

HAF/HVF

ANSI Standard

VACUUM CIRCUIT BREAKER INSTRUCTION MANUAL

Applied Rating:

4.76kV	50kA	1200 – 3000A
15kV	40kA	1200 – 3000A
38kV	31.5kA	1200 – 3000A



■ NOTICE:

- Read and understand these instructions before attempting any unpacking assembly, operation or maintenance of the circuit breaker.
- This instruction manual should be applied only to HVF/HAF Series vacuum circuit breaker.
- This instruction booklet does not include all items regarding installation and maintenance procedures.
- For more information, please contact HD HYUNDAI ELECTRIC or one of our partners.

Safety Practices

This instruction manual applies only to HVF/HAF Series vacuum circuit breakers regarding installation and maintenance procedures.

Installing and maintaining these products improperly may result in serious personal injury, property damage, or even death. Therefore this instruction manual must be read and understood at any step in unpacking, assembly, operation, and maintenance of the breaker.

Only qualified persons who are familiar with installing and maintaining circuit breakers are permitted to work on the those persons at any time.

Signal Words

Signal words used in this instruction manual are divided by DANGER, WARNING and CAUTION depending on the situation.



Indicates an imminently hazardous point which, if ignored, will result in death or serious injury. This is the most dangerous point.



Indicates a potentially hazardous point which, if ignored, could result in death or serious injury.



Indicates a potentially hazardous point which, if ignored, may result in minor or moderate injury. This signal also warns operators not to work unsafely

Safety Practices During Moving



- ☐ When the breaker need to be moved on flat area, grab the handle and move the breaker
- ☐ When the breaker is lifted by the rope, it can lean to the terminal side. Make sure of not making any damage on person and products.

Safety Practices

Safety Practices During Installation



- ☐ Do not work on the breaker unless the primary circuits are disconnected.
- ☐ When connecting bus-bars, tighten bolts using our standards.
- ☐ The product should be installed and tightened on the plate area.
- ☐ Do not install the breaker in areas with high temperature, high humidity, dust, corrosive or vibrating conditions.
- ☐ Concrete dust or any other dust should not be inside of the product when it installed. It can cause fire or mis-operation.
- ☐ Connect the control jack tight, otherwise it can cause the mis-operation

Safety Practices During Operation



- ☐ Do not touch the main and control circuit while the products in operation. The hazardous voltage can cause serious problem.
- ☐ Do not let the product stay in the DISCONNECTION position with UNLOCK state.
- ☐ When the heavy product fall down on the ground, it can cause the serious accident or product damage.

Safety Practices During Maintenance



- ☐ Before doing any maintenance, always open the breaker and make sure that the main and control circuits are not charged.
The voltage can be hazardous.
- ☐ Discharge the springs and open the breakers before performing any breaker maintenance, inspection or repair.
Charged closing or tripping spring can cause serious injury.
- ☐ Use the standard pressure torque to tighten the bolts. Loosening the bolts can cause fire.
- ☐ Replacing parts should be done by our service agent.
- ☐ Operating the breaker should not be used more than its life time specified in catalogue.

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MEMO

Product Scope

1-1 HVF Type (HVF □□□□¹⁾)

Fig. 1-1

Rated Voltage (kV)	Breaking Current (kA)	Power Freq. Withstand Volt. (kV, 1 min)	Impulse Withstand Volt. (kV)	Rated Current (A)				
				630 (600)	1250 (1200)	2000	2500	3150
38	31.5	80	150(170) ²⁾		7052	7054	7056	7057

1-2 HAF Type (HAF □□□□-□¹⁾)

Fig. 1-2

Rated Voltage (kV)	Breaking Current (kA)	Power Freq. Withstand Volt. (kV, 1 min)	Impulse Withstand Volt. (kV)	Rated Current (A)				
				630 (600)	1250 (1200)	2000	2500	3150
4.76	50	19	60		1072-3	1074-3		1077-3
15	40	36	95		2362-3	3464-4	2366-4	2367-3

- 1) Type NO. Suffix in the “□□□□¹⁾” and “□□□□-□¹⁾” shall be listed as shown in the column of rated current.
- 2) Impulse withstand voltage “()” is available on request.

Technical Data

2-1 Service Condition

- 1) Site Altitude: Less than 1000 m
- 2) Relative Humidity: Less than 95%
- 3) Ambient Temperature: MAX 40 / MIN -25 °C

CAUTION

Consideration of site altitude!!!



If the site altitude is higher than 1000 m, dielectric strength of the breaker will be reduced according to the altitude. Therefore, the values of power frequency withstand voltage and lightning impulse withstand voltage should be selected.

≥ Rated withstand voltage according to rated voltage X k
(k: Refer to Table 2-1.)

For higher humidity, it is required to use a heater in the switchgear to prevent dewdrops on the insulation material and the consecutive decrease in dielectric strength.

Table 2-1 Correction factor as a function of site altitude

Applied Altitude	1000m	1500m	2000m	2500m	3000m
Correction Factor (k)	1.0	1.05	1.1	1.15	1.2

2-2 Motor

HAF & HVF VCB have motor-spring type stored-energy operating mechanism. The closing operation can be done only after the closing spring is charged.

Consumption during the operation is shown in Table 4, and the inrush current may be disregarded since it lasts for only a brief period.

The closing spring is fully tensioned by motor (M1) with the rated voltage applied through terminal no.1&2 of standard control circuit. Then the limit switch (S21, S22) stop the motor, and the spring indicator shows "SPRING CHARGED" by link activation as shown in Fig.1. The charged VCB can carry out the open-close-open sequential operation and also the next close-open operation without delay.

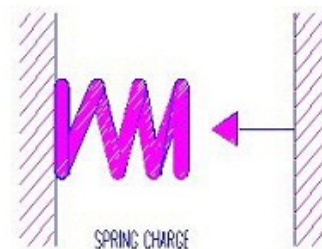
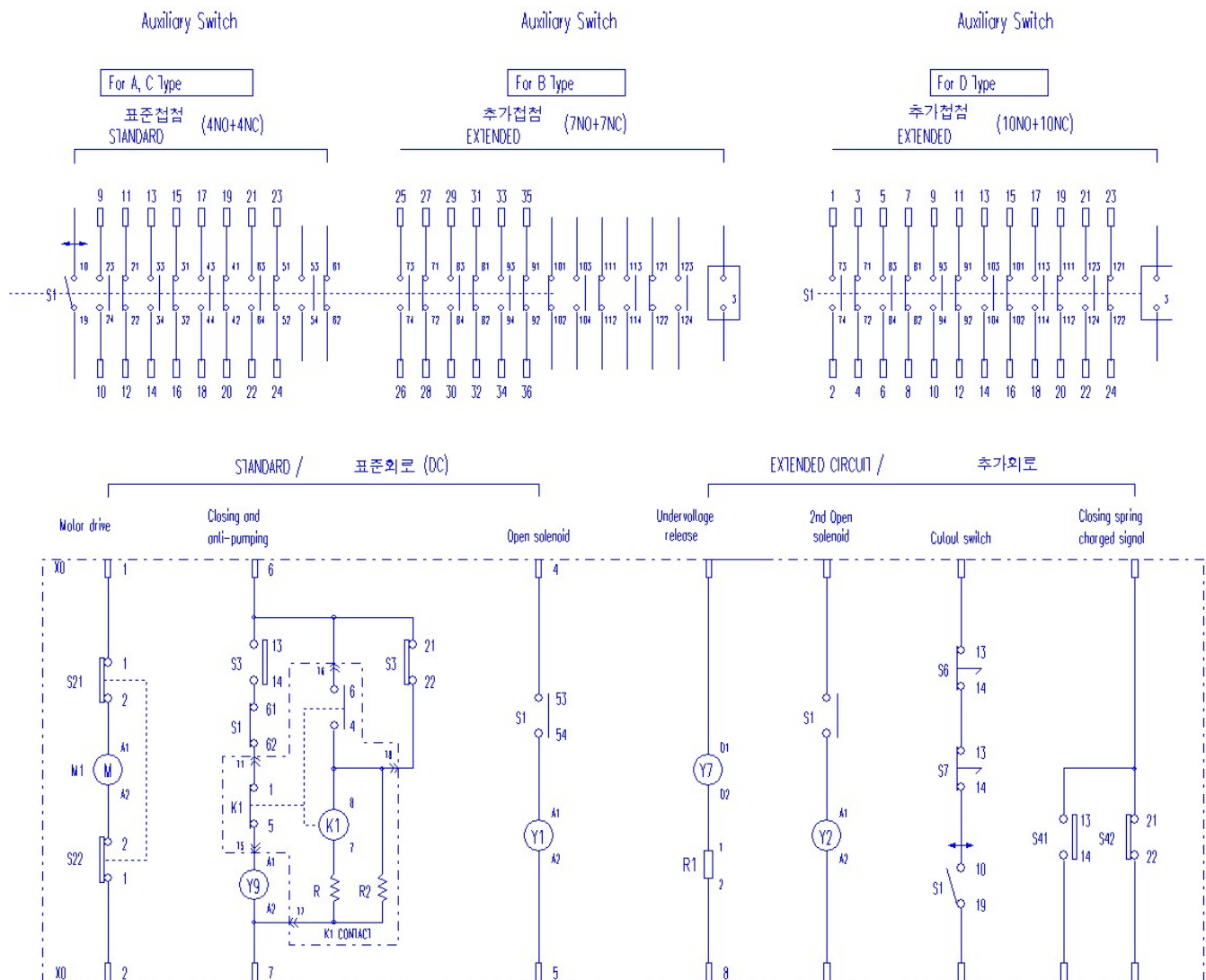


Fig.2-1
State of Spring

Technical Data

Fig.2-2 Standard Circuit Diagram Charged



M1	Motor operating mechanism	Y1	Open solenoid	S1	Auxiliary switch
K1	Anti-pumping contactor	Y2	2nd open solenoid	S3	Limit switch (K1 control)
R1	Resistor	Y4	C.T. operated release	S5	Limit switch supplied with the lockout (prevents closing by electrical means when lock-out effective)
X0	Plug connector	Y7	Under-voltage release	S6, S7	Cutout switches
		Y9	Closing solenoid	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.
3. Standard contacts can be insufficient on the request of the extended circuit.

Technical Data

2-3 Multiple Auto-Reclosing

HVF & HAF circuit breakers are capable of auto-reclosing and can also be used for multiple reclosing for the following operating sequence

O-0.3s-CO-15s-CO-15s-CO..... (O: tripping; C: closing)

2-4 Interlock Mechanism of the Draw-Out Type Breaker

The draw-out type circuit breaker has an interlock mechanism which prevents trouble due to misoperation. The sensing parts check the position of the circuit breaker and prevent it from closing if the associated disconnecter is not allowed for safe operation.

CAUTION



Mis-operation or carelessness may result in serious injury or property damage.

With the breaker closed, the draw in & out operation is impossible. Do not push too hard on the breaker under improper condition.

2-5 Closing (Y9) and Anti-Pumping (K1)

When closing authorization is applied through terminals nos. 6 & 7, Solenoid Y9 unlatches the closing spring, and thus closes the circuit breaker electrically.

Immediately after the breaker closes, Aux. S/W, S1 open the circuit of closing, and limit switch S3 and anti-pumping relay K1 switch affect to Y9 so that they can not be reactivated until the continuous closing command is interrupted. Thus the breaker can meet the IEC requirements for anti-pumping and trip-free operation.

At the same time, the contact pressure spring is compressed properly to maintain sufficient contact pressure on the moving contact of the vacuum interrupters while the breaker is in the closed position, and the tripping spring is compressed for the opening operation.

Technical Data

2-6 Open solenoid (Y1)

When the opening command is applied, the tripping spring is unlatched by the trip solenoid Y1 and the force turns the torque to rotate the brake shaft to make the opening position.

Immediately after the breaker is open, the indicator displays the open state and Aux. S/W, S1 open the opening circuit.

2-7 Auxiliary Switch (S1)

The standard auxiliary contacts for external connection are composed of 4NO+4NC. These contacts are wired to the control jack (XO).

Rated Insulation Voltage: AC/DC 250 V

Continuous Current: 10 A

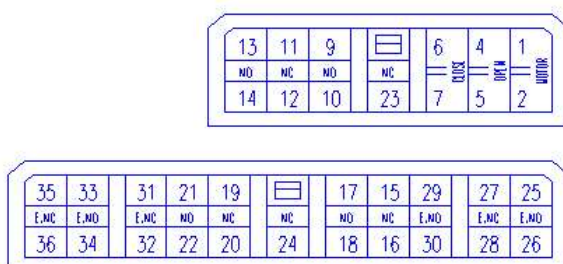
Making Current: 30 A

Switching Current: 2 A at DC 220 V, $\tau=20$ ms

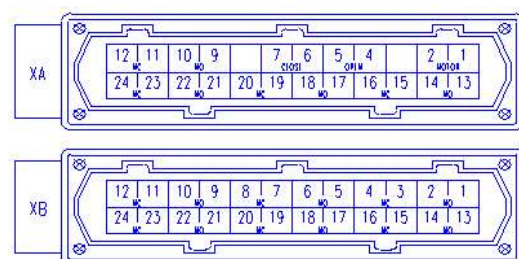
* The maximum connection 10NO+10NC is available on request.

Fig. 2-3 Arrangement of control jack

Fixed type control jack (A/B type)



Draw-out control jack (C/D type)



2-8 Condenser Trip Device

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

The contacts B1, B2 of auxiliary relay are connected with tripping push button as shown below. The breaker can be opened automatically in case of power failure and terminals 5, 7 can be used as AC power supply connecting to the motor or closing circuit.

Technical Data

CAUTION



This device maintains 30 seconds for the voltage which can trip the breaker just one time.
It cannot be operated properly if used for other purposes or if the circuit is modified without consulting the manufacturer.

Fig. 2-4 Condenser trip device

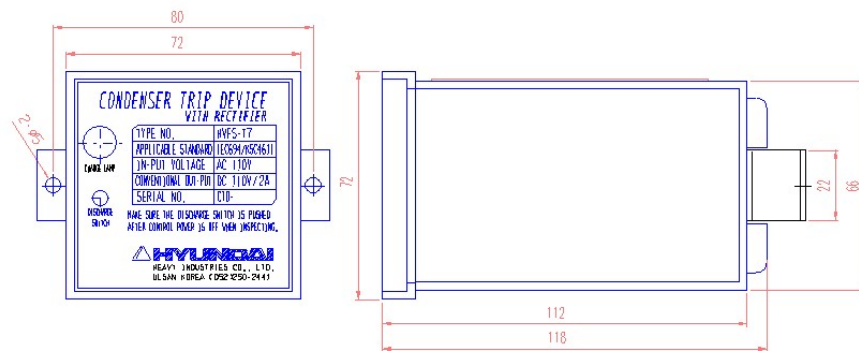
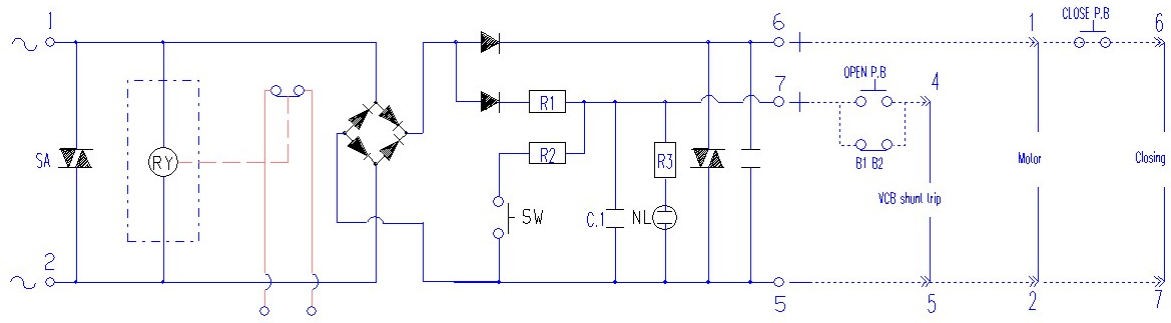


Fig. 2-5 Circuit diagram of condenser trip device



2-9 Under Voltage Release (Y7)

The UVR (Y7) having a spring-energy storing mechanism, is used for the continuous monitoring of circuits, and can open the circuit breaker automatically when the control voltage drops lower than the drop-out voltage.

And the latching mechanism of the release can be excited to hold the closing condition of the circuit breaker when the control voltage rise than the pick-up voltage.

- Drop-out Voltage: 35~60% of rated control voltage
- Pick-up Voltage: 75~85% of rated control voltage

If it is necessary to lock the automatically tripping function of the release at the lower control voltage, you can place the lock-screw as shown in Fig. 2-6.

And the release can be operated again by shifting the screw down as shown in Fig. 2-7

Technical Data

Fig. 2-6 Locked state

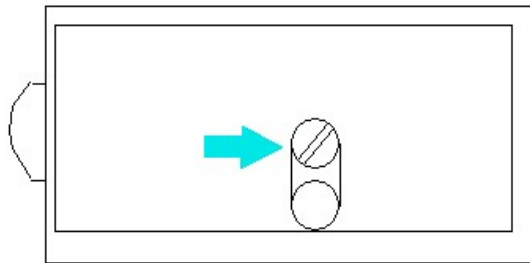
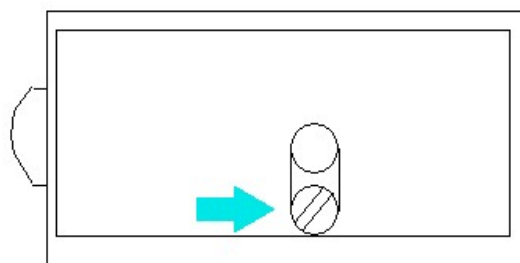


Fig. 2-7 Unlocked state



2-10 2nd Open Solenoid (Y2)

2nd trip solenoid (Y2) can be attached to the HYUNDAI HAF/HVF circuit breaker putting aside the 1st trip solenoid (Y1), so that the circuit breaker can be opened with more safety.

2-11 Cutout Switch

The cutout switch consists of two limit switches, which are connected in series with the impulse contact of the auxiliary switch in the alarm circuit.

When the VCB is opened locally, the cutout switch interrupts the tripping signal.

* Closing time of impulse contact is more than 10 ms.

2-12 "Closing Spring Charge" Signal

Using the auxiliary switches S41, S42 operated by the closing spring, the spring charged indicator is displayed for visual checking.

Handling and Installing the Breaker

CAUTION



Excessive weight will cause the serious injury, property damage, or even death.

To avoid this situation, do not transport a circuit breaker on a lift truck or other lifting facility in the raised position.

3-1 Unloading and Storage

When unloading from the vehicle, avoid turning it over. Special care should be taken to avoid shocks.

If vacuum circuit breakers must be stored prior to use, they should be stored only in dry, dust-free and well ventilated rooms, with the breakers in the OFF position and the stored-energy spring mechanism in the released position.

3-2 Unpacking

When opening the package, also avoid turning it over and special care should be taken to not damage the breaker. Handle carefully the insulated parts, vacuum interrupters, main circuit, disconnecting unit, front panel and so on.

3-3 Inspection after Unpacking

- (1) Check the type rating and quantities with the specification sheet.
- (2) Check the circuit breaker for any damage or missing materials.
- (3) Check all accessories and spares supplied. Also, check to see if these parts are damaged.

3-4 Installation

Before installing the circuit breaker into the switchgear, check the type rating and for any signs of damage again. Wipe the breaker with a dry cloth to remove dirt and dust.

Mount the draw-out unit (if it is used) on a level floor by means of screwing through the mounting holes on the bottom. Then, the tolerance on the level should be within 1 mm.

If required, adjust the level using a liner.

Handling and Installing the Breaker

Wipe the connecting surface with a dry cloth to remove dirt and dust before connecting main circuit bus-bars and earth terminal, and be careful not to shock the draw-out unit and breaker.

NOTE: Refer to our catalogue "HAF&HVF Vacuum Circuit Breaker" for mounting hole sizes of the each draw-out unit and earth terminal's size.

D A N G E R

**Heavy weight!**

Please use lifter to remove or install the breaker in the upper position of the switchgear.

Do not stand below the lifted breaker.

3.5 Inspection Before Operation

- (1) Check to see if the breaker is installed properly.
- (2) Operate the breaker a few times manually to ensure that the breaker is closed and opened smoothly. Then, operate the breaker using the motor operating mechanism with the auxiliary power, and check the ON/OFF indicator and charged state of the closing spring.
- (3) Check that no tools and materials are left near the breaker.
- (4) Ground all possible parts of circuit breaker.

D A N G E R

**Charged closing or tripping spring can cause serious injury.**

To avoid this situation, always be attentive to the mechanism of sudden movement before taking any action on the circuit breaker. Discharge the springs and open the breakers before performing any breaker maintenance, inspection or repair.

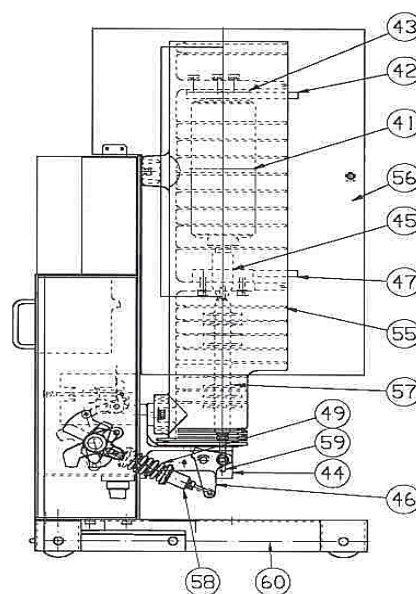
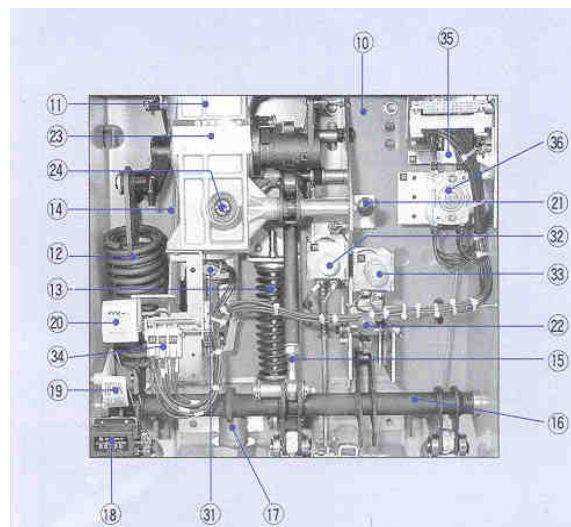
3.6 Manual Operation

- (1) Insert the handle-crank in the hole and turn it clockwise until the indicator displays "SPRING CHARGED".
- (2) Press the "ON" button. Be sure to check that the breaker is closed and the ON/OFF indicator displays "CLOSE".
- (3) Press the "OFF" button. And, be sure to check that the breaker is opened and the ON/OFF indicator displays "OPEN".

Structure and Operation

4-1 Description of HVF VCB

NO	ITEM
10	Housing Box
11	Gear Box
12	Closing Spring
13	Tripping Spring
14	Link
15	Coupling Bar
16	Breaker Shaft
17	Dash Pot
18	Counter
19	ON/OFF Indicator
20	Spring Charged Indicator
21	Closing Button
22	Tripping Button
23	Name Plate
24	Hole for Manual Charging
31	Motor
32	Closing Solenoid (Y9)
33	Tripping Solenoid (Y1)
34	Limit Switch (S21, S22, S3)
35	Anti-Pumping Contactor
36	Auxiliary Switch (S1)
41	Vacuum Interrupter
42	Upper Terminal
43	Upper Spacer
44	Lower Pole Support
45	Ring Contact
46	Lever
47	Lower Terminal
49	Contact Pressure Spring
55	Insulation Frame
56	Barrier </td
57	Insulation Rod
58	Spring Guide
59	Eye Bolt
60	Truck



Structure and Operation

4-2 Explanation of Operation

1) Charging

When the charging mechanism (11) is activated by a hand or a motor (31), the charging shaft (11-1) of the mechanism turns by the gears and the driver (11-2) so that the closing spring is tensioned.

When the closing spring is fully tensioned. The closing pawl (11-3) makes the closing spring be latched.

2) Closing

When closing command is applied, the closing spring is unlatched by the activation of the closing pawl. By the energy occurred from the discharging of the closing spring, the coupling bar is powerfully pushed down via the charging shaft and the cam (11-1).

Consequently, the breaker shaft is turned until the moving contact is fully closed and latched by the trip pawl (25-1).

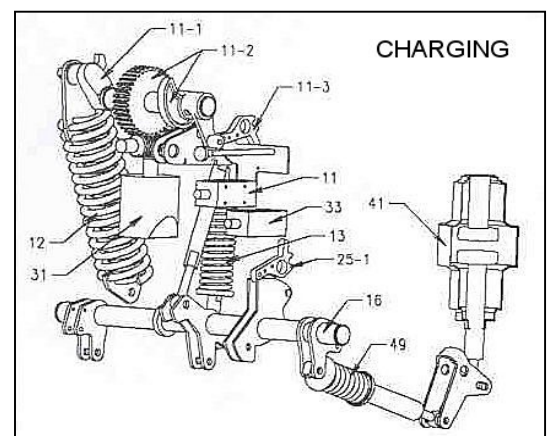
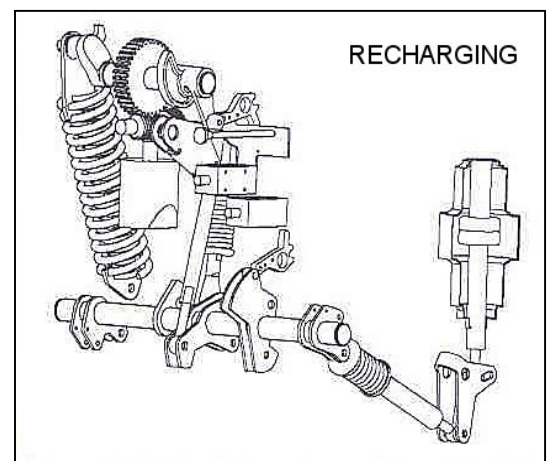
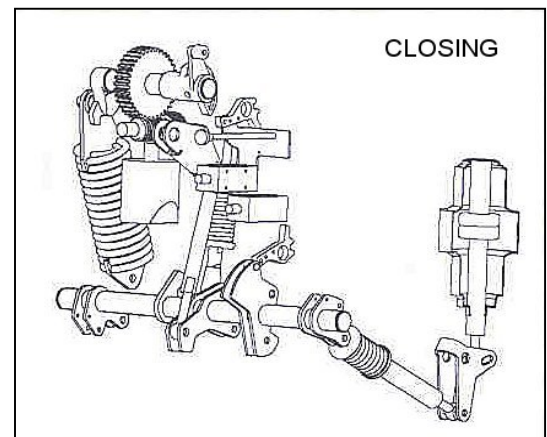
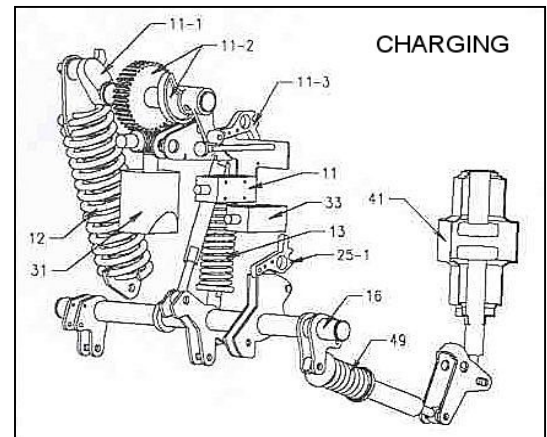
At the same time, the contact pressure spring is compressed to insure sufficient contact pressure on the moving contact while the breaker is in the closed position, and the tripping spring (12) is compressed for the consequent opening operation.

3) Recharging

After the closing operation, the closing spring can be immediately recharged by a motor or hand so that the breaker immediately reclose in case of closing command applied.

4) Opening

When opening command is applied, the tripping spring is unlatched by the activation of the trip pawl, and the breaker shaft is returned to the open position.



Structure and Operation

4-3 Draw In & Out Operation of HVF VCB

CAUTION

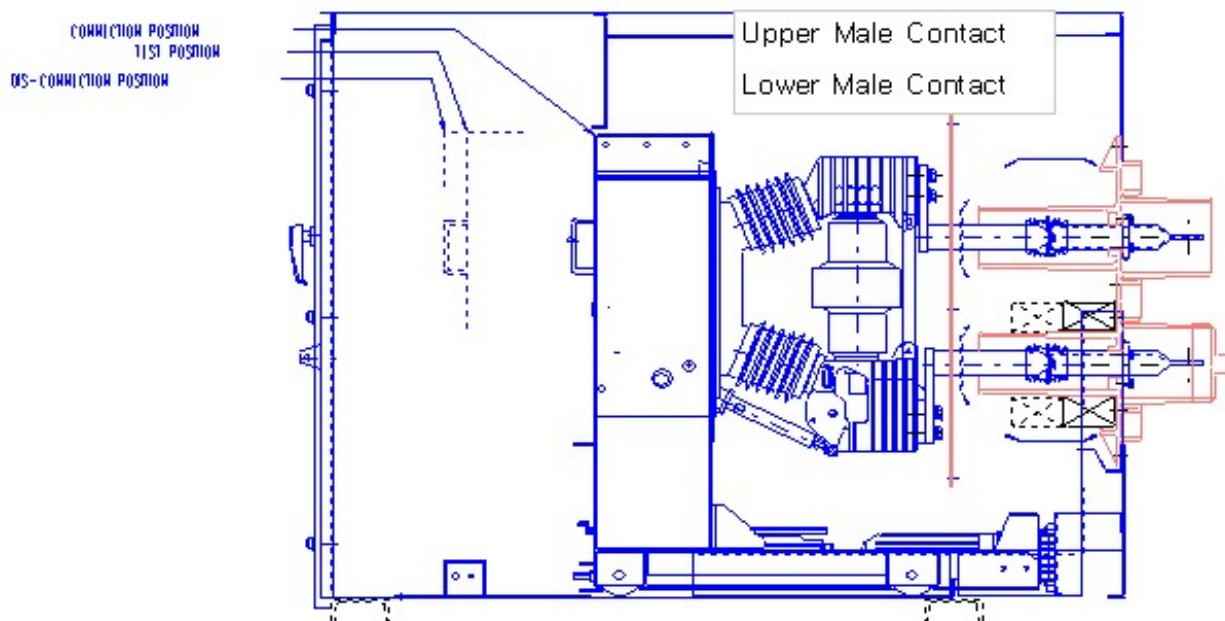


- BEFORE INSERTING OR WITHDRAWING THE BREAKER, THE BREAKER SHOULD BE OPEN AND THE RACK HANDLE STAYED IN UPWARD. FAILURE TO DO SO COULD RESULT IN PRODUCT DAMAGE AND ACCIDENT.
- THE RACK HANDLE SHOULD BE OPERATED WITH THE HAND AND DO NOT PUSH TOO HARD.
- THE RACK HANDLE SHOULD BE OPERATED ONLY FOR MOVING THE BREAKER BECAUSE THE BREAKER WILL BE OPENED AS OPERATING THE RACK HANDLE IN THE SERVICE CONDITION.

NOTE:

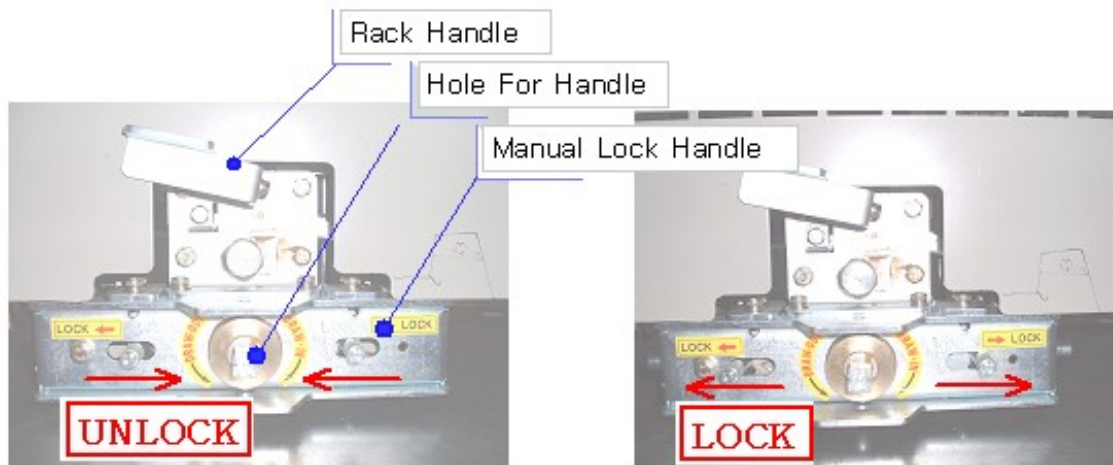
EXPLANATION OF THE EACH POSITION

- **DISCONNECTION POSITION:** The state of isolation with the switchgear and the breaker completely. Only can be operated manually.
- **TEST POSITION:** The state of isolation with the switchgear and the breaker. But the control power which charge the closing spring is supplied and the several test can be done to the breaker for inspection in this position
- **CONNECTION POSITION:** The state of connection with the female contact of the breaker and the male contacts of the switchgear. The breaker is ready for carrying the rated current in this position.



The position of the breaker in each position

TRANSFORMATION FOR ALL



UNLOCK state of the manual lock handle.

LOCK state of the manual lock handle.

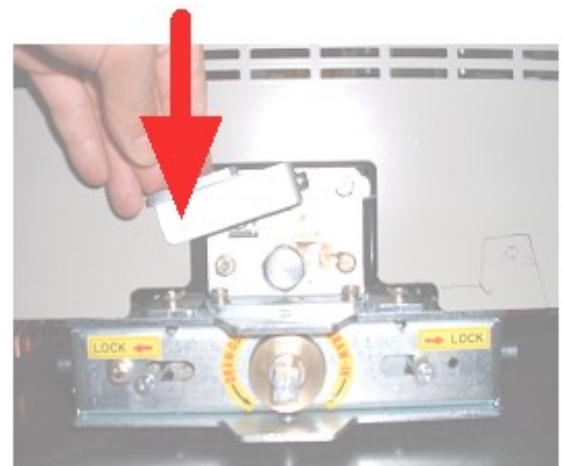
(1) BEFORE INSERTING THE BREAKER

Make sure that the breaker is open and the spring indicator displays "SPRING RELEASED". Otherwise, push the closing button and trip button in order without the control power.

And also, set the manual lock handle to the UNLOCK position.

(2) INSERTING TO THE DISCONNECTION POSITION

Put the breaker to the switchgear and push it slowly until it stopped. When it stopped, set the manual lock handle to the LOCK position. This is the disconnection position.



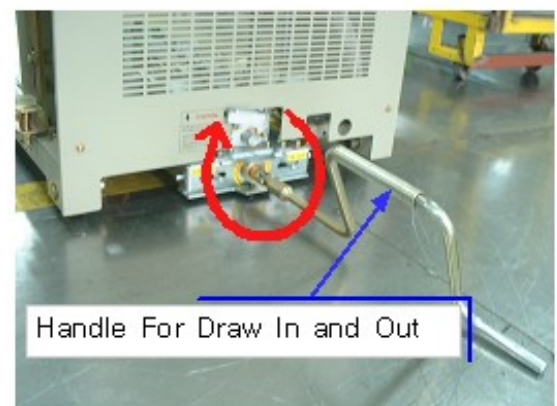
Push down the rack handle.

(3) INSERTING TO THE TEST POSITION

Push down the rack handle with hand and make sure that being stayed in down without holding it.

Insert the handle into the Hole and turn it clockwise direction.

If the closing spring was charged, it will be released at certain point before reaching the test position for full safety. The rack handle will be moved upward in the test position.



INSERTING : Clockwise direction
WITHDRAW : Anticlockwise direction

(4) INSERTING TO THE CONNECTION POSITION

Push down the rack handle again with hand and make sure that being stayed in down without holding it.

And then, turn it clockwise direction.

The rack handle will be moved upward in the test position and the breaker is finally ready to close for service.

(5) WITHDRAWING THE BREAKER

For withdrawing the breaker from the switchgear, follow the reverse procedure of inserting the breaker.

CAUTION

In the "connection" or "disconnection" position, the rack handle will move upward so that the circuit breaker is locked. The circuit breaker can be closed after it has been locked.



When the breaker is located between the "connection" and "test" position or the "test" position and the "disconnection" position, the rack handle is stayed horizontally so that the circuit breaker cannot be closed.

Maintenance and Inspection

HYUNDAI HVF/HAF Vacuum Circuit Breakers require little maintenance because of their simplified operating mechanisms and robust construction.

In fact, only the parts subject to normal wear and aging need be serviced to ensure fully reliable service. The interval at which these jobs should be carried out and the amount of work involved depend upon

- The number of short circuit interruptions
- The switching frequency
- The actual service time
- Environmental conditions

But, the service intervals indicated below are only approximate and should be adjusted to suit particular operation or environmental conditions. Under normal condition the vacuum interrupters need not be serviced.

CAUTION

Failure to maintain the equipment could result in death, serious injury or product failure and can prevent successful functioning of the connected apparatus.



Do not work on a breaker in the "connection" position.

Do not work on a breaker with springs charged or contacts closed.

Do not leave maintenance tools around the breaker.

While the work is in progress, all auxiliary voltage sources must also be disconnected.

5-1 Visual Inspection

The purpose of visual inspection is to check the exterior of the breaker in usual operation. Once a year, a general visual inspection is should be carried out. And, the outer insulation parts should be wiped with a rag more frequently if the breakers are exposed to a dust-loaden.

TABLE 1. The visual inspection lists

INSPECTION	D E S C R I P T I O N
CIRCUIT BREAKER	Check if ON/OFF indicator is normal Check for the presence of dust or moisture Check for unusual noise, smell or discoloration
TEMPERATURE RISE	Check for inside of the switchgear for normal temperature Check for main-circuit terminals for discoloration or traces of overheat.
CONTROL VOLTAGE	Check the operating voltage and the control voltage with voltmeter

Maintenance and Inspection

5-2 Periodical Inspection

Periodical inspection is generally made once every 3 years though it depends on the operating condition of the circuit breaker. The operating mechanisms should be oiled and lubricated in specific parts or every 10 years or after 10,000 make-break operations. Table 2 shows items and intervals of the periodical inspection.

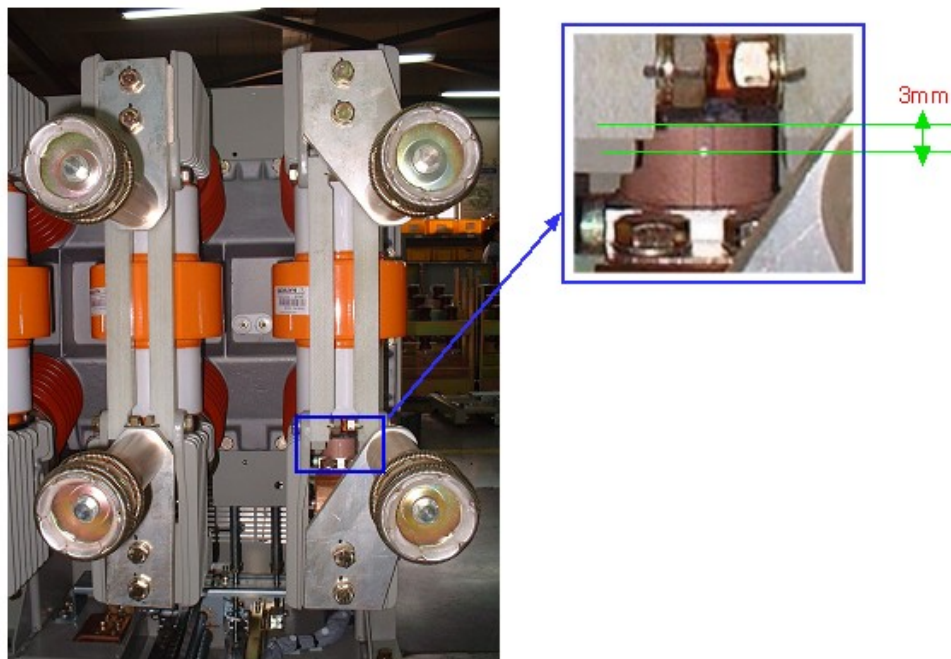
Table 5-2. The lists and interval of the periodical inspection

INSPECTION ITEMS	DESCRIPTION	INTERVAL REMARK
General Check	1. Clean the insulated surface with a dry cloth to remove dust and moisture,	3 years
	2. Check the exterior for damage,	
	3. Check for loose bolts and nuts in the operating mechanism and the external parts,	
	4. Check stop ring and stop retainer for damage,	
	5. Check the connection between terminals and conducts,	
Operation Test	1. Operate a few times manually and electrically and check each part for proper function,	2,000 operations or 10 operations of short circuit currents
	2. Check ON/OFF indicator and counter for proper function,	
	3. Check the compressed length of contact press sp, according to appendix A,	
Insulation Resistance	1. Measure insulation resistance between phases and between pole-earth with 1000 V megger. If the measured value is less than 500 MΩ, check the cause,	3 years
	2. Check insulation resistance between control circuit and earth 500 V megger. If the measured value is less than 2 MΩk, check the cause,	
Withstand Voltage Test	1. Test the breaker with power withstand voltage test according to appendix A,	3 years
Lubrication	1. Lubricate each part of operating mechanism,	10 years or 5,000 operations
	2. Clean disconnection unit with a dry cloth and a small amount of grease (conductive grease: lithium soap-based grease),	
Vacuum Interrupter	1. Check the contact erosion. (In closed condition, V should be replaced if half of the white mark visible,)	5,000 operations
	2. With the circuit opened, check vacuum degree,	

Maintenance and Inspection

5-3 Contact Erosion Limit

Since 3mm the contacts are contained inside the interrupter, they remain clean and require no maintenance. However, during high current interruptions there may be a minimum amount of erosion from the contact surfaces. Maximum permitted erosion is 3 mm. To determine contact erosion, close the breaker and observe the vacuum interrupter moving stem from the rear of the breaker. If the **WHITE MARK** on each stem is visible, the erosion has not reached maximum value thus indicating satisfactory contact surface of the interrupter. If the white mark is not visible, the vacuum interrupter must be replaced.



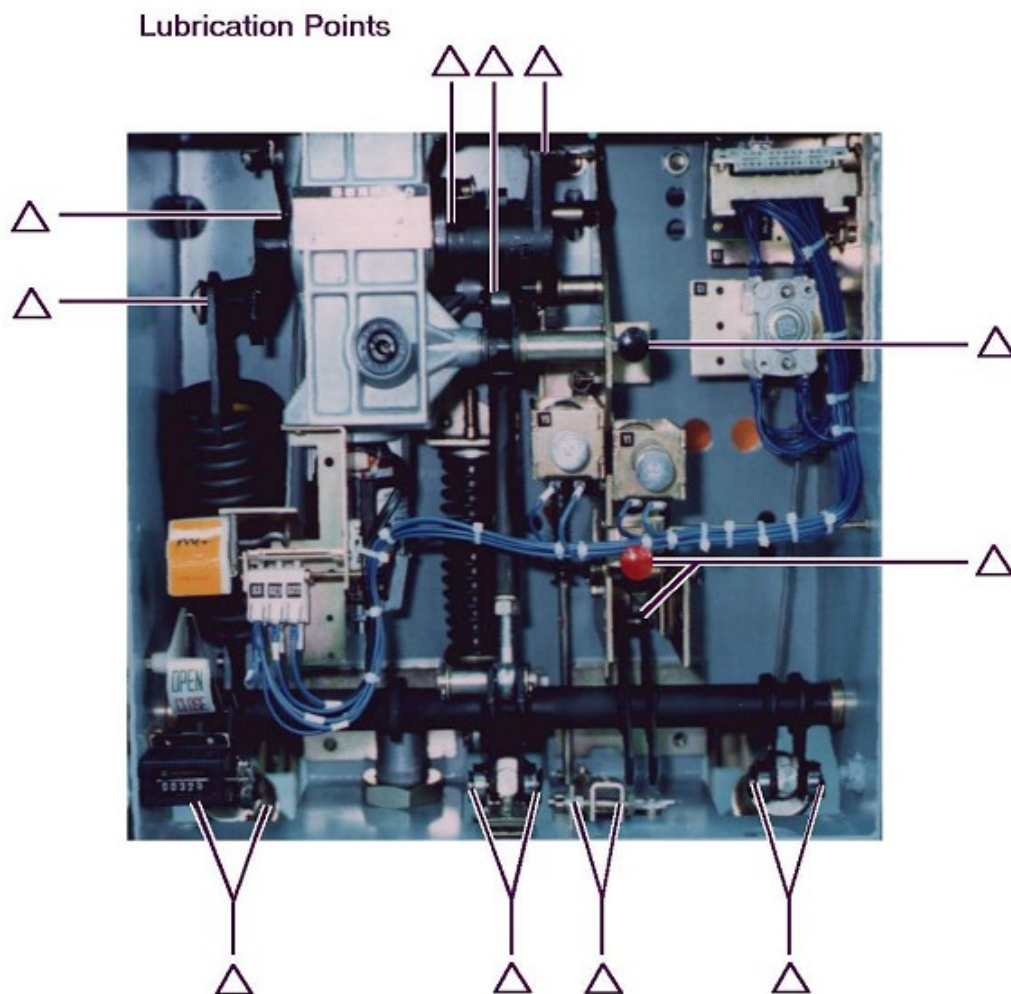
Check the contact erosion limit

5-4 Troubleshooting

SYMPTOM	CAUSE	ACTION
	Motor switch off	Check the Cable of Motor Line
	No control power	Breaker in Disconnection Position
	Motor will not run	Replace the Motor
	Spring charged	Check the Spring Charge Indicator
	Closing spring not charged	Charge Closing Spring
	Breaker closed	Check the OPEN/CLOSE Indicator
	Breaker is not in proper position	Set into the Disconnect, Test or Connect Position
	No electrical close signal	Verify Control Power Available Check Close Solenoid
	Breaker open	Check the OPEN/CLOSE Indicator
	No electrical open signal	Verify Control Power Available Check the Open Solenoid

Maintenance and Inspection

5-5 Lubrication points



Lubrication of the operating mechanism is necessary only every 10 years or every 10,000 operating cycles.

In general, the circuit breaker requires only moderate lubrication at regular intervals and all excess must be removed with a clean cloth to prevent any accumulation of dust or dirt. Avoid any lubricant on insulation or other electrical parts.

Moving parts should then be moved slightly to let the grease penetrate and become properly distributed.

Now operate the breaker several times manually.

Our recommended grease for lubrication is *Shell Albania No. 2*.

The points to be lubricated inside of mechanism housing are shown in Fig. 5-2.

Appendix

APPENDIX A, Basic Specification of HVF HAF VCB Series

TYPE	Standard	Power Frequency Withstand Voltage (kV/1min)	Control Circuit Withstand Voltage (kV/1min)	VI TYPE	VI GAP (mm)	Compressed Length of contact Sp. CONTACT SP.
HAF1072/4/7	ANSI	19	2	HVS10027	8.5 ± 1	5~9
HAF2362/4/6/7	ANSI	36	2	HVS10027	11 ± 1	5~9
HVF7052/4/6	ANSI	80	1.5	HVS03640	20 ± 1	5~9

Maintenance Recording Sheet

Date	The Substance of service	Service Agent	Engineer	Cost/Free	Remarks	Signature

- Please get the signature.
- Every time this recording sheet should be filled for maintenance of the breaker.

TRANSFORMATION
FOR ALL

MEMO



Korea

Head Office	477, Bundang Suseo-ro, Bundang-gu, Seongnam-si, Korea	Tel: +82-2-479-9180	Fax: +82-2-500-4958
Factory	53, Je3gongdan 3-gil, Seoun-myeon, Anseong-si, Gyeonggi-do, 17605, Republic of Korea	Tel: +82-52-202-8179	Fax: +82-52-202-8100
Reliability Center	17-10, Mabuk-ro 240beon-gil, Giheung-gu, Yongin-si, Gyeonggi-do, Korea	Tel: +82-31-289-5000	Fax: +82-31-289-5040

Overseas Subsidiaries

Atlanta	2405 Satellite Blvd, Duluth GA 30096, U.S.A.	Tel: +1-678-789-1885	
Alabama	215 Folmar Parkway, Montgomery, AL 36105, U.S.A	Tel: +1-334-481-2000	Fax: +1-334-386-8994
Arabia	Office No. 529, 5th floor Akaria-3 Building, Olaya Street, PO Box 9187, Riyadh 11413, Kingdom of Saudi Arabia	Tel: +966-11-419-0168	Fax: +966-11-419-0220
Yangzhong	No.9, Xiandai Road, Xinba Scientific and Technologic Zone, Yangzhong, Jiangsu, P.R.C. Zip:212212, China	Tel: +86-511-8842-0510	Fax: +86-511-8842-0388

Branch Offices

London	50-68 High Street, Weybridge, KT13 8BL, United Kingdom	Tel: +44-7979-125051	
Frankfurt	Eschborner Landstrasse 55, 60489 Frankfurt am Main, Germany	Tel: +49-69-7490-3934	
Moscow	World Trade Center, Ent.6, #412, Krasnopresnenskaya Nab.12, Moscow, 123610, Russia	Tel: +7-495-258-1381	
Riyadh	Office No. 530A, 5th Floor Akaria-2 Bldg., Olaya St., Short Address RHOB6847, Riyadh 12244, Kingdom of Saudi Arabia	Tel: +966-11-210-1107	Fax: +966-11-210-1107
Dubai	Unit 205, Emaar Square Building NO.4 Sheikh Zayed Road, Pobox 252458, Dubai, U.A.E	Tel: +971-50-321-8154	Fax: +971-4-425-7996
Bangkok	19th Floor, Unit 1908, Sathorn Square Office Tower, 98 North Sathorn Road, Silom, Bangrak, Bangkok 10500, Thailand	Tel: +66-02-115-7920	Fax: +66-2-115-7898
Ho Chi Minh	Room 1405, 14th Floor Centec Tower, 72-74 Nguyen Thi Minh Khai Street Vo Thi Sau Ward, District 3, Ho Chi Minh City, Vietnam	Tel: +84-28-3535-0465	
Osaka	1-Room 5th Floor Nagahori Plaza Bldg. 2-4-8 Minami Senba, chuo-ku, Osaka 542-0081, Japan	Tel: +81-6-6261-5766~7	Fax: +81-6-6261-5818

R&D Centers

Switzerland	Hardturmstrasse 135, CH-8005, Zurich, Switzerland	Tel: +41-76-241-6707	
Hungary	H-1145 Bacsikai utca 29/a, Budapest, Hungary	Tel: +36-1-273-3733	
China	Room 10102, Building 10, 498 Guoshoujing Road, Pudong, Shanghai, China(201203)	Tel: +86-21-5013-3393 #139	

Customer Service
service@hd.com

www.hd-hyundaielectric.com