spring Stored Energy		
	Supply voltage (V)	DC 24, 48, 60, 110, 125, 220 / AC 110, 125, 220		
	Current (A)	Refer to Table 2 on page 16		
Closing & Tripping Control	Tripping system	Shunt Trip		
	Supply voltage (V)	DC 24, 48, 60, 110, 125, 220 / AC 110, 125, 220		
	Current (A)	Refer to Table 2 on page 16		
Operating life (times)	Mechanical operation	30,000		
	Electrical operation	Refer to Table 3 on page 18		
Auxiliary contacts		4NO + 4NC (Max. 10NO + 10NC + 1W)		
Applicable type of mounting		XA③, ES, FS, HS, GS		
Weight of breaker (Draw-out type without cradle)		1 150 2 160 4 180	1 150 2 160 4 180	2 165 4 180 7 200

① Type number in the square "□" shall be listed as shown in the line for the rated current.
② Opening Time of 50ms is available on request.
③ Fixed type (XA) is available on request.

Type & Rating

HVF VCB - 12 kV

Type No. ①	HVF 204□	HVF 205□ (HVF 2152) ②	HVF 206□ (HVF 2162) ②	HVF 207□
Application standard	IEC60056			
Rated voltage (kV)	12			
Frequency (Hz)	50 / 60			
Rated current (A)	1 630 2 1250 4 2000	1 630 2 1250 4 2000 6 2500	2 1250 4 2000 7 3150	2 1250 4 2000 7 3150
Rated short-circuit breaking current (kA)	25	31.5	40	50
Rated short-circuit making current (kA)	65	82	104	130
Short-time withstand current for 3 sec	25	31.5	40	50
Operating duty	O-0.3 s-CO-3 min-CO		CO-15 s-CO	
Power-frequency withstand voltage (kV, 1 min)	28			
Impulse withstand voltage (kV, 1.2 x 50μ s)	75	75(95③)	75(95③)	75(95③)
Closing time (ms)	75			
Opening time (ms)	60(50④)			
Breaking time (cycles)	5			
Closing Operation – System	Motor Spring Stored Energy			
Closing Operation – Supply voltage (V)	DC 24, 48, 60, 110, 125, 220 / AC 110, 125, 220			
Closing Operation – Current (A)	Refer to Table 2 on page 16			
Closing & Tripping Control – Tripping system	Shunt Trip			
Closing & Tripping Control – Supply voltage (V)	DC 24, 48, 60, 110, 125, 220 / AC 110, 125, 220			
Closing & Tripping Control – Current (A)	Refer to Table 2 on page 16			
Operating life (times) – Mechanical operation	30,000			10,000
Operating life (times) – Electrical operation	Refer to Table 3 on page 18			
Auxiliary contacts	4NO + 4NC (Max. 10NO + 10NC + 1W)			
Applicable type of mounting	XA⑤, HS, GS			
Weight of breaker (Draw-out type without cradle)	1 150 2 160 4 180	1 165 2 165 4 190 6 200	2 165 4 190 7 240	2 165 4 190 7 240

① Type number in the square "□" shall be listed as shown in the line for the rated current.
② This is the type no. for narrow-size VCB.
③ Impulse withstand voltage of 95 kV is available on request.
④ Opening Time of 50 ms is available on request.
⑤ Fixed type (XA) is available on request.

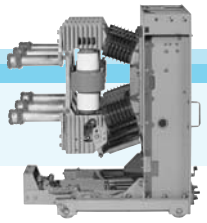
Type & Rating

HVF VCB - 24 kV / 38 kV

Type No. ①	HVF 601□	HVF 604□	HVF 605□	HVF 606□ (High insulation)	HVF 705□	HVF 706□
Application standard	IEC60056				ANSI C37	
Rated voltage (kV)	24				38	
Frequency (Hz)	50 / 60					
Rated current (A)	1 630 2 1250	1 630 2 1250 4 2000	2 1250 4 2000 6 2500	2 1250 4 2000 7 3150	2 1200 4 2000 7 3000	2 1200 4 2000 7 3000
Rated short-circuit breaking current (kA)	12.5	25	31.5	40	31.5	40
Rated short-circuit making current (kA)	31.5	65	82	104	82	104
Short-time withstand current for 3 sec	12.5	25	31.5	40	31.5	40
Operating duty	O-0.3 s-CO-3 min-CO					
Power-frequency withstand voltage (kV, 1 min)	50			60	80	
Impulse withstand voltage (kV, 1.2 x 50μ s)	125			150	150(170②)	
Closing time (ms)	75					
Opening time (ms)	60(50③)			50		
Breaking time (cycles)	5			4		
Closing Operation — System	Motor Spring Stored Energy					
Closing Operation — Supply voltage (V)	DC 24, 48, 60, 110, 125, 220 / AC 110, 125, 220					
Closing Operation — Current (A)	Refer to Table 2 on page 16					
Closing & Tripping Control — Tripping system	Shunt Trip					
Closing & Tripping Control — Supply voltage (V)	DC 24, 48, 60, 110, 125, 220 / AC 110, 125, 220					
Closing & Tripping Control — Current (A)	Refer to Table 2 on page 16					
Operating life (times) — Mechanical operation	30,000			20,000		
Operating life (times) — Electrical operation	Refer to Table 3 on page 18					
Applicable type of mounting	4NO + 4NC (Max. 10NO + 10NC + 1W)					
Applicable type of mounting	XA④, ES, FS, HS, GS		HS, GS	XA, HS, GS, CS, MS		
Weight of breaker (Draw-out type without cradle)	1 630 2 165	1 170 2 170 4 190	2 170 4 190 6 270	2 340 4 365 7 400	2 340 4 365 7 400	2 340

① Type number in the square "□" shall be listed as shown in the line for the rated current.
② Impulse withstand voltage of 170 kV is available on request.
③ Opening Time of 50 ms is available on request.
④ Fixed type (XA) is available on request.

Type & Rating



Ordering form for HAF Type

Please stipulate the complete ordering form as shown in below table.
Special design, which is not identified in the ordering form, shall be informed in advance.

HAF □ □ □ □ - □ □ □ □ □ □ □ - □ □ ■ ■

Basic order no. suffix
Breaker (type no.)

❶ ❷ ❸ ❹ ❺ ❻

❶ 1st order no. suffix (type of mounting).

- X Fixed breaker without cradle
- E Draw-out breaker with E-type cradle (nonmetallic partition without shutter)
- F Draw-out breaker with F-type cradle (nonmetallic partition with shutter)
- C Draw-out breaker with C-type cradle (metallic partition, bushing, auto jack, TOC, MOC & shutter without cell) ANSI standard

❷ 2nd order no. suffix (control voltage for motor).

1 DC24 V 2 DC48 V 3 DC60 V 4 DC110 V 5 DC125 V 6 DC220 V 7 AC110 V 9 AC220 V

❸ 3rd order no. suffix (control voltage for closing solenoid).

1 DC24 V 2 DC48 V 3 DC60 V 4 DC110 V 5 DC125 V 6 DC220 V 7 AC110 V 9 AC220 V

❹ 4th order no. suffix (control voltage for trip solenoid).

1 DC24 V 2 DC48 V 3 DC60 V 4 DC110 V 5 DC125 V 6 DC220 V 7 AC110 V 9 AC220 V

❺ 5th order no. suffix (aux. contacts & control jack).

- X Without control jack
- A Double control jack mounted on the breaker body, 4NO + 4NC
- B Double control jack mounted on the breaker body, 7NO + 7NC
- C Single control jack leaded out from the breaker body with a 0.8m cable 4NO + 4NC
- D Double control jack leaded out from the breaker body with two 0.8m cables, 10NO + 10NC

❻ 6th order no. suffix (position switch & others).

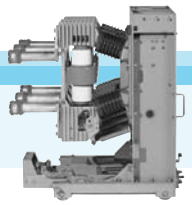
- R □ 2nd shunt release (□: order no. for control voltage as shown below)
- U □ Under voltage release (□: order no. for control voltage as shown below)
- L □ Lockout relay (□: order no. for control voltage as shown below)
- V □ Varistor module (□: order no. for varistor)
- P 0 Cam for position switch
- P 2 Position switch
- E L Electrical local closing
- C 0 Cut-out switch
- T 5 Opening time 50 ms required
- Z Z Special design or accessories
- C □ CT. operated release (1 : 0.5 A, 2 : 1.0 A) only HAF VCB

※ - Order no. for control voltage of 6th order no. suffix.

1 DC 24 V 2 DC48 V 3 DC60 V 4 DC110 V 5 DC125 V 6 DC220 V
7 AC110 V 9 AC220 V

- Detailed outline drawings will be submitted upon request.

Type & Rating

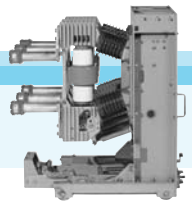


HAF VCB - 4.76/7.2 kV

Type No. ①		HAF 107□ - 3	HAF 104□ - 4	HAF 105□ - 4	HAF 116□ - 3	HAF 117□ - 3
Application standard		ANSI C37	IEC60056		IEC60056 /ESB150	IEC60056
Rated voltage (kV)		4.76	7.2			
Frequency (Hz)		50 / 60				
Rated current (A)		2 1200 4 2000 7 3000	1 630 2 1250 4 2000	1 630 2 1250 4 2000 6 2500	2 1250/1200 4 2000 6 2500 7 3150/3000	2 1250 6 2500 7 3150
Rated short-circuit breaking current (kA)		50	25	31.5	40	50
Rated short-circuit making current (kA)		130	65	82	104	130
Short-time withstand current for 3 sec		50	25	31.5	40	50
Operating duty		CO-15 s-CO	O-0.3 s-CO-3 min-CO		CO-15 s-CO	
Power-frequency withstand voltage (kV, 1 min)		19	20			
Impulse withstand voltage (kV, 1.2 x 50μ s)		60				
Closing time (ms)		60	75			
Opening time (ms)		50	60(50②)			
Breaking time (cycles)		5				
Closing Operation	System	Motor Spring Stored Energy				
	Supply voltage(V)	DC 48, 60, 110, 125 / AC 110, 125, 220				
	Current (A)	Refer to Table 2 on page 16				
Closing & Tripping Control	Tripping system	Shunt Trip				
	Supply voltage (V)	DC 48, 60, 110, 125, 220 / AC 110, 125, 220				
	Current (A)	Refer to Table 2 on page 16				
Operating life (times)	Mechanical operation	10,000	30,000			10,000
	Electrical operation	Refer to Table 4 on page 19				
Auxiliary contacts		4NO + 4NC (Max. 10NO + 10NC + 1W)				
Applicable type of mounting		X, C	X, E, F			
Weight of breaker (Main body)		2 160 4 160 7 170	1 99 2 99 4 115	1 100 2 100 4 115 6 125	2 135 4 135 6 135 7 135	2 160 6 160 7 160

①Type number in the square "□"shall be listed as shown in the line for the rated current.
②Opening Time of 50 ms is available on request.

Type & Rating

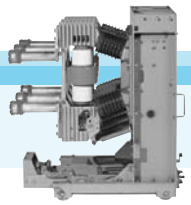


HAF VCB -12 kV

Type No. ①		HAF 154□ - 4	HAF 175□ - 4	HAF 176□ - 3	HAF 177□ - 3
Application standard		IEC60056			
Rated voltage (kV)		12			
Frequency (Hz)		50 / 60			
Rated current (A)		1 630 2 1250 4 2000	1 630 2 1250 4 2000 6 2500	2 1250 4 2000 6 2500 7 3150	2 1250 6 2500 7 3150
Rated short-circuit breaking current (kA)		25	31.5	40	50
Rated short-circuit making current (kA)		65	82	104	130
Short-time withstand current for 3 sec		25	31.5	40	50
Operating duty		O-0.3s-CO-3 min-CO		CO-15s-CO	
Power-frequency withstand voltage (kV, 1 min)		28			
Impulse withstand voltage kV, 1.2 x 50μ s)		75			
Closing time (ms)		75			
Opening time (ms)		60(50②)			
Breaking time (cycles)		5			
Closing Operation	System	Motor Spring Stored Energy			
	Supply voltage (V)	DC 48, 60, 110, 125, 220 / AC 110, 125, 220			
	Current (A)	Refer to Table 2 on page 16			
Closing & Tripping Control	Tripping system	Shunt Trip			
	Supply voltage (V)	DC 48, 60, 110, 125, 220 / AC 110, 125, 220			
	Current (A)	Refer to Table 2 on page 16			
Operating life (times)	Mechanical operation	30,000			10,000
	Electrical operation	Refer to Table 4 on page 19			
Auxiliary contacts		4NO + 4NC (Max. 10NO + 10NC + 1W)			
Applicable type of mounting		X, E, F			
Weight of breaker (Main-body)		1 100 2 100 4 117	1 108 2 108 4 124 6 125	2 135 4 135 6 135 7 135	2 160 6 160 7 160

① Type number in the square "□" shall be listed as shown in the line for the rated current.
② Opening Time of 50 ms is available on request.

Type & Rating



HAF VCB - 15/24/25.8 kV

Type No. ①	HAF 234□ - 4	HAF 235□ - 4	HAF 236□ - 3	HAF 611□ - 4	HAF 612□ - 4	HAF 613□ - 4	HAF 614□ - 4
Application standard	IEC60056		IEC60056 / ANSI C 37	IEC60056			IEC60056 / ESB150
Rated voltage (kV)	15			24			24 / 25.8
Frequency (Hz)	50 / 60						
Rated current (A)	1 630 2 1250 4 2000 6 2500	1 630 2 1250 4 2000 6 2500	2 1250/1200 4 2000 6 2500 7 3150/3000	1 630 2 1250	1 630 2 1250	1 630 2 1250 4 2000	1 630/600 2 1250/1200 4 2000 6 2500
Rated short-circuit breaking current (kA)	25	31.5	40	12.5	16	20	25
Rated short-circuit making current (kA)	65	82	104	32.5	41.6	52	65
Short-time withstand current for 3 sec	25	31.5	40	12.5	16	20	25
Operating duty	O-0.3 s-CO-3 min-CO		CO-15 s-CO	O-0.3 s-CO-3 min-CO			
Power-frequency withstand voltage (kV, 1 min)	36			50			
Impulse withstand voltage (kV, 1.2 x 50μ s)	95			125			
Closing time (ms)	75						
Opening time (ms)	60(50②)						
Breaking time (cycles)	5						
Closing Operation – System	Motor Spring Stored Energy						
Closing Operation – Supply voltage (V)	DC 24, 48, 60, 110, 125, 220 / AC 110, 125, 220						
Closing Operation – Current (A)	Refer to Table 2 on page 16						
Closing & Tripping Control – Tripping system	Shunt Trip						
Closing & Tripping Control – Supply voltage (V)	DC 24, 48, 60, 110, 125, 220 / AC 110, 125, 220						
Closing & Tripping Control – Current (A)	Refer to Table 2 on page 16						
Operating life (times) – Mechanical operation	30,000						
Operating life (times) – Electrical operation	Refer to Table 4 on page 19						
Auxiliary contacts	4NO + 4NC (Max. 10NO + 10NC + 1W)						
Applicable type of mounting	X, E③, F③	X, E, F	X, E, F, C④	X, E, F	X, E, F	X, E, F	X, E, F
Weight of breaker (Main body)	1 109 2 109 4 125 6 126	1 112 2 112 4 128 6 129	2 139 4 139 6 139 7 139	1 100 2 100	1 100 2 100	1 100 2 100 4 128	1 115 2 115 4 131 6 134

① Type number in the square "□" shall be listed as shown in the line for the rated current.
② Opening Time of 50 ms is available on request.
③ E and F-type cradle are not applicable to 2500 A
④ C-type cradle is not applicable to 3000 A

Construction & Operation

The HYUNDAI HVF & HAF vacuum circuit breaker's superiority lies in its compact size, weight, and quiet low-vibrating operation, along with its reliability and maintenance-free service.

Break poles

As shown in Fig. 7 and Fig. 8, the pole parts are mounted on the rear of the mechanism housing by insulation frames in the HVF type and by post insulators in the HAF type, with air-insulated assemblies.

Some HAF models are fitted with phase-barriers depending on dielectric requirements.

Operating mechanism

HVF & HAF circuit breakers have motor-spring stored energy mechanisms of the same design.

They consist of the spring-charging mechanism, closing and trip spring, motor, solenoids, auxiliary switches, spring-charged signal, and on/off indicator, as in the standard version.

Depending on the intended switch functions, the operating mechanism can be supplemented by two releases: a lockout, a cut-out switch, a limit switch for closing the spring-charged signal, electrical local closing, and longer auxiliary switch.

The released closing spring is automatically recharged by the motor and capable of the switching sequences "open-close-open", which is required when unsuccessful auto-reclosing operation is attempted.

The vacuum interrupter is mounted rigidly in the insulation frame and supports so that it can withstand forces arising from switching operation and contact pressure.

When closed, the necessary contact pressure is established by the contact pressure spring and the atmospheric pressure.

The contact pressure spring automatically compensates for the arc erosion, which is very small.

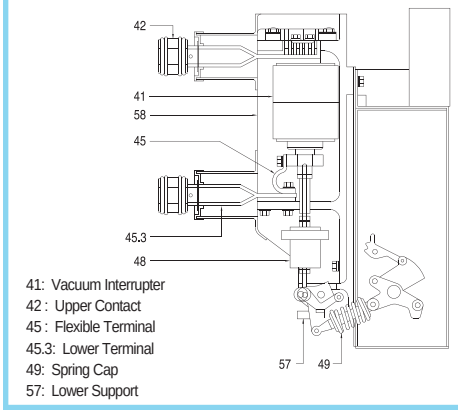


Fig. 7 Pole parts of HVF vacuum circuit breaker.

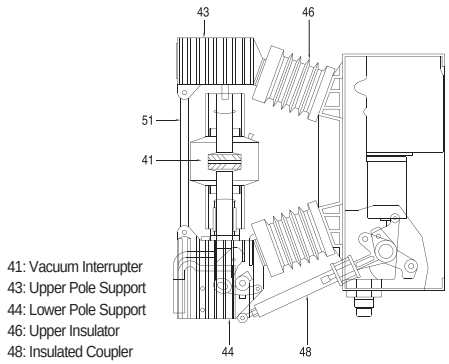
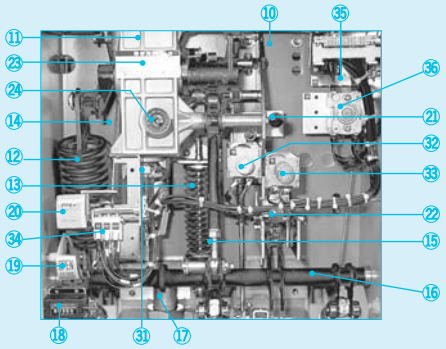


Fig. 8 Pole parts of HAF vacuum circuit breaker



10: Housing Box
11: Gear Box
12: Closing Spring
13: Trip Spring
14: Link
15: Closing Bar
16: Breaker Shaft
17: Dash Pot
18: Counter
19: On / Off Indicator
20: Spring Charged Indicator
21: Closing Button
22: Trip Button
23: Name Plate
24: Manual Charging Operation Hole
31: Motor
32: Closing Solenoid
33: Trip Solenoid
34: Limit Switch
35: Anti-Pumping Contactor
36: Auxiliary Switch

Fig. 9 Operating mechanism for HVF & HAF vacuum circuit breaker.

Type of mounting

In the standard version, fixed type and several kinds of draw-out type breakers are available.
The standard version of draw-out type breakers is equipped with the drawable truck, mechanical interlock and main-circuit disconnecting unit.
In addition, three kinds of draw-out units can be supplied for the mounting of the breaker in the switchgear:

- ◇ E Cradle: Draw-out breaker with E-type cradle (nonmetallic partition without shutter)
- ◇ F Cradle: Draw-out breaker with F-type cradle (nonmetallic partition with shutter)
- ◇ H Cradle: Draw-out breaker with H-type cradle (metallic partition & bushing without shutter) IEC standard
- ◇ G Cradle: Draw-out breaker with G-type cradle (metallic partition & bushing with shutter) IEC standard
- ◇ C Cradle: Draw-out breaker with C-type cradle (metallic partition, bushing, auto jack, TOC, MOC & shutter without cell) ANSI standard
- ◇ M Cradle: Draw-out breaker with M-type cradle (metallic partition, bushing, auto jack, TOC, MOC & shutter with cell) ANSI standard

Motor drive

The motor used for charging the closing spring operates in short-time duty.
The current consumption, as shown in table 2, is the maximum value during operation.
The inrush current may be disregarded since it lasts for only a very brief period.

Solenoids

Solenoids transfer the commands which are inputted remotely to the circuit breaker latching mechanism, and thus close or open the device.

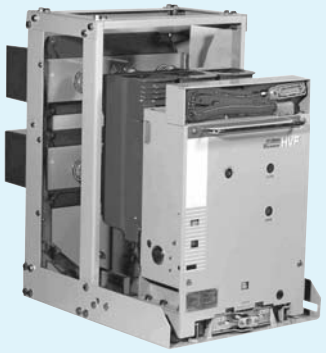


Fig.10 HVF VCB with G type draw-out unit.

The closing solenoid unlatches the charged closing spring, and thus closes the circuit breaker electronically.
The opening solenoid (shunt release) unlatches the opening and contact pressure springs, and thus opens the breaker.
The current consumption, as shown in the Table 2, is the maximum value during operation.

Auxiliary contacts & connector for secondary connection

The following versions are available:

- ◇ X: Without control jack
- ◇ A: Double control jack mounted on the breaker body, 4NO + 4NC
- ◇ B: Double control jack mounted on the breaker body, 7NO + 7NC
- ◇ C: Single control jack leaded out from the breaker body with a 0.8m cable, 4NO + 4NC
- ◇ D: Double control jack leaded out from the breaker body with two 0.8m cables, 10NO + 10NC

Rating of auxiliary contacts

- ◇ Operating voltage: Max. 250 V AC, DC
- ◇ Continuous thermal current: 10 A
- ◇ Making current: 30 A
- ◇ Switching capacity: 2A at DC220 V, T=20 ms

[Table 2] Current consumption & operating voltage of the motor & solenoids.

Rated voltage	Current consumption (A)			Operating voltage
	Motor	Closing solenoid	Trip solenoid	
DC 24	21	4	4	For motor: 85~110% of rated voltage For closing control: 85~110% of rated voltage For trip control: 70~110% of DC rated voltage For trip control: 85~110% of AC rated voltage
DC 48	10.5	2.7	2.7	
DC 60	8	1.7	1.7	
DC 110	4.5	1.3	1.3(2.0①)	
DC 125	4.5	1.5	1.5(2.0①)	
DC 220	2.3	0.65	0.65	
AC 110	6.4	1.3	1.3	
AC 220	3.2	0.65	0.65	

① When adopted trip time 50 ms solenoid

Current Carrying Capacity

HYUNDAI vacuum circuit breakers may be operated at ambient temperatures between -25℃ and +40℃.

The rated normal currents listed in Table 4 were determined according to IEC standards at an ambient temperature of 40℃.

If the breaker is operated at a different temperature, a correction of the operating current must be considered.

Fig.13 shows appropriate operating currents at different ambient temperatures.

The diagram, however, is applied only to open-type switchgears.

Thus, when a metal enclosed switchgear is used, load currents must be reduced accordingly.

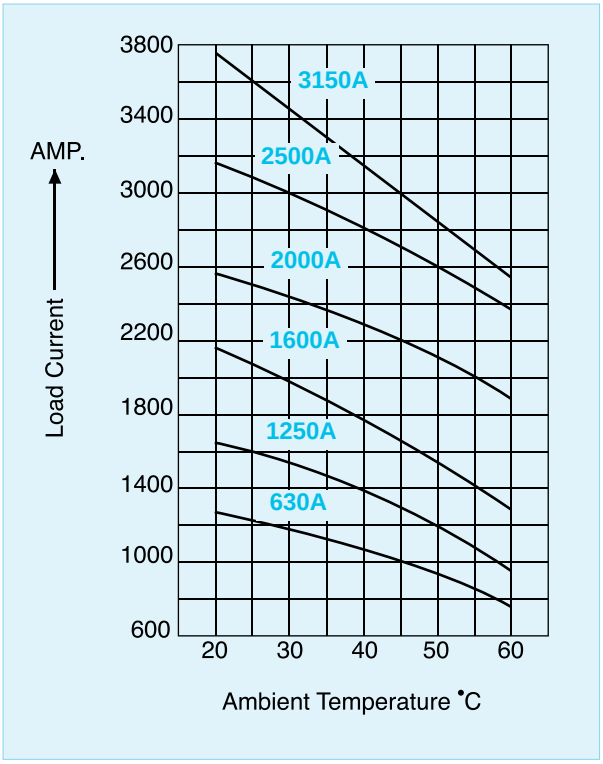
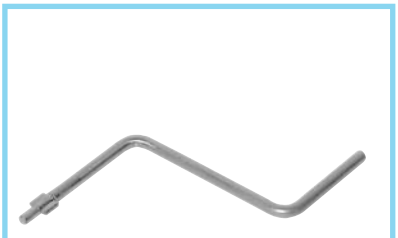
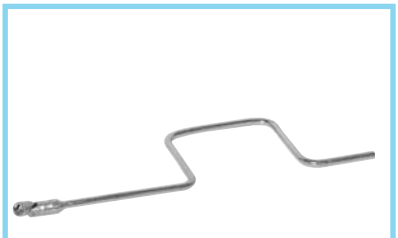


Fig. 13 Vacuum circuit breaker, load characteristics.

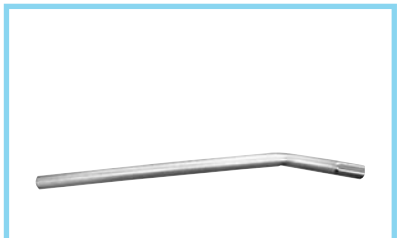
Standard Accessory



Operating handle for HVF & HAF type



Draw-out handle for HVF(GS, HS) type



Draw-out handle for HVF(ES, FS) type

Service Life

HYUNDAI vacuum circuit breaker needs minimum maintenance due to the simple operating mechanism and robust construction.

Vacuum Circuit Breaker shall be maintained periodically to ensure the perfect performance during mechanical and/or electrical lifetime. Please refer to the Instruction Manual for the detailed information.

Fig. 11-1

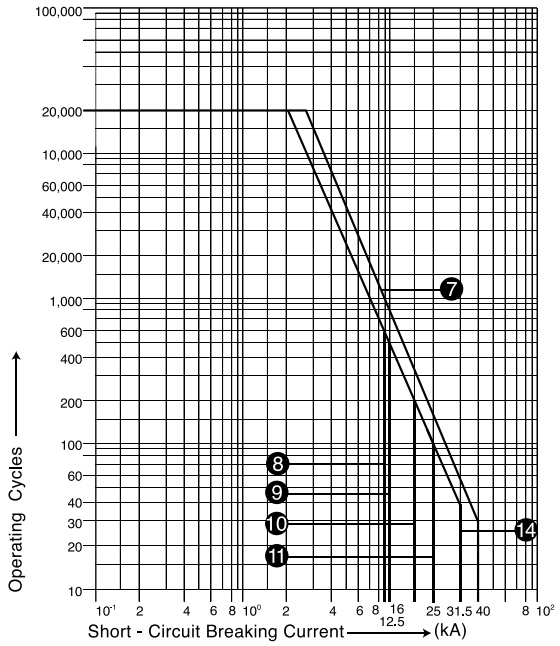


Fig. 11-2

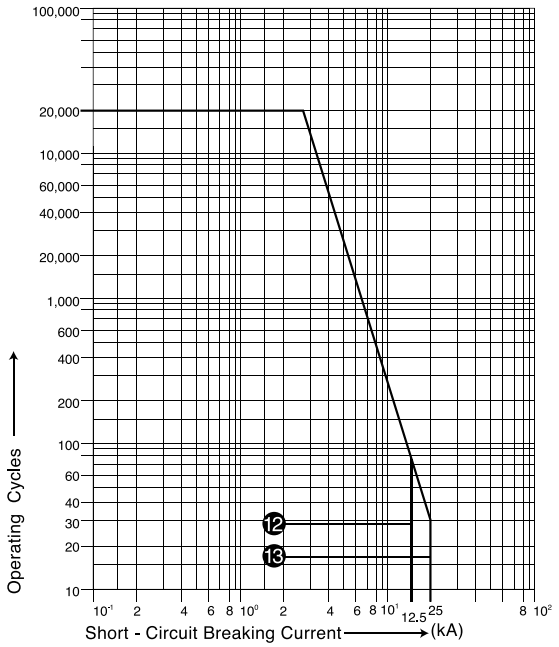


Fig. 11 Permissible operating numbers as a function of breaking current

[Table 3] Determination of load characteristics numbers for HVF vacuum circuit breakers.

Rated voltage	kV	7.2			12				24			38	
Rated short-circuit breaking current	kA	25	31.5	40	25	31.5	40	50	12.5	25	31.5	31.5	40
Curve number	630 A	❶	❷		❶	⓮			⓬	⓭			
	1250 A	❶	❷	❼	❶	⓮	❺	❻	⓬	⓭	⓮	⓮	⓮
	2000 A	❶	❷	❼	❶	⓮	❺	❻		⓭	⓮	⓮	
	2500 A			❼			❺	❻		⓭	⓮	⓮	
	3150 A			❼			❺	❻				⓮	

Service Life

Fig. 11-3

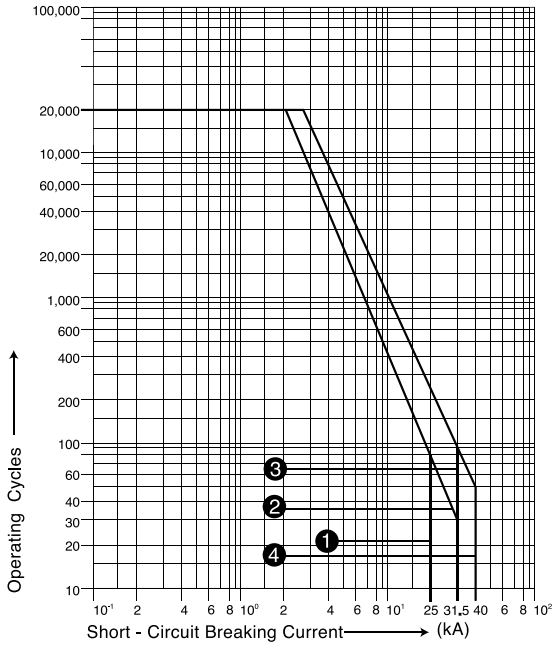


Fig. 11-4

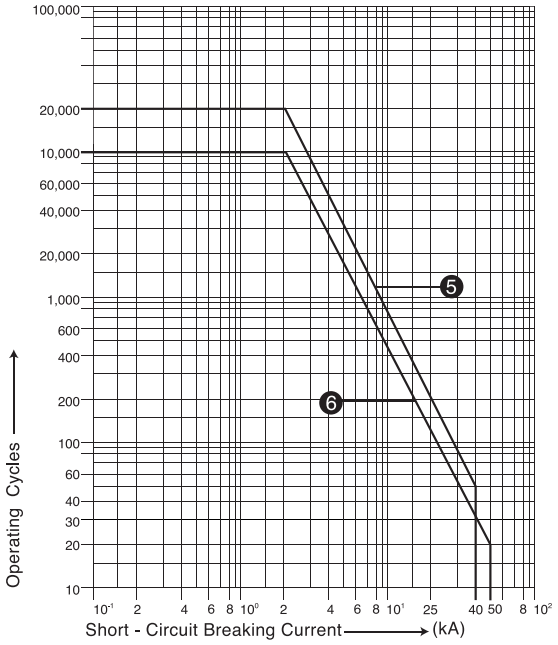


Fig. 11 Permissible operating numbers as a function of breaking current

[Table 4] Determination of load characteristic numbers for HAF vacuum circuit breakers.

Rated voltage	kV	4.76, 7.2				12				15			24			
Rated short-circuit breaking current	kA	25	31.5	40	50	25	31.5	40	50	25	31.5	40	12.5	16	20	25
Curve number	630 A	❶	❷			❶	❸			❶	❸		❽	❾	❿	⓫
	1250 A	❶	❷	❹	❻	❶	❸	❼	❻	❶	❸	❼	❽	❾	❿	⓫
	2000 A	❶	❷	❹	❻	❶	❸	❼		❶	❸	❼			❿	⓫
	2500 A		❸	❹	❻		❸	❼	❻		❸	❼				⓫
	3150 A			❺	❻			❼	❻			❼				

Optional Accessory

2nd shunt release with attachment

2nd shunt releases are used to open the circuit breaker automatically with appropriate protective relays or by deliberate electrical or mechanical action.
They are designed for connection to external voltage (AC or DC); however, in special cases they may also be connected to voltage transformers.

Undervoltage release with attachment

Undervoltage releases are used to open the circuit breakers automatically in the event that the operating voltage drops below a specified level.
They can be connected to voltage transformers, but they are also available for DC operation.
The deliberate tripping of the undervoltage release is accomplished by means of an opening contact in the control circuit.
If the coil is de-energized by short-circuiting, built-in resistors limit the short-circuit current.

Varistor module

When the motor, solenoid, and shunt releases are switched in DC circuits, it is possible for surges to be produced which might cause great damage to solid-state devices.
By additionally connecting the varistor module to the motor and solenoid, the damage can be effectively eliminated.

Capacitor trip unit

It is recommended that the capacitor trip unit be employed for a trip operation of the breaker when the control source is lost in the AC control system.

Order no.	HVFS-T7	HVFS-T9
Rated input voltage	AC 110 V	AC 220 V
Charging voltage	DC 145 V	DC 290 V

Electrical lockout with attachment

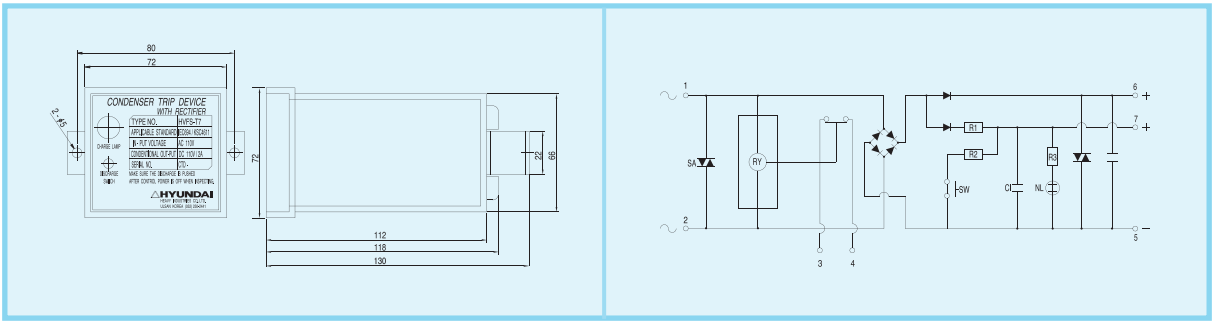
The lockout relay is an electromagnetic device actuated by DC or AC voltage for the voltage-independent interlocking of switching devices.
It enables the operation of circuit breakers at a voltage of ≥ 85% of the rated voltage, and lock operation at a voltage of ≤ 60% of the rated voltage.
The lockout relay actuates the closing solenoid or the ON button mechanically.

A lockout relay is used in circuit breakers with indirect releases.
As a result, the breaker can be closed by release of the lockout only when the undervoltage release is energized, ensuring proper closing operation.
Unsuccessful attempts at closing are prevented if the auxiliary voltage has failed fully or partially.
Since the undervoltage release does not latch if the auxiliary voltage is insufficient or has failed, a circuit breaker not equipped with a lockout relay would close and immediately reopen unnecessarily.

Vacuum checker

The portable vacuum checker can be used for checking the vacuum degree.

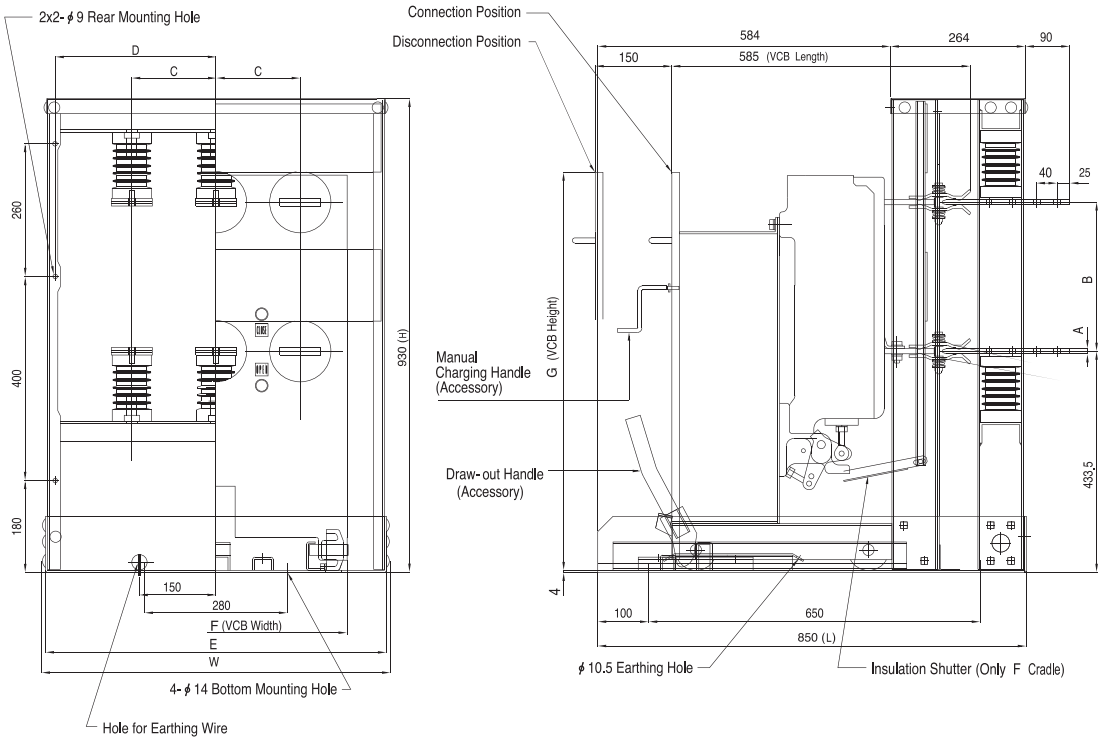
Order no.	HAFS-VC9
Rated input voltage	AC 220 V
Rated output voltage	AC 11 kV / 22 kV
Dimensions	W200 × L350 × H176
Weight	22 kg

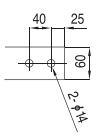
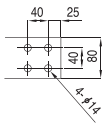
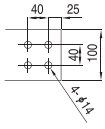


Dimension

HVF / 7.2 kV Draw-out Type VCB with E&F Cradle

Dimension in mm



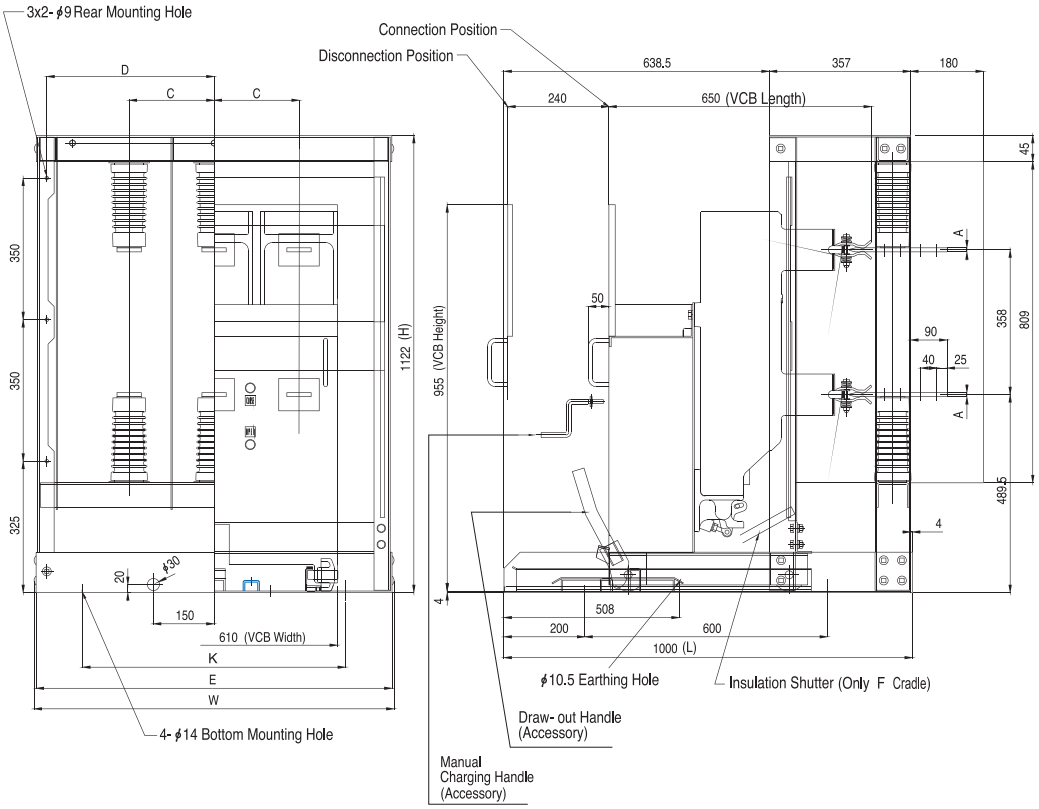
Type	Dimension (mm)										Terminal type	Main terminal		
	W	L	H	A	B	C	D	E	F	G		A type	B type	C type
HVF 1041	650	850	930	10	292	165	296	630	514	780	A			
HVF 1042														
HVF 1051 / 1052 / 1162											B			
HVF 1044 / 1054	750				305	210	346	730	610	845	C			
HVF 1062				15							B			
HVF 1064											C			

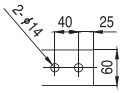
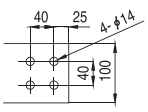
※ This drawing can be revised without notice.

Dimension

HVF / 24 kV Draw-out Type VCB with E&F Cradle

Dimension in mm



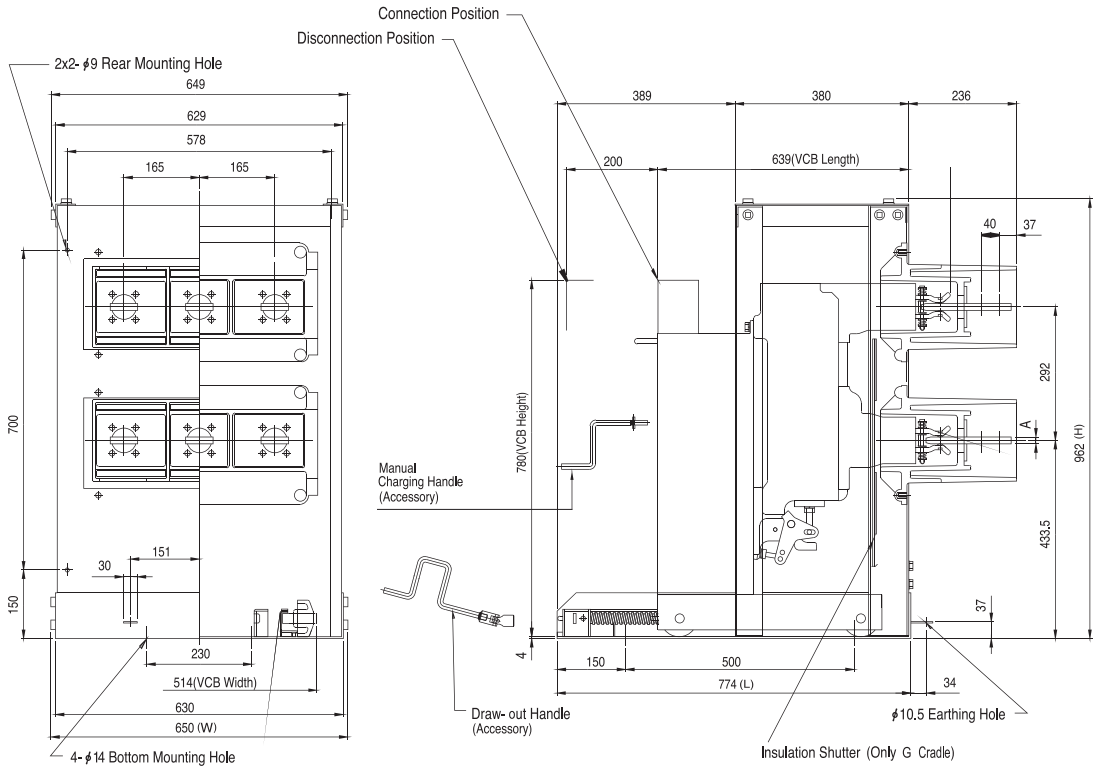
Type	Dimension (mm)								Terminal type	Main terminal	
	W	L	H	A	C	D	E	K		A type	B type
HVF 6011 / 6041	900	1000	1122	10	210	419	880	650	A		
HVF 6012 / 6042				15							
HVF 6044	980			15	250	459	960	730	B		

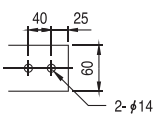
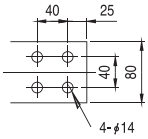
※ This drawing can be revised without notice.

Dimension

HVF / 7.2~12 kV Draw-out Type VCB with H&G Cradle

Dimension in mm



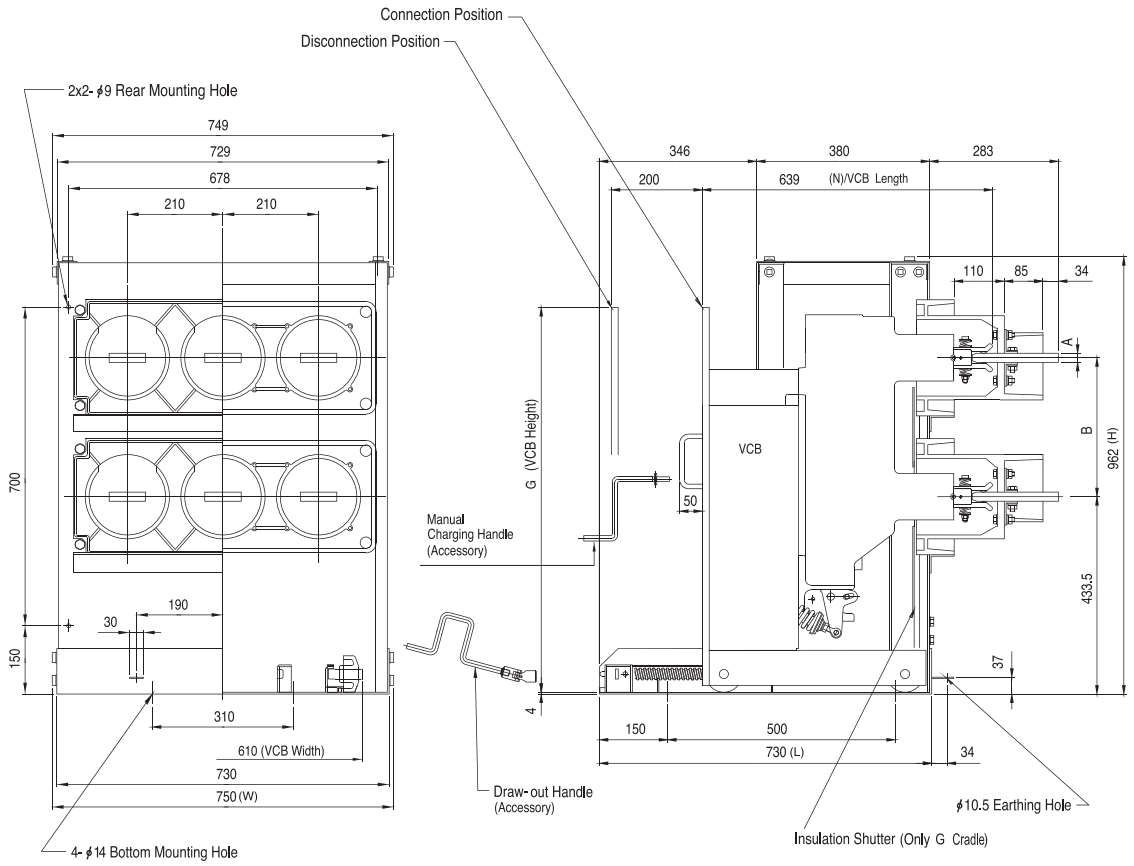
Type	Dimension (mm)				Terminal type	Main terminal	
	W	L	H	A		A type	B type
HVF 1041 / 2041	650	774	962	10	A		
HVF 1042 / 2042				15			
HVF 1051 / 1052					B		

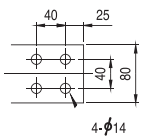
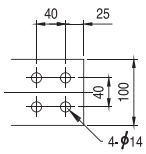
※ This drawing can be revised without notice.

Dimension

HVF / 7.2~12 kV Draw-out Type VCB with H&G Cradle

Dimension in mm



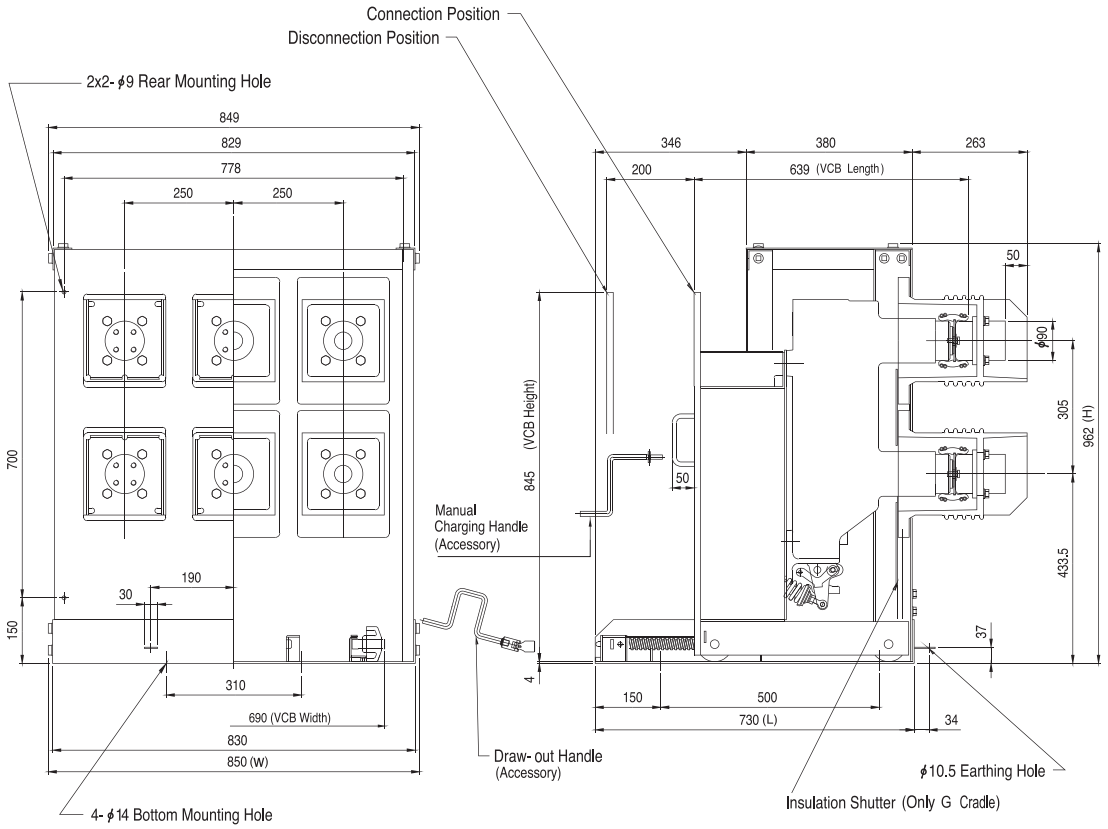
Type	Dimension (mm)						Terminal type	Main terminal	
	W	L	H	A	B	G		A type	B type
HVF 1044 / 1054 / 2044	750	730	962	15	292	780	B		
HVF 1062 / 2051 / 2052 / 2062 / 2072					305	845	A		
HVF 1064 / 2054 / 2064 / 2074							B		

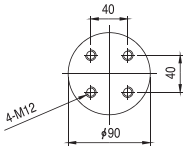
※ This drawing can be revised without notice.

Dimension

HVF / 7.2~12 kV Draw-out Type VCB with H&G Cradle

Dimension in mm



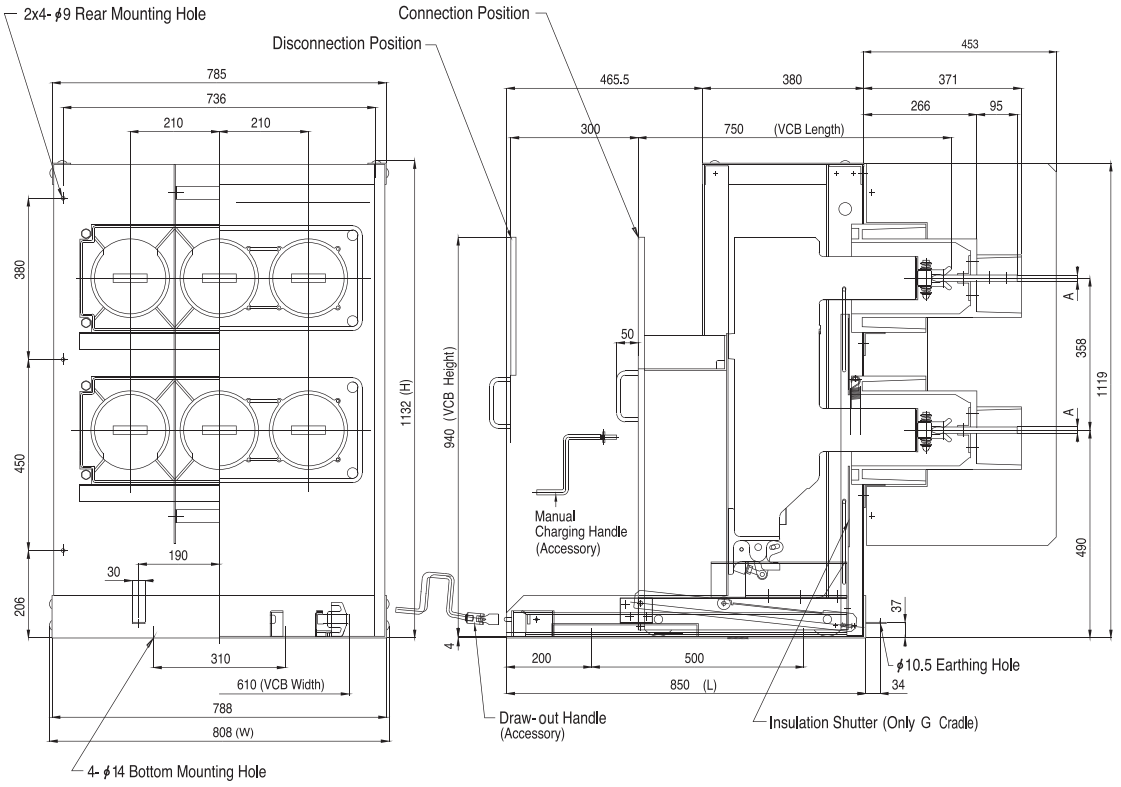
Type	Dimension (mm)			Main terminal
	W	L	H	
HVF 1067 HVF 2056 / 2067/ 2077	850	730	962	

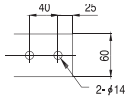
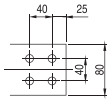
※ This drawing can be revised without notice.

Dimension

HVF / 24 kV Draw-out Type VCB with H&G Cradle

Dimension in mm



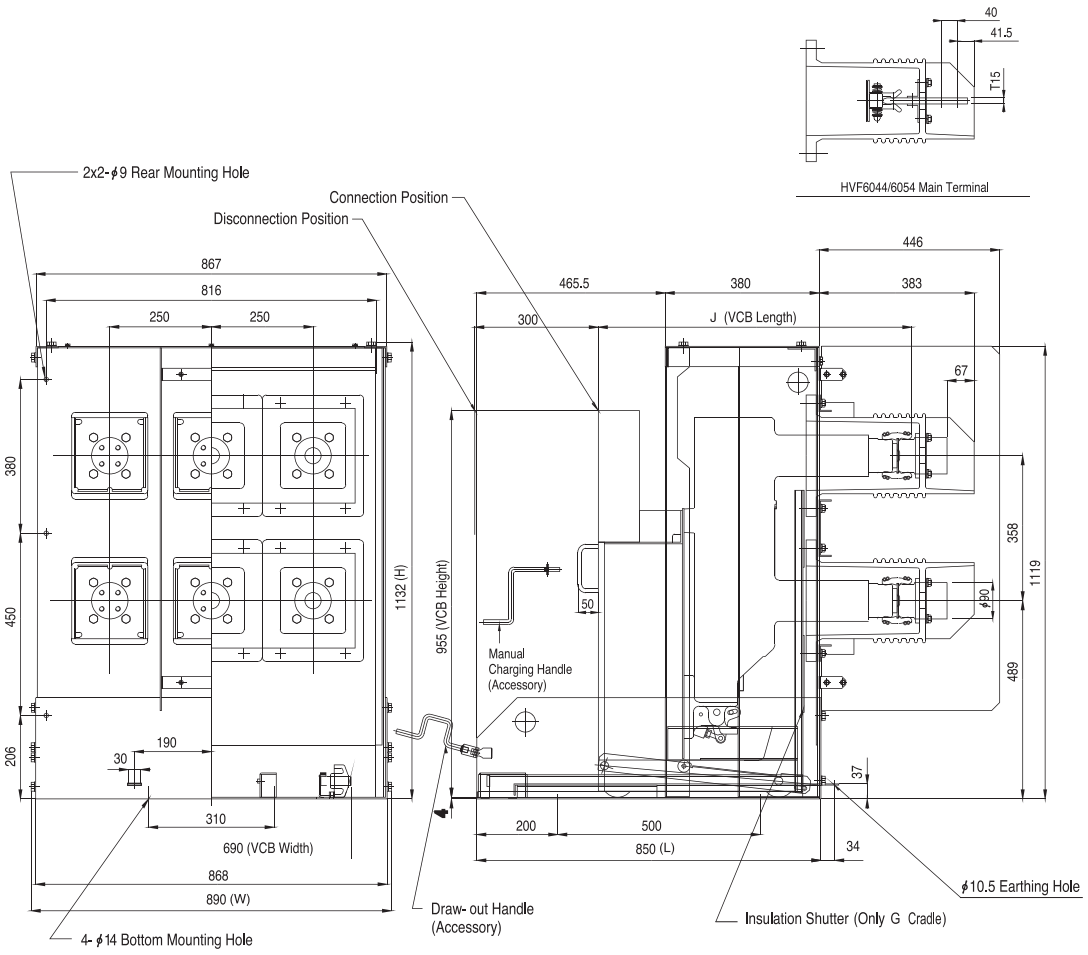
Type	Dimension (mm)				Terminal TYPE	Main terminal	
	W	L	H	A		A TYPE	B TYPE
HVF 6011 / 6041	808	850	1132	10	A		
HVF 6012 / 6042				15			
HVF 6052					B		

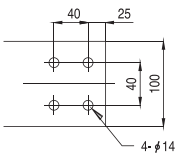
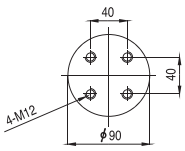
※ This drawing can be revised without notice.

Dimension

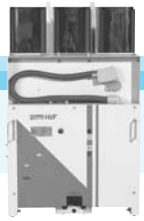
HVF / 24 kV Draw-out Type VCB with H&G Cradle

Dimension in mm



Type	Dimension (mm)				Terminal type	Main terminal	
	W	L	H	J		A type	B type
HVF 6044 / 6054	890	850	1132	730	A		
HVF 6056				770	B		

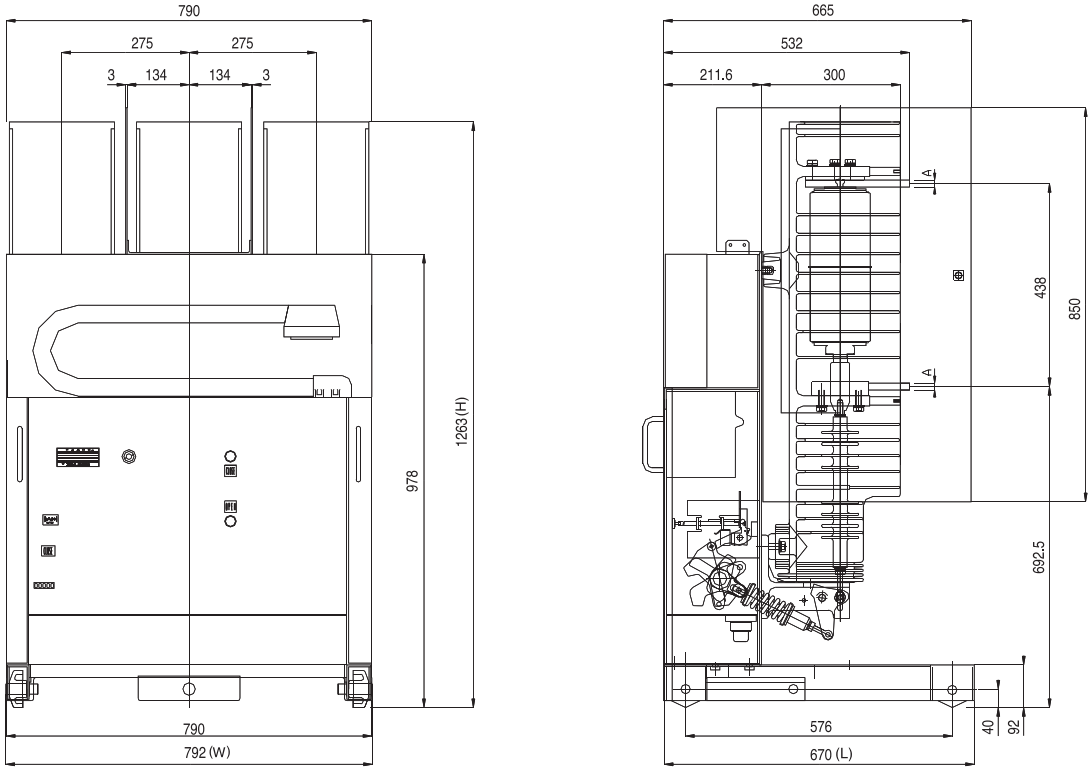
※ This drawing can be revised without notice.

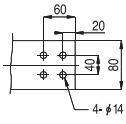
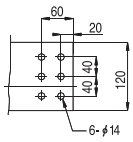


Dimension

HVF / 24~38 kV Fixed Type VCB

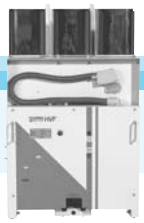
Dimension in mm



Type	Dimension (mm)				Terminal type	Main terminal	
	W	L	H	A		A type	B type
HVF 6062 / 7052	792	670	1263	15	A		
HVF 6064 / 7054				20			
HVF 6067 / 7057				30	B		

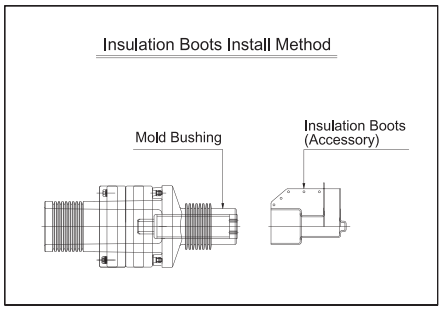
※ This drawing can be revised without notice.

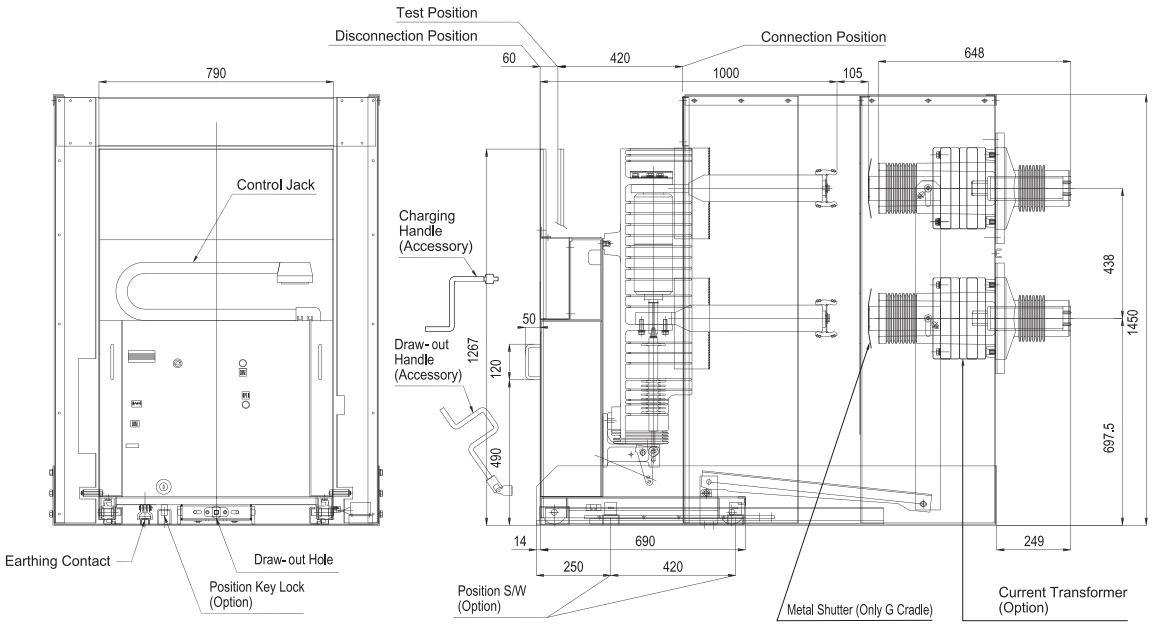
Dimension

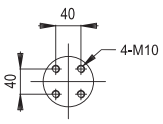


HVF / 24 kV, 36 kV Draw-out Type VCB with H&G Cradle, IEC Standard

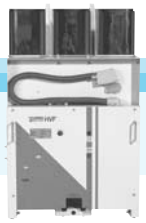
Dimension in mm





Type	Rating	Main circuit terminal
HVF 6062/6064/6067	24 kV 40 kA	
HVF 7052/7054/7057	36 kV 31.5 kA	

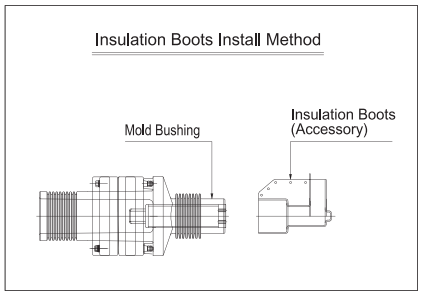
※ This drawing can be revised without notice.

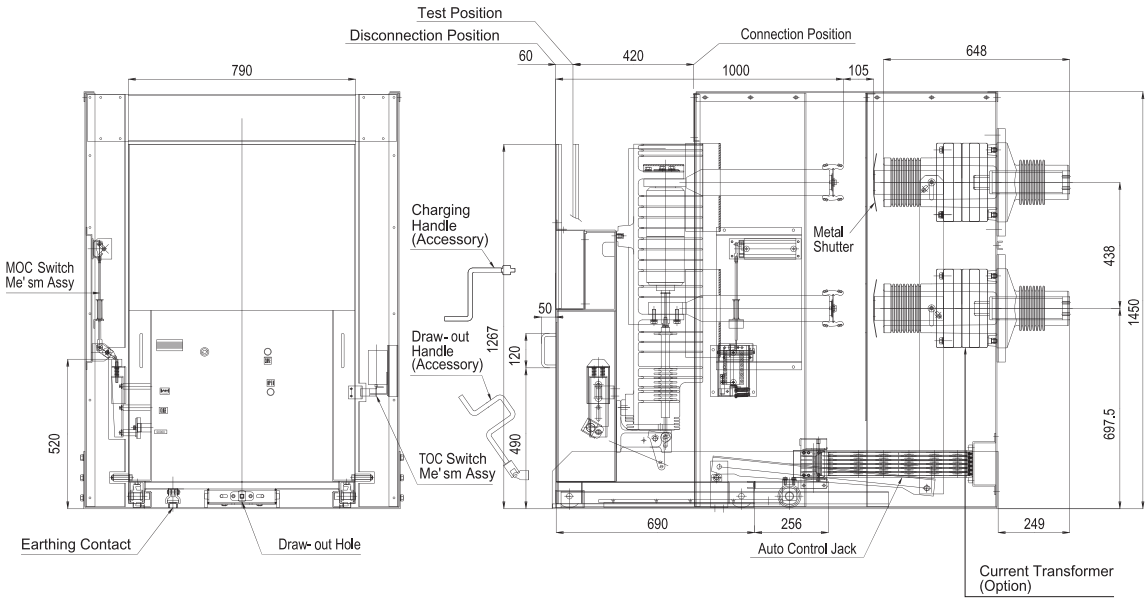


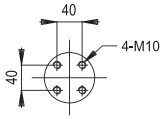
Dimension

HVF / 38 kV Draw-out Type VCB with C Cradle, ANSI Standard

Dimension in mm





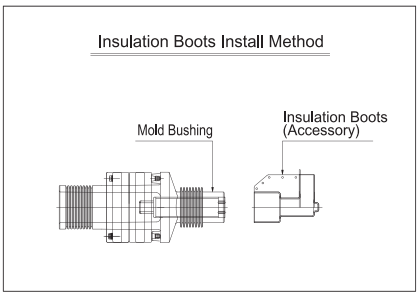
Type	Rating	Main circuit terminal
HVF 7052/7054/7057	38 kV 31.5 kA	
HVF 7062/7064/7067	38 kV 40 kA	

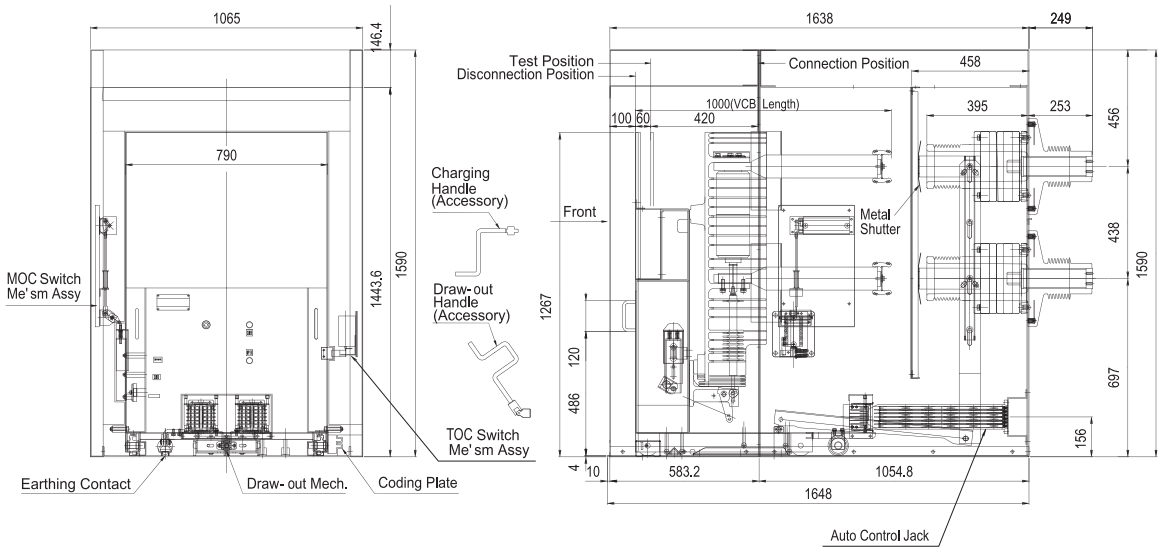
※ This drawing can be revised without notice.

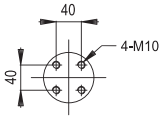
Dimension

HVF / 38 kV Draw-out Type VCB with M Cradle, ANSI Standard

Dimension in mm

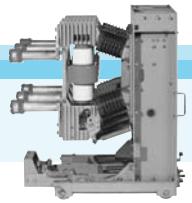




Type	Rating	Main circuit terminal
HVF 7052/7054/7057	38 kV 31.5 kA	
HVF 7062/7064/7067	38 kV 40 kA	

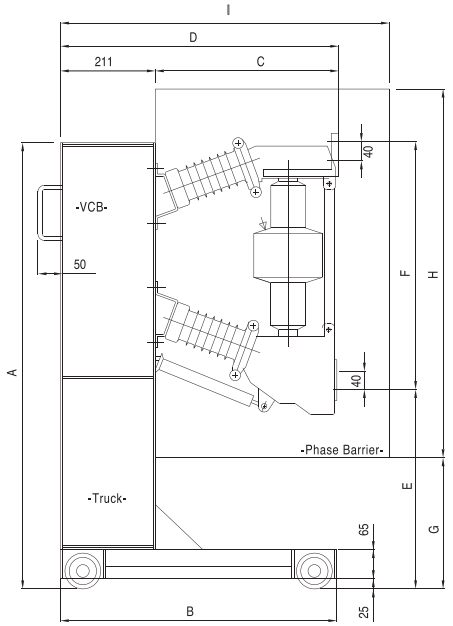
※ This drawing can be revised without notice.

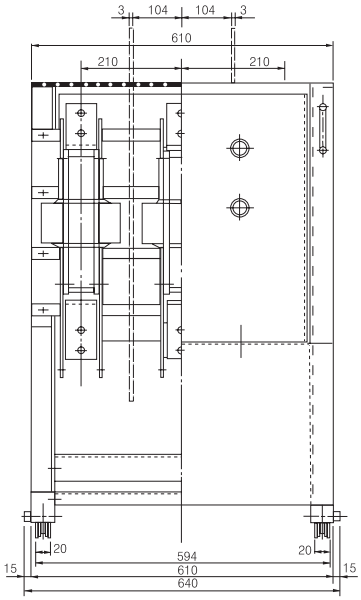
Dimension



HAF / Fixed Type VCB

Dimension in mm

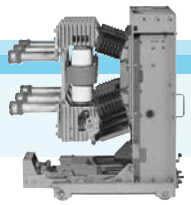




Type	Dimension										Main circuit terminal	
	A	B	C	D	E	F	G	H	I	Terminal type	A type	B type
HAF 1041/1042	844	550	323	534	324	453	Without phase barrier			A		
HAF 1044			313	524	284	493				C		
HAF 1051/1052			323	534	324	453				A		
HAF 1054			313	524	284	493				C		
HAF 1056			350	561	270	519				C		
HAF 1162/1762					302					B		
HAF 1164/1166/1167 1764/1766/1767										C		
HAF 1172/1772			356	567						B		
HAF 1176/1177/1776/1777										C		
HAF 1541/1542			360	571	310	479				A		
HAF 1544			350	561	270	519				C		
HAF 1751/1752			360	571						A		
HAF 1754			350	561						C		
HAF 1756										C		
HAF 2341/2342	966	600	360	571	433	479	318	715	615	A	C type	
HAF 2344/2346			350	561	393	519				C		
HAF 2351/2352			360	571						A		
HAF 2354/2356			350	560						C		
HAF 2362					423					B		
HAF 2364/2366/2367										C		
HAF 6111/6112/6121/6122 6131/6132/6141/6142			392	603	439	535	288	800	760	A		
HAF 6134/6144/6146					399	575				C		

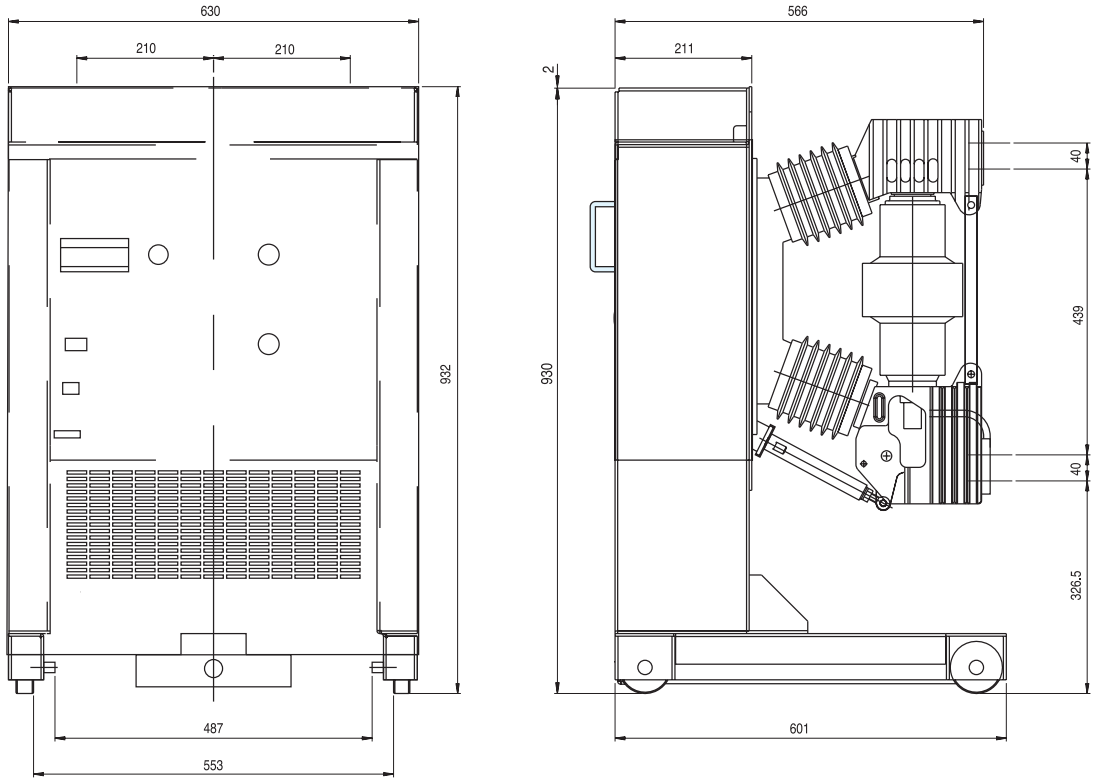
※ This drawing can be revised without notice.

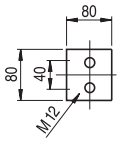
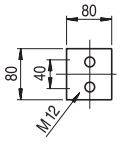
Dimension



HAF / 4. 76 kV, 15 kV Fixed Type VCB (ANSI Standard)

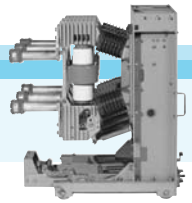
Dimension in mm



Type	Rating	Main circuit terminal
HAF 1072	4.76 kV 50 kA 1200 A	
HAF 2362	15 kV 40 kA 1200 A	
HAF 1074/1077	4.76 kV 50 kA 2000, 3000 A	
HAF 2364	15 kV 40 kA 2000, 3000 A	

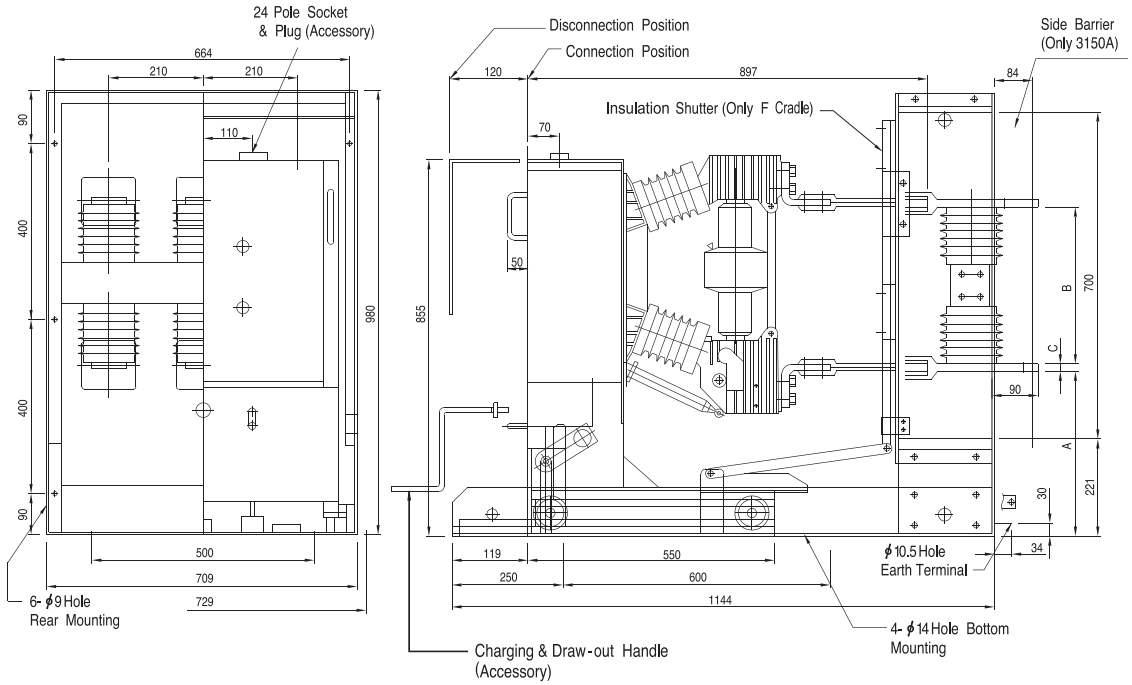
※ This drawing can be revised without notice.

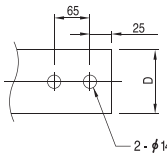
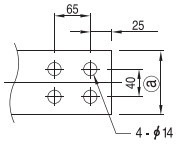
Dimension



HAF / 7.2 kV Draw-out Type VCB with E&F Cradle

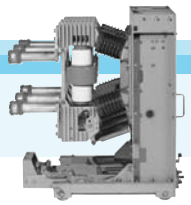
Dimension in mm



Type	Dimension				Terminal type	Main circuit terminal	
	A	B	C	ⓐ		A type	B type
HAF 1041	432	260	10	60	A		
HAF 1042				80			
HAF 1044/1051/1052/1054/1056	427		15		B		
HAF 1162/1164/1166	377	360					
HAF 1167				120			
HAF 1172/1176				80			
HAF 1177				120			

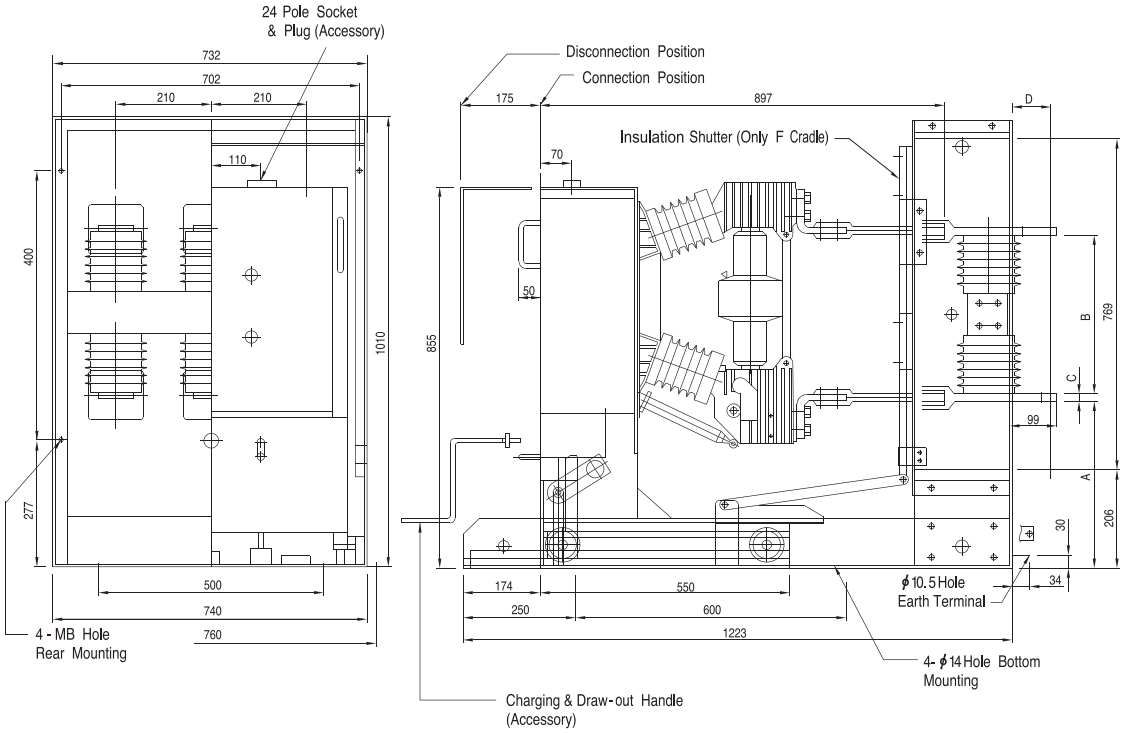
※ This drawing can be revised without notice.

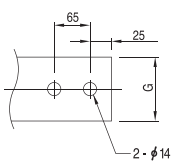
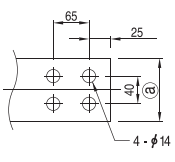
Dimension



HAF / 12 kV Draw-out Type VCB with E&F Cradle

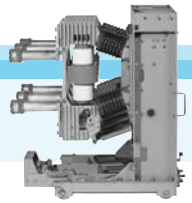
Dimension in mm



Type	Dimension					Terminal type	Main circuit terminal	
	A	B	C	D	ⓐ		A type	B type
HAF 1541/1542	382	360	10	99	60	A		
HAF 1544/1751/1752/1754	377		15		80	B		
HAF 1756				139	100			
HAF 1762/1764/1772				99	80			
HAF 1766/1776				139	100			
HAF 1767/1777					120			

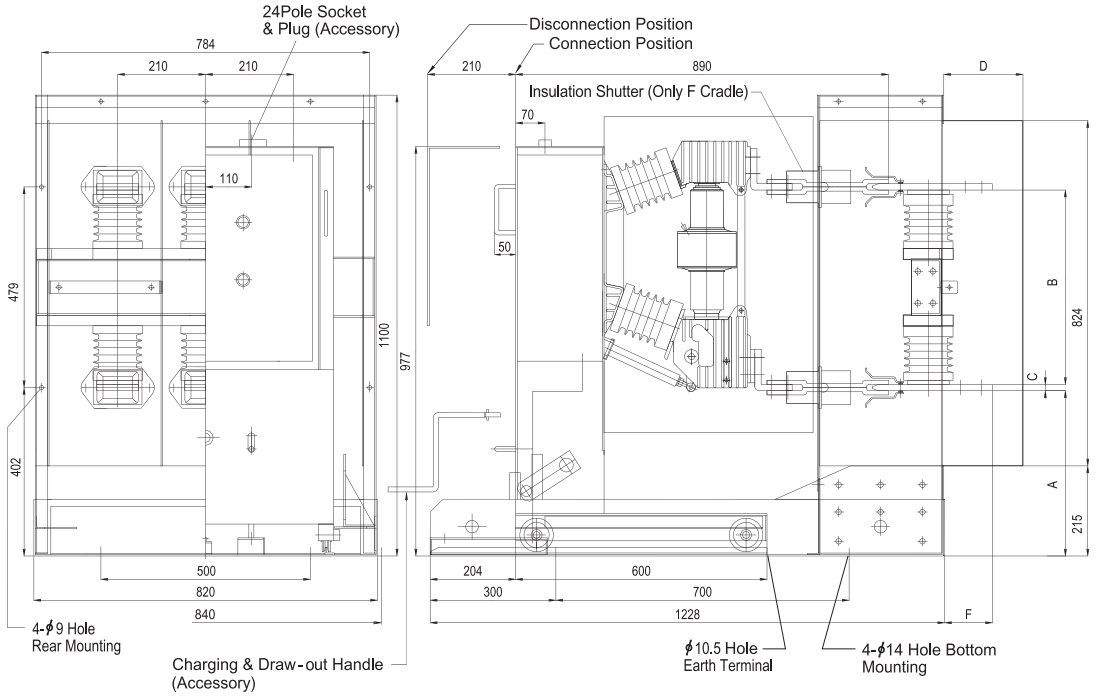
※ This drawing can be revised without notice.

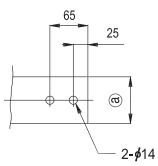
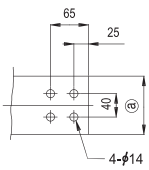
Dimension



HAF / 15 kV Draw-out Type VCB with E&F Cradle

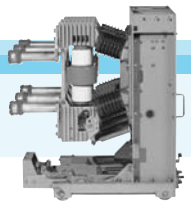
Dimension in mm



Type	Dimension						Terminal type	Main circuit terminal	
	A	B	C	D	F	ⓐ		A type	B type
HAF 2341/2342	369	464	10	189	115	80	A		
HAF 2344/2351/2352/2354	364		15			80	B		
HAF 2356						100			
HAF 2362/2364	394					80			
HAF 2366						100			
HAF 2367				268	205	120			

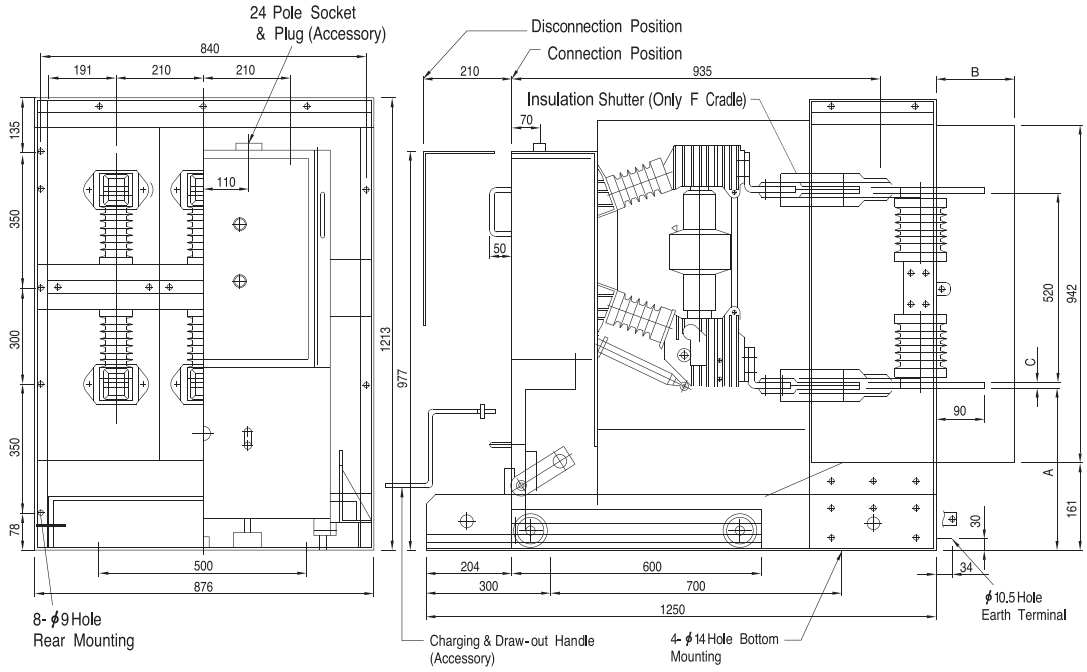
※ This drawing can be revised without notice.

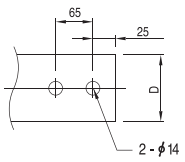
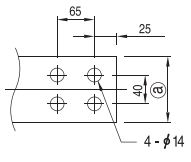
Dimension



HAF / 24 kV Draw-out Type VCB with E&F Cradle

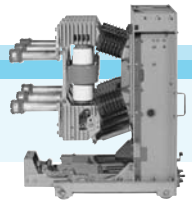
Dimension in mm



Type	Dimension				Terminal type	Main circuit terminal	
	A	B	C	ⓐ		A type	B type
HAF 6111	380	175	10	60	A		
HAF 6112				80			
HAF 6121/6122/6131/6132/6141/6142							
HAF 6134/6144	377		15		B		
HAF 6146		275		100			

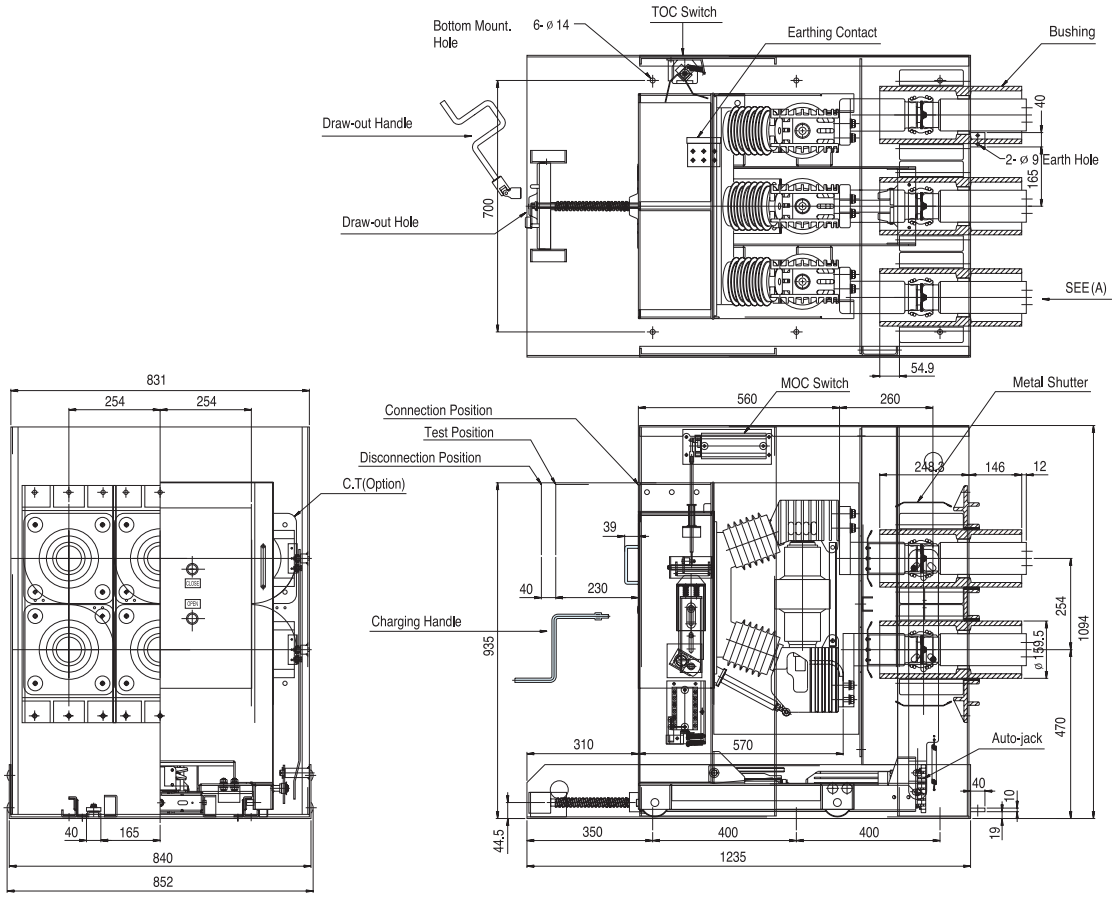
※ This drawing can be revised without notice.

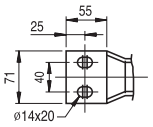
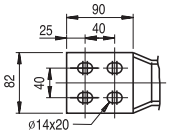
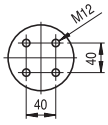
Dimension



HAF / 4.76 kV, 15 kV Draw-out Type with C-type Cradle

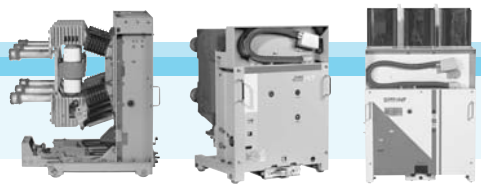
Dimension in mm



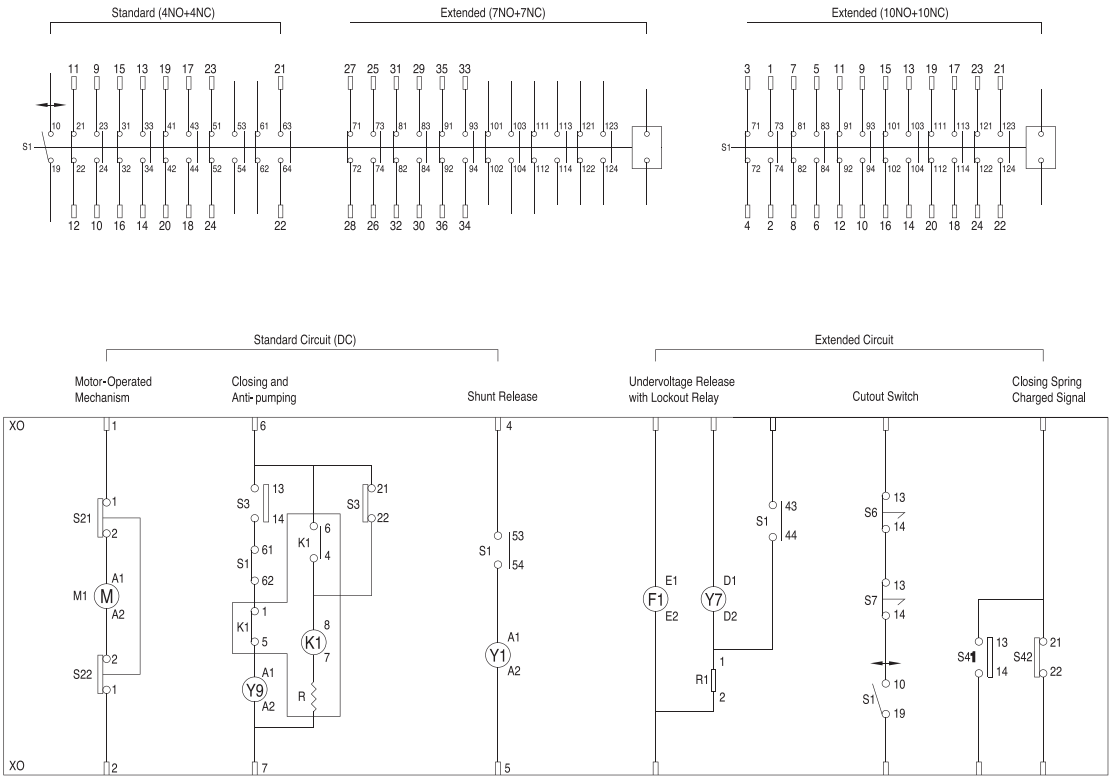
Type	Rating	Main circuit terminal
HAF 1072 - 3	4.76 kA 50 kA 1200 A	 T=15.0
HAF 2362 - 3	15 kA 40 kA 1200 A	
HAF 1074 - 3	4.76 kA 50 kA 2000 A	 T=20.0
HAF 2364 - 3	15 kA 40 kA 2000 A	
HAF 1077 - 3	4.76 kA 50 kA 3000 A	 ϕ =89.0

※ This drawing can be revised without notice.

Schematic Diagram



Dimension in mm



M1: Motor operating mechanism
F1: Lockout
K1: Anti-pumping contactor
R1: Resistor
X0: Plug connector

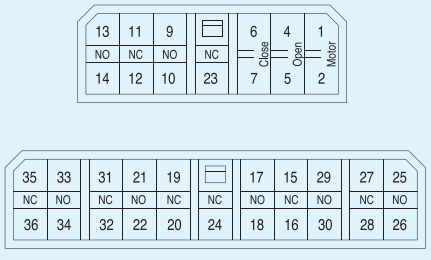
Y1: Shunt release
Y7: Undervoltage release
Y9: Closing solenoid

S1: Auxiliary switch
S3: Limit switch (K1 control)
S6, S7: Cutout switches
S21, S22: Limit switches (interrupt motor circuit after spring charged)
S41, S42: Position switch (spring charged status signal)

NOTE: 1. Extended circuit spec & connection line number are defined by user's request.
2. For the AC control circuit, the rectifier should be attached on the standard circuit.

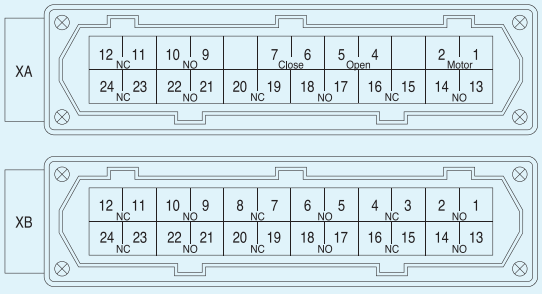
Control Jack Application

Mounted on type control jack (A & B type)



※ A type and B type are the same except inner materials.

Leaded out type control jack (C & D type)



※ C type is XA only

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