GE

DEH-50001 Installation, Operation and Maintenance Manual

SecoVac* Vacuum Circuit Breaker

For 5kV-15kV IEEE Metal-clad Switchgear

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Hazard Classifications

The following important highlighted information appears throughout this document to warn of potential hazards or to call attention to information that clarifies a procedure.

Carefully read all instructions and become familiar with the devices before trying to install, operate, service or maintain this equipment.

DANGER

Indicates a hazardous situation that, if not avoided, will result in death or serious injury.

WARNING

Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION

Indicates that if the hazard is not avoided could result in minor or moderate injury.

NOTICE

It is used to notify of practices not related to personal injury.

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SecoCube® SecoBloc®

SecoVac® VB2+ Multilin®

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Warranty

This document is based on information available at the time of its publication. While efforts have been made to ensure accuracy, the information contained herein does not cover all details or variations in hardware and software, nor does it provide for every possible contingency in connection with installation, operation, and maintenance. Features may be described herein that are not present in all hardware and software systems.

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No warranties of merchantability or fitness for purpose shall apply.

Contact your local sales office if further information is required concerning any aspect of SecoGear switchgear operation or maintenance.

1. Introduction

The SecoVac Vacuum Circuit Breaker (VCB) is designed for application in AC power systems up to 15kV maximum rated voltage and is used for controlling and protecting electrical equipment in industrial, mining, power plants and substation applications. The VCB meets the requirements of IEEE C37.04, C37.06, C37.20.2 and C37.09. No such assurances are given with respect to local codes and ordinances, as they vary greatly. The VCB is a drawout design for use in GE SecoGear Metal-clad Switchgear and SecoBloc OEM Modules.

2. Safety Instruction

Each user must maintain a safety program for the protection of personnel, as well as other equipment, from the potential hazards associated with electrical equipment.

The following requirements are intended to augment the user's safety program, but NOT supplant the user's responsibility for devising a complete safety program. The following basic industry practiced safety requirements are applicable to all major electrical equipment such as switchgear or switchboards. GE neither condones nor assumes any responsibility for practices which deviate from the following:

1. ALL ELECTRICAL PARTS MUST BE ASSUMED TO BE ENERGIZED UNLESS THEIR POTENTIAL HAS BEEN MEASURED AS GROUND POTENTIAL AND ADEQUATE CAPACITY GROUNDING ASSEMBLIES HAVE BEEN APPLIED.
2. It is strongly recommended that all equipment be completely de-energized, verified to be "dead", and then grounded with adequate capacity grounding assemblies prior to any maintenance. The grounding cable assemblies must be able to withstand energizing fault levels so that protective equipment may clear the circuit safely. Additional discussion on this concept is covered in Chapter 20 of ANSI/ NFPA 70B, Electrical Equipment Maintenance.
3. Although interlocks to reduce some of the risks are provided, the individual's actions while performing service or maintenance are essential to prevent accidents. Each person's knowledge, mental awareness, and planned and executed actions often determine if an accident will occur. The most important method of avoiding accidents
4. The open gap of a vacuum interrupter should not be considered a safe means of isolating the circuit. Withdraw the circuit breaker from the connected position for proper lockout.
5. Before starting maintenance the secondary connectors and spring energy must be discharged and main contacts open. Failure to do so could result in physical injury.
6. Although the interrupting arc is quenched within a closed vacuum tube, it is recommended that flammable materials be stored away from the switchgear. Never extinguish an electrical fire.

All personnel associated with installation, operation and maintenance of electrical equipment (such as power circuit breakers and other power handling equipment) must be thoroughly instructed, with periodic retraining, regarding power equipment in general as well as the particular model of equipment with which they are working.

Instruction books, actual devices and appropriate safety and maintenance practices such as OSHA publications, National Electric Safety Code (ANSI C2), National Electric Code, and National Fire Protection Association (NFPA) 70B Electrical Equipment Maintenance must be closely studied and followed. During actual work, supervision should audit practices to assure conformance.

3. Receiving

Every package leaving the factory is plainly marked with the order number and customer's PO number. Contents of each shipping package are listed on the Packing List

NOTICE

To avoid loss of any parts when unpacking, the contents of each container should be carefully checked against the packing list before discarding the packing material.

Inspecting for Damage

All equipment leaving the factory is carefully inspected and packed by personnel experienced in the proper handling and packing of electrical equipment. Upon receipt of any equipment, immediately perform a visual inspection to ascertain if any damage has been sustained in shipping or if there are any loose parts.

Filing a Claim

If any damage is evident, or indication of rough handling is visible, file a claim for damage at once with the transportation company and notify the nearest General Electric Company Sales Office immediately. Information on damaged parts, part number, case number, requisition number, etc., should accompany the claim.

Transport and Handling

Caution should be observed when moving and installing breakers. The breaker can be moved with a fork lift or floor lift when the breaker is on a pallet or other support material. Do not lift circuit breakers by inserting fork lift or trolley arms directly under the breaker. This can damage the breaker.

Use of the specially designed breaker lift truck is recommended when lifting a breaker not mounted on a pallet. It is necessary to use the truck when placing a breaker into or removing it from the metal-clad switchgear. Reference DEH-500012.

To lift the breaker with a hoist, use two 1/2 inch diameter hooks rated at least 500 pounds each. Lifting locations are provided in the side frame members. (Figure 1) Use a spreader wider than the breaker to prevent slings/chains from contacting the interrupter poles.

Figure 1: Lifting Hole Detail on Circuit Breaker

CAUTION

Do not let the lifting straps contact the epoxy pole units during the lift.

Storage Conditions

It is recommended that the breaker be put immediately in its permanent location. If this is not possible, the following precautions must be taken to assure proper breaker storage.

1. The breaker should be protected against condensation, preferably by storing it in a dry room of moderate temperature (23° to 100°F/-5°C to 38°C). Short term storage and transportation is allowed at minimum -22°F (-30°C).
2. Circuit breakers for outdoor metal-clad switchgear should be stored in the equipment only when power is available and the heaters are in operation to prevent condensation.
3. The breaker should be stored in a clean location, free from corrosive gases or fumes; particular care, for example, should be taken to protect the equipment from moisture and cement dust, as this combination is present at construction sites and has a very corrosive effect on many parts. Damage is possible if stored on side/back or top.

4. Rollers, latches, etc., of the operating mechanism should be coated with a thin film of GE #0282A2048P009, or Mobil Epic Series 102 grease to prevent rusting.

If the breaker is stored for an extended period of time, it should be inspected periodically to see that rusting has not started and to ensure good mechanical condition. If the breaker is stored under unfavorable atmospheric conditions (see page 11 for Normal Service Conditions), it should be cleaned and dried out before being placed in service.

4. Service Conditions

Normal Service Conditions

Unless otherwise specified, SecoVac VB2+ circuit breakers, including the operating devices and the auxiliary equipment which form an integral part of the breaker, are intended to be used in accordance with their rated operating parameters and normal service conditions listed as follows:

- The ambient air temperature does not exceed 100°F (38°C) and its average value, measured over a period of 24hrs, and does not exceed 95°F (35°C). The minimum operating ambient air temperature is 5°F (-15°C). Short term storage and transportation is allowed at minimum -22°F (-30°C).
- The altitude does not exceed 3300 feet (1000m).
- The ambient air is not significantly polluted by dust, smoke, corrosive and/or flammable gases, vapors or salt.
- The conditions of humidity are as follows:
  - The average value of relative humidity, measured over a period of 24hrs, does not exceed 95%.
  - The average value of water vapor pressure, measured over a period of 24hrs, does not exceed 2.2kPa.
  - The average value of the relative humidity, measured over a period of one month, does not exceed 90%.
  - The average value of water vapor pressure, measured over a period of one month, does not exceed 1.8kPa.
  - For maintenance, high potential testing the humidity should not exceed 80% over a period of 24hrs prior to test as noted by IEEE.

Special Service Conditions

If the actual service conditions differ from the normal service conditions, the circuit breaker and associating devices and auxiliary equipment shall be designed and made to comply with any special service conditions required by the user which must be discussed with GE in advance. Normally, the following special service conditions will be encountered:

- At sites with altitude above 3300 feet (1000m), the effects of the reduction in dielectric strength of the air must be taken into account. GE can supply circuit breakers which can be applied in areas above 3300 feet (1000m); however derating factors as recommended by IEEE Standards must be applied. At the same time, the insulation level in switchgear should be taken into account and should be discussed with GE in advance.
- The ambient temperature is above 104°F (40°C). The service current of circuit breaker shall be derated as recommended by IEEE Standards. Please consult with GE in advance.

Attention:

When circuit breakers are operated in areas with high humidity and/or major rapid temperature fluctuations, there is a risk of condensation. Thus the circuit breaker should be placed into operation as soon as possible after the packaging is removed. Energize equipment heaters as soon as possible after the switchgear is installed.

Please consult GE for special application conditions.

5. Technical Data

Table 1: Breaker Weights-gross

RATED CURRENT (A)	RATED SHORT-CIRCUIT CURRENT (KA)	WEIGHT (KG)	WEIGHT (LBS)
1200	31.5	170	375
1200	40	190	419
2000	40	220	485
3000	40	280	617

Table 2: Breaker Ratings

PARAMETER	UNIT	VALUE
Maximum rated voltage	kV	15
Rated continuous current	A	1200/2000/3000
Frequency	Hz	50/60
Rated power frequency withstand voltage (1min)	kV	36
Rated lightning impulse withstand voltage (peak values)	kV	95
Rated short circuit interrupting current	kA	31.5/40
Rated short time withstand current (2s)	kA	31.5/40
Rated peak withstand current	kA	82/104
Rated peak close and latch current	kA	82/104
Rated auxiliary control voltage	V	48/125/250 DC, 120/240 AC
Opening time	ms	20-50
Closing time	ms	30-70

Table 3: Charging Motor

RATED VOLTAGE (V)	ENERGY STORING PERIOD UNDER RATED OPERATION VOLTAGE (S)	INPUT POWER (W)
DC 48	<15s	150
DC 125	<15s	150
DC 250	<15s	150
AC 120	<15s	150
AC 240	<15s	150

Table 4: Close and Trip Coils

RATED VOLTAGE (V)	MAX POWER CONSUMPTION (VA)
DC 48	350
DC 125	350
DC 250	350
AC 120	350
AC 240	350

Table 5: Auxiliary Contact Rating

RATED VOLTAGE (V)	RATED CURRENT (A)	INTERRUPTING CURRENT
220 DC	15	3
380 AC	15	15

6. Overall Dimensions

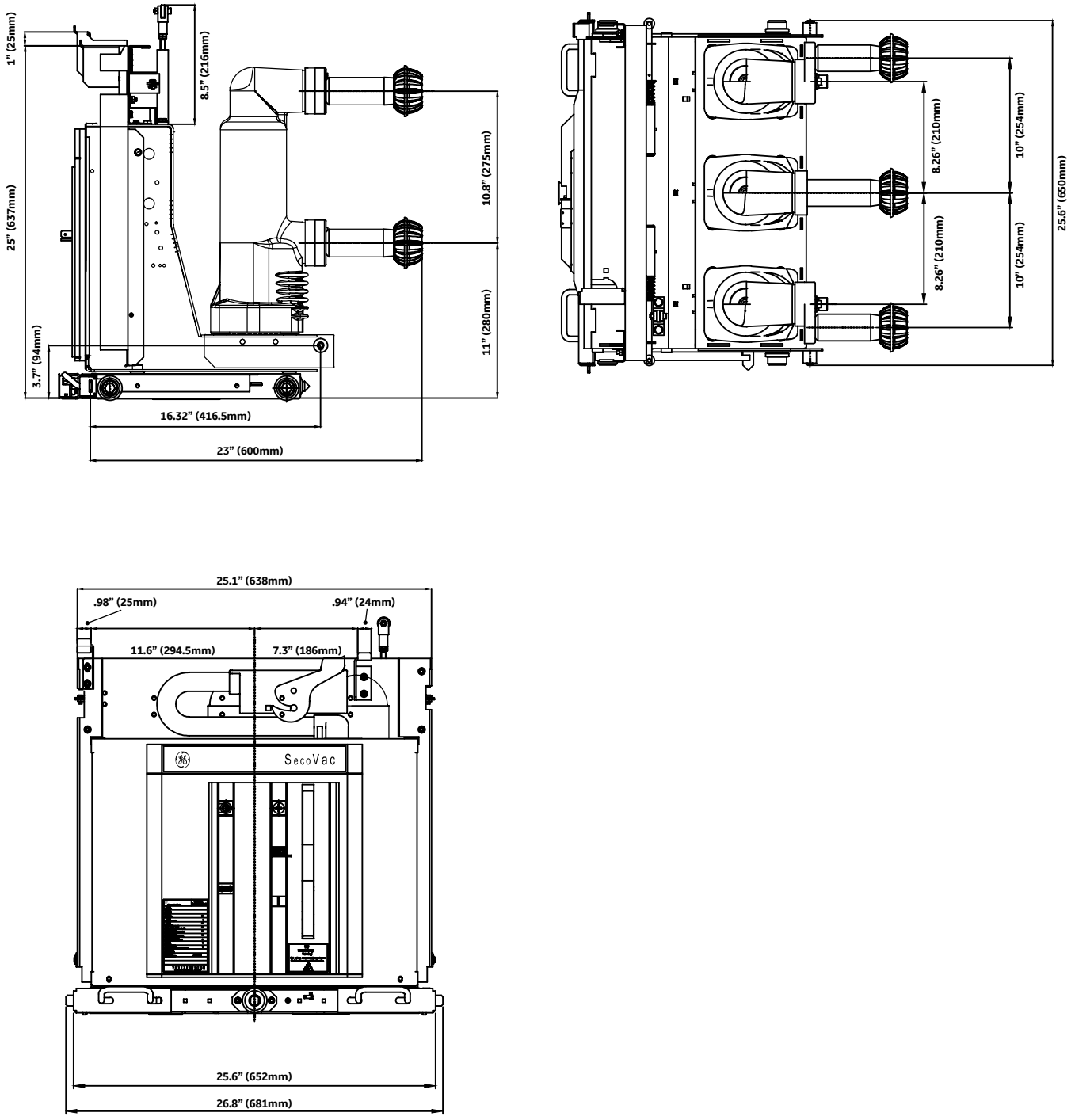
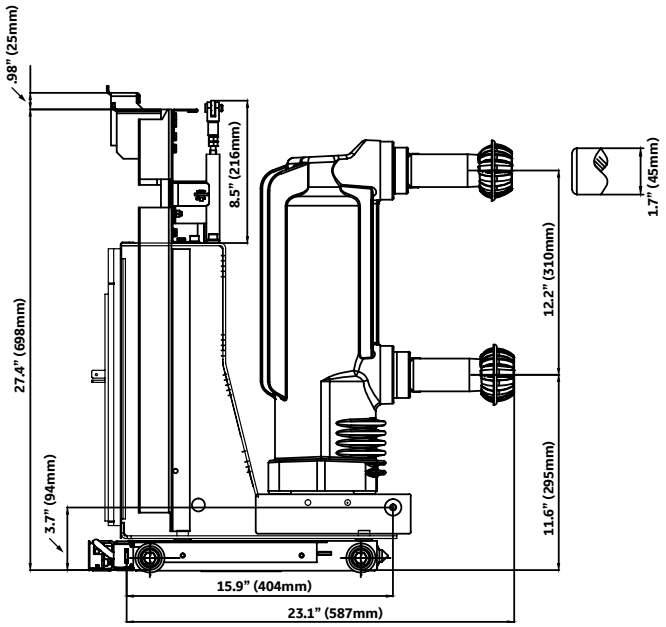
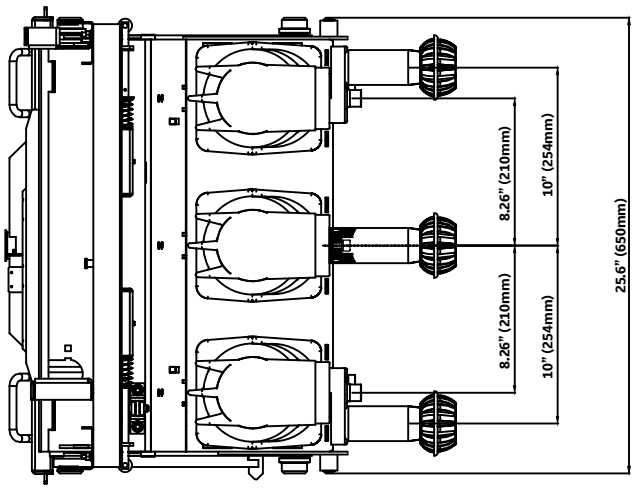
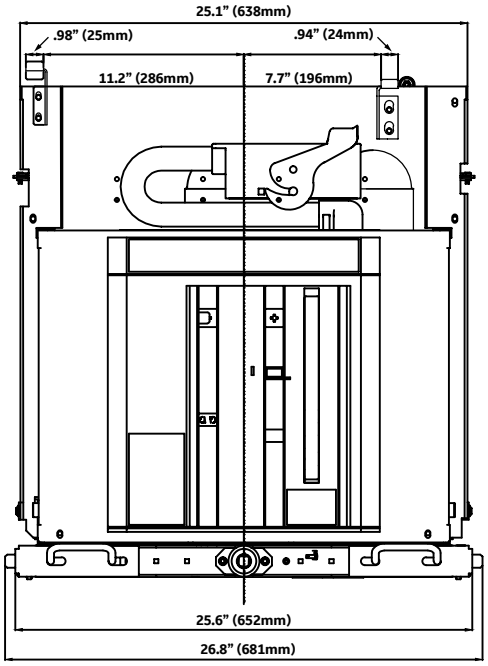


Figure 2: SecoVac VB2+/1200A-31.5kA, inches (mm)

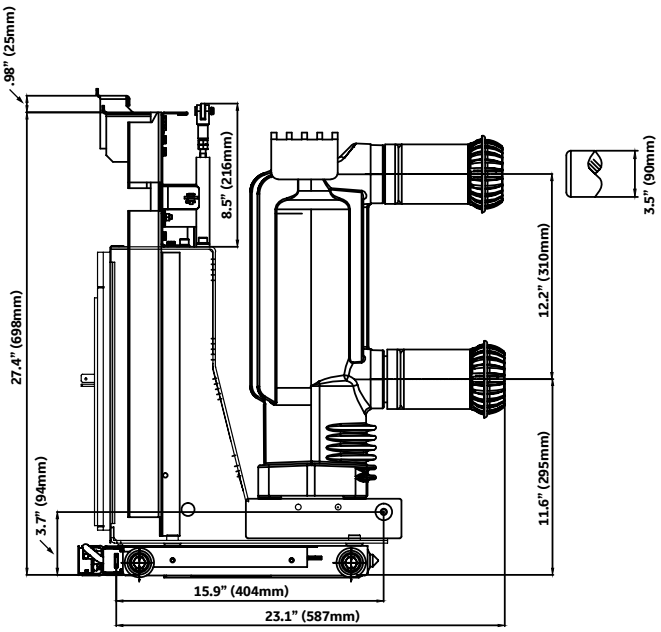


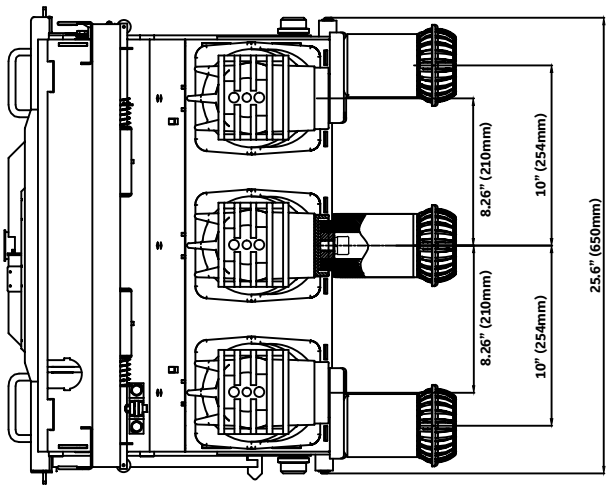


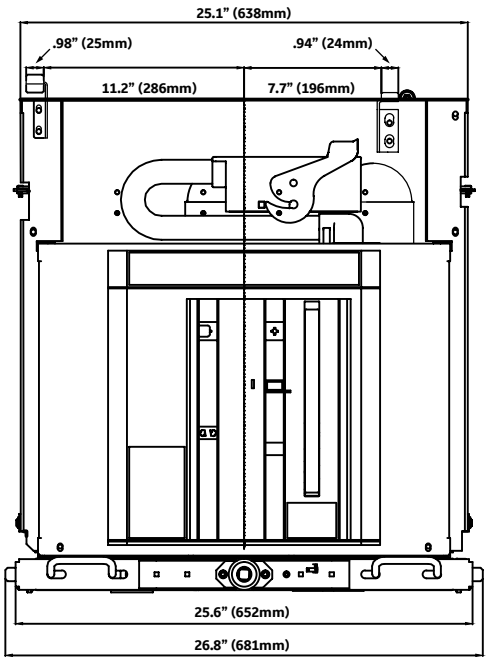


SPECIFICATION	D INCHES (MM)
1200A, 40kA	1.77" (45)

Figure 3: SecoVac VB2+/1200A/40kA, inches (mm)







SPECIFICATION	D INCHES (MM)
2000A, 40kA	2.75" (70)

Figure 4: SecoVac VB2+/2000A-40kA, inches (mm)

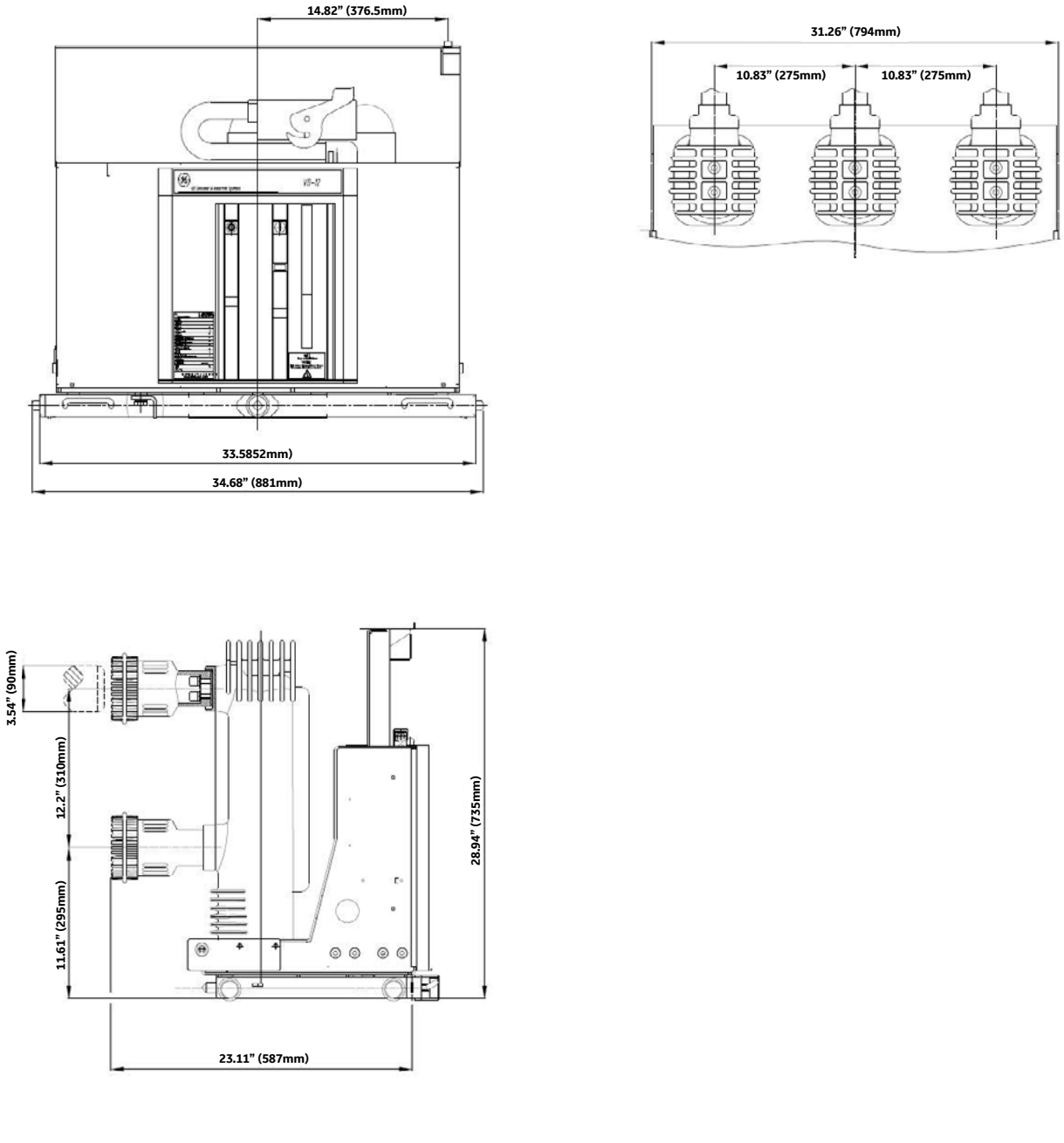
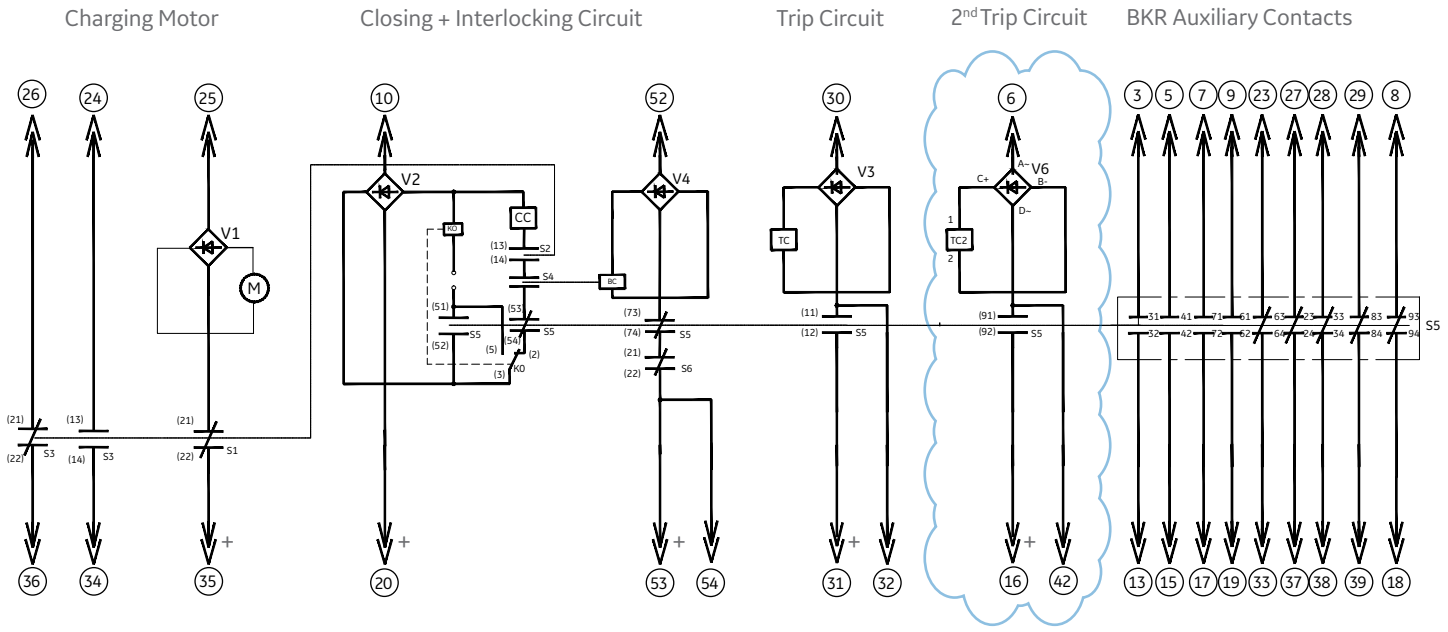
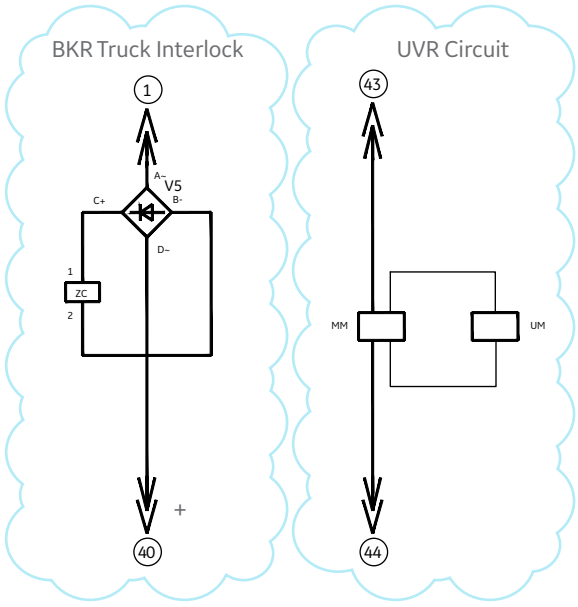


Figure 5: SecoVac VB2+/3000A-40kA, inches (mm)

Note: Plungers not shown.

7. Internal Wiring Diagram





S1~S3	Energy Storing Travel Switch
KO	Anti-pumping Relay
S4	Close Block Contact
S5	52 Auxiliary Switch
V1~V6	Rectifier
S6	Limit Switch for Trip Free
TC	Trip Coil
M	Spring Charging Motor
CC	Closing Coil
TC2	2nd Trip Coil (optional)
MM UM	UVR Coil (optional)
BC	Close Block Solenoid
ZC	BKR Lock Solenoid (optional)

Notes:

1. This wiring diagram describes that a breaker is open, racked to test position with spring in discharge state.
2. Optional features are shown in the cloud.
3. (xx) Auxiliary contact number.
4. (xx) Breaker secondary pin number.

8. Operation

The SecoVac VB2+ vacuum circuit breaker uses vacuum interrupters for the making and breaking of the electric power circuit. The primary cluster contacts on the drawout breaker connect with fixed primary contacts in switchgear breaker cell and a secondary disconnectable plug connects with the secondary circuit located in the switchgear. The vacuum interrupters and main contact parts are embedded in epoxy resin using APG process, which ensure the vacuum interrupters are protected from environmental influence and mechanical damage.

Operating Mechanism

The spring operating mechanism consists of a modular, compact spring charging design which is equipped with a manual charging device which uses a charging handle, and an electric charging device which charges the spring via a motor. The mechanism has reclose function. On the front panel of the circuit breaker, there are Open/Close, Charged/Discharged indicators and manual operating handle. The operator can charge the spring remotely manually or by electric power and the status of the circuit breaker can be observed on the front panel.

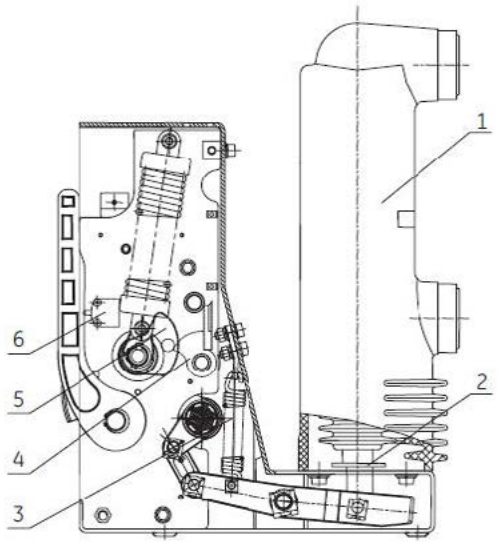
The circuit breaker can be either opened or closed by the push buttons on the breaker or remotely via the closing coil and tripping coil. An instruction label for manual spring discharge is provided on the breaker.

Figure 6: SecoVac VB2+ Vacuum Circuit Breaker

9. Principle of Operation

Vacuum Interrupter

The vacuum pressure within the evacuated envelope of vacuum interrupter is less than 10-5 torr. Under normal operating conditions the interrupter is closed. Arcing is established within the interrupter by withdrawing the lower moving contact from upper fixed contact. The burning arc releases metal vapor from the contact surfaces. The metal vapor continually leaves the inner contact region and recondenses on the contact surfaces and surrounding metal vapor condensation shield. The shield is isolated from both contacts and serves to protect the glass or ceramic envelope from vapor deposition. At current zero, vapor production ceases, the original vacuum condition is reinstated and the current is interrupted. The dielectric strength across the contacts of the interrupter also recovers, such that restrike is prevented. With the contacts in the open position, the system voltage is withstood internally by the contact gap and externally by the insulating envelope.



1. Embedded Pole
2. Insulating Rod
3. Opening Spring
4. Holder
5. Cam
6. Position Switch

Figure 7: Close Spring Charging

Close Spring Charging

(see Figures 7 & 8 for features described)

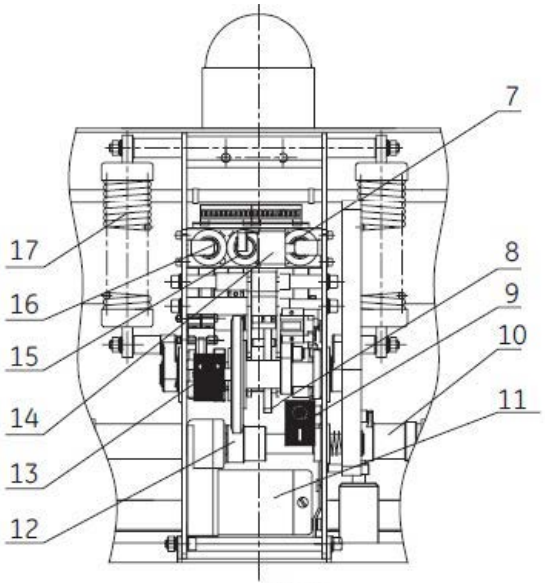
The energy necessary for closing the circuit breaker is provided by the closing spring. Spring charging can be accomplished by the electric charging motor, or by the integral manual charging handle.

Spring Charged by Motor

The spring charging mechanism consists of a charging motor, gear wheel, cam, holder and closing spring. When the spring charging motor (feature 11) is running, the pinion on the output shaft (feature 12) of the motor rotates, driving the gear wheel. The holder attached to the gear wheel rotates the cam fixed on the shaft, which then forces the shaft to rotate, stretching the closing springs (feature 17) for closing energy. When the block on the gear wheel is pushed away, the clutch is separated and the holder (feature 4) will hold the roller on the cam (feature 5) to keep the springs charged, the spring charge limit switch (feature 6) will cut the secondary supply to charging motor, thus the charging operation is completed.

Spring Charged Manually:

When spring is charged by manual means, the spring-charging handle on the mechanism is pumped up and down repeatedly, to complete the above mentioned spring charging process. When the charging operation is complete, you can feel the free movement of the charging handle and the spring charging indicator (feature 13) will show charged. The operating mechanism is ready for the next operation.



7. Closing Coil
8. Holder
9. Close/Open Indicator
10. Main Shaft
11. Motor
12. Output Shaft
13. Charging Indicator
14. Lock Electromagnet
15. Over Current Release
16. Tripping Coil
17. Closing Spring

Figure 8: Close Spring Charging

Close Operation

When the closing coil is energized, the holder (feature 4) will rotate counter- clockwise to break away from the roller on the cam (feature 5). The cam, under the action of the force from closing spring (feature 17), will rotate clockwise, pushing the roller on the main shaft, which will cause the main shaft (feature 10) to rotate counter clockwise. The main shaft moves the connecting rods down via the arm, so that the insulating rods (feature 2) move upward, which intern moves the movable contacts to the fixed contacts. After the closing operation is finished, the closed/ open indicator (feature 9) will indicate "Close", and the power to the closing circuit is interrupted by breaker auxiliary contacts. If the external power supply is maintained, the charging circuit will recharge the spring.

Open Operation

When the breaker receives an opening command (the opening pushbutton is pressed or the trip coil (feature 16) is energized), trip coil pushes the trip latch, which in turn rotates the trip shaft clockwise. Under the action of opening spring (feature 3) and contact wipe springs, main shaft will move clockwise, and the insulating rods (feature 2) will force the movable contacts to separate from the fixed contacts. The buffer will absorb the residual energy and tripping operation is completed. After the tripping operation is finished, the close/open indicator (feature 9) will indicate "Open". Meanwhile, the counter will record the operation.

Interlocks

The following interlocks are incorporated to help ensure the safe operation of the breaker.

Negative Trip Interlock:

The Negative Interlock will prevent closure of the circuit breaker while racking of the circuit breaker between the "DISCONNECTED/TEST" and the "CONNECTED" position by blocking the closing lever.

Positive Trip Interlock:

Positive interlock prevents the racking of a Closed breaker in the Connected or Test/Disconnect position. The interlock linkage from the mechanism will lock the lead screw to prevent the racking operation.

Trip Free:

If the mechanical tripping signal is applied and held prior to the application of a closing signal (mechanical or electrical) the limit switch shown in Figure 10 (feature 1) will disconnect the supply to the closing coil magnet, and the plunger of the closing coil magnet will block the closing push button to close the breaker mechanically. At the same time, the plunger will de-activate the micro switch (Figure 10 (feature 4)) whose N/O contact is connected in series with the closing coil, which will not allow the breaker to close electrically.

When no voltage is applied to the block Close interlock, the circuit breaker cannot be closed with the CLOSE pushbutton.

Anti-Pumping:

The SecoVac breaker is equipped with an electrical anti-pump feature. This prevents the breaker from closing in the case of a fault that does not clear and a continuous close signal is given. The breaker will not reclose as long as the device initiating closing is maintained.

Automatic Spring Discharge:

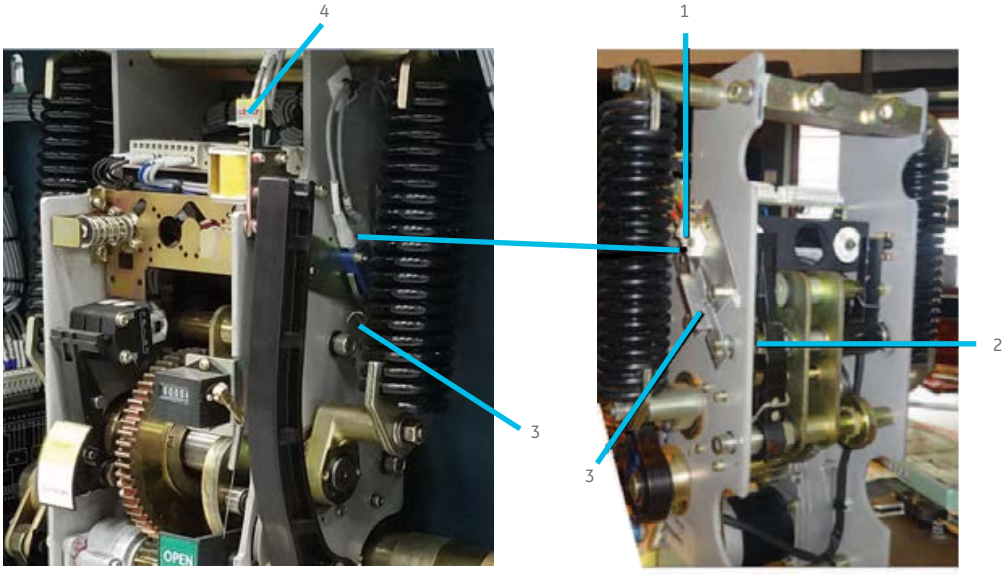
The Automatic Spring Discharge (ASD) feature opens the breaker when leaving or entering the compartment, assuring that the charging springs are discharged, Figure 9.

Figure 9: Automatic Spring Discharge (ASD) Interlock Plungers

Reclosing

Auto Reclosing

When the circuit breaker is closed, and control power is present, the spring charge mechanism will recharge the closing springs so that the circuit breaker is capable of immediately reclosing after tripping.



1. Limit Switch
2. Trip Shaft
3. Operating Lever
4. Micro Switch

Figure 10: Circuit Breaker Trip Free Arrangement

Direct Acting Undervoltage Trip Device

Most SecoVac circuit breakers can be provided with a direct-acting undervoltage trip device. The undervoltage trip device is a factory-installed unit, which is an integral part of the breaker mechanism. Its function is to monitor the DC trip control voltage and to mechanically trip the breaker if that control voltage is lost. The UV device will also block closing of the breaker if the control voltage is not 80% or more of the nominal value.

10. Installation

Correct installation is of primary importance, thus the manufacturer's instructions must be fully complied with to ensure safe and reliable operation. It is good practice to wear gloves for handling the breaker during the installation.

CAUTION

Personnel installing this equipment must be thoroughly familiar with this instruction manual and all articles of the National Electrical Code applicable to the installation of this switchgear. In addition, all installation drawings, both mechanical and electrical, must be understood and strictly followed to prevent damage to the switchgear or equipment being protected by the switchgear.

NOTICE

Before installation work is started, it is important to review all of the drawings provided, including the GE equipment arrangement drawings, site installation drawings, elementary and remote connection drawings, mechanical connection drawings, and the summary of equipment list.

Consult publication DEH-500012, SecoVac Lift Truck for additional specific details regarding insertion and removal of the VCB into the equipment.

Checks Before Installation

After the breaker is unpacked, check the breaker poles for any cracks or breakage. The product nameplate and product certificate shall conform to the order.

- Check goods according with the packing list.
- Clean the insulating parts with a clean dry cloth.
- Check that the upper and lower terminals are clean and free of any damage caused by transport or storage.
- Verify the condition of the vacuum interrupter through power frequency withstand voltage test (Hipot), apply the rated power frequency withstand phase to phase and phase to ground for 1 min. (see Table 10)

Before installing a rollout or breaker into the cubicle, be sure to grease the following key items to increase ease of movement and general maintenance (use the recommended greases listed in the Lubrication section):

- Breaker/rollout clusters and primary stabs in the cubicle.
- Ground bar on the bottom of the breaker/rollout and ground shoe in the cubicle.
- Rollers on the breaker/rollout and the rails with-in the cubicle.

Use the recommended greases listed in the Lubrication section.

When installing a new breaker or when moving a breaker from one compartment to another, you must verify the MOC switch plunger height. Proper adjustment of this feature is required to assure that the MOC switch and associated circuits operate correctly.

MOC Switch Plunger Adjustment

MOC Switch Plunger Assembly Height Adjustment:

1. Rack breaker into the CONNECTED position in the cubicle.
2. Set the gap between the roller on the breaker MOC actuator (plunger) and the bottom of the MOC paddle in the cubicle to 1-3 mm, by adjusting the height of the rollers and clevis on the breaker. A feeler gauge or other appropriate measuring device should be used to verify the proper gap.
   a. Breaker MOC plunger assembly can be adjusted by rotating the "clevis" on the threads of the plunger (see Figure 11) and tightening down the two jam nuts when the clevis is set to the desired height. Torque nuts to 28Nm.
   b. To help ensure they are set properly, close the breaker to take out any slop in the plunger assembly and then make final adjustments to make sure the clevis is straight and in the correct orientation.
3. Close the breaker in the CONNECTED position and check the contacts on all 8 stages of the MOC switch to ensure they change state when the breaker is closed.
4. Rack the breaker out to the TEST position. Verify there is a 1-3 mm gap between the roller on the breaker MOC plunger assembly and the bottom of the MOC paddle. Following the adjustment steps above.
5. Close the breaker in the TEST position and check the contacts on all 8 stages of the MOC switch to ensure they change state when the breaker is closed.

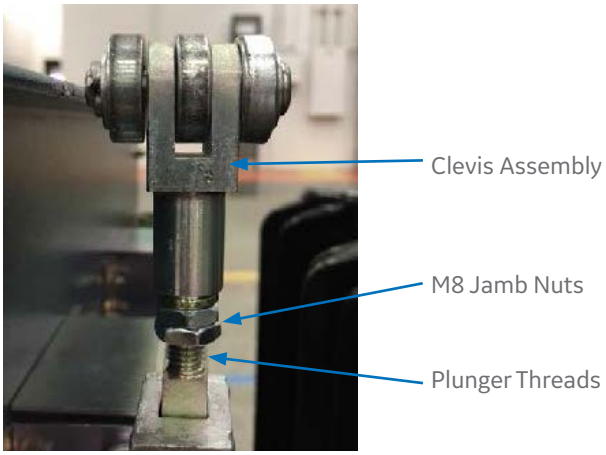


Figure 11: MOC Plunger Assembly

Circuit Breaker Insertion/Removal

- Insert the circuit breaker into the cell using the lifting truck as per the equipment instruction manual and push into the test position.
- Insert the racking handle and rotate the handle clockwise until the position indicator shows the breaker in connected position (about 20 rotations).

To rack breaker to DISCONNECTED/TEST position, rotate racking handle counter-clock wise until the position indicator shows the breaker in the test position.

NOTICE

To avoid possible damage to the racking mechanism, do not continue to turn the racking handle after the breaker has reached the disconnected or connected positions.

Commissioning

- All commissioning and operation work shall be carried out by persons who have received suitable training and understand the performance of the circuit breaker. Correct protective and preventive measures shall be taken during commissioning.
- Before commissioning is performed, make sure that all control circuits are not energized and that the breaker is removed from the metal-clad unit.
- Do not work on or install the breaker or mechanism while it is in the closed position.
- Do not work on or install the breaker while the closing spring is charged.
- Using the product under normal working conditions and within the range of technical data according to IEEE C37.04, will ensure the correct performance of the circuit breaker.
- After the installation of the circuit breaker into switchgear, the breaker should only be subjected to normal recommended operating conditions.

WARNING

HIGH VOLTAGE
Arc Flash & Shock Hazard

Operation & Service by qualified personnel only.

Follow all safety procedures and wear proper PPE in accordance with NFPA 70E.

Failure to comply can result in serious injury or death.

Preparation Work (Prior to Energization)

- Check the circuit breaker for any damage.
- Clean the pole assemblies and other insulated parts with a clean dry cloth.
- Remove lifting hooks (if used) from the circuit breaker prior to insertion/operation.
- Check the connecting status of the primary and secondary circuits as well as the grounding.
- Manually perform spring-charging, opening and closing operations to ensure the breaker is working properly.

11. Maintenance

WARNING

HIGH VOLTAGE
Arc Flash & Shock Hazard

Operation & Service by qualified personnel only.

Follow all safety procedures and wear proper PPE in accordance with NFPA 70E.

Failure to comply can result in serious injury or death.

Early vacuum interrupter designs employed spiral contacts that formed intense arcs that could rapidly erode electrode surfaces. The type of contact found in this circuit breaker is a state of the art axial magnetic field type. This method creates a low energy highly defuse plasma arc that is evenly distributed across the contact surface. The design is capable of 30,000 continuous current operations or 150 short circuit operations.

As the circuit breaker reaches the 10,000 operations or 25 years of operation limit, it is recommended that interrupter contact resistance readings be recorded and reported to GE service for evaluation. As the breaker approaches end of life, it is recommended that checks be made to guarantee the vacuum interrupter contacts have not exceeded the allowable wear of 3mm. SecoVac VB2+ provides a visual indication of the wear located on the back area of the circuit breaker element, under the vacuum poles. Additionally, Vacuum Interrupter integrity test shall be performed at 75% of rated Power Frequency withstand voltage to check the circuit breaker. Other than these tests and checks, the vacuum interrupter is a sealed for life and does not need maintenance. Contact your local GE Sales Rep for further instructions if needed.

Maintenance Rules

- The user shall not replace any original parts with replacement parts from a different manufacturer.
- Prior to maintenance, remove the circuit breaker from the switchgear. Make sure that the circuit breaker is open, closing spring discharged and the power supply is off.
- Before any maintenance work is performed, make sure that all control circuits are not energized and that the breaker is removed from the metal-clad unit.
- Do not work on the breaker or mechanism while it is in the closed position.
- Do not work on the breaker while the closing spring is charged.
- Using the product under normal working conditions and within the range of technical data according to IEEE C37.04, will ensure the correct performance of the circuit breaker.
- The replacement of the embedded vacuum interrupter poles and operating mechanism should only be performed by GE authorized personnel.

Maintenance Cycle

Periodic maintenance can help extend the operational life of your SecoGear equipment and SecoVac breaker. Therefore GE IS recommends an operational and visual inspection of the following parts/assemblies every 500 operations.

- Kirk lock assembly (if installed) (breaker)
- Operating Mechanism Spring Charging Motor (breaker)
- Breaker MOC plunger assembly (breaker)
- Manual charging handle (breaker)

The frequency of required maintenance depends on the severity of the service conditions of the switchgear application. Typical mechanical life of the VB2+ breaker is 10,000 operations. If the service conditions are mild, the suggested interval between maintenance operations is no more than 5 years or 2,000 normal load switching operations.

Mild service conditions are defined as an environment in which the switchgear is protected from the deleterious effects of conditions such as:

- Salt spray
- Changes in temperature that produce condensation
- Conductive and/or abrasive dust
- Damaging chemicals and fumes
- Vibration or mechanical shock
- High relative humidity (90%)
- Temperature extremes, below –22° F(30° C) or above 104° F (40° C)

Lubrication

After each 2000 operations, inspection and lubrication is necessary.

CAUTION

Remove all excess lubricant with a clean cloth to avoid accumulation of dirt or dust.

Maintenance after 2000 cycles includes cleaning of circuit breaker by opening front cover. In general, the circuit breaker requires moderate lubrication. Bearing points and sliding surfaces should be lubricated at the regular inspection periods with a thin film of grease. Before lubricating, remove any hardened grease and dirt from latch and bearing surfaces with mineral spirits, then wipe with a clean rag. Apply a thin coat of lubrication to all the moving parts, and gears in the circuit breaker mechanism. See areas indicated by blue ovals in Figure 12.

The following are the recommended lubricants for various applications:

- Electrical contact surfaces, i.e. primary stabs/clusters: GE #0282A2048P009 or #2142500200 (red grease used at plant), Mobil EPIC EP 102
- Gears/moving parts in the charging mechanism: Molykote G-4700 (used by the plant), Molykote G-4500, Mobil grease 28, or GE #0282A2048P009
- Gears in the undercarriage: Molykote G-4700 (used by the plant), Molykote G-4500, or GE #0282A2048P009
- Breaker rails and moving surfaces: Molykote G-4700 (used by the plant), Molykote G-4500, or GE #0282A2048P009

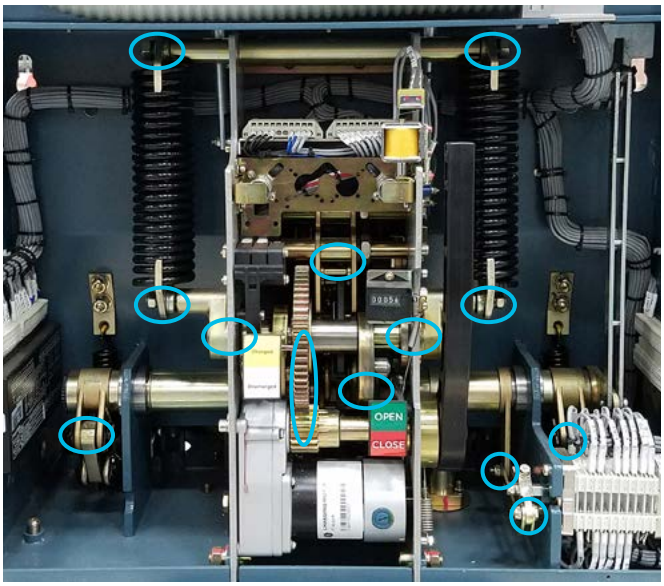


Figure 12: Areas for Recommended Lubrication

Maintenance Checklist

Operating Mechanism

- Visual check of all elements and mechanical interlocks for any damage.
- Check the tightness of nuts and bolts. Check split pins for any breakage and for loose or missing parts.
- Check the rubbing and sliding surfaces inside the mechanism, lubricant shall be applied to the moving and friction areas prior to installation (see Figure 12).
- Check the counter for correct operation.
- Check and ensure the interlocks function as per page 20.
- Visually check the oil buffer (dashpot, Figure 13) for oil leakage or any other damage.
- Check the auxiliary switch and position switch for proper operation by performing open close operation.
- Check the charging motor.
- Check the closing, tripping and latch coils functioning.
- Check the terminals of secondary wiring and connector.
- Check for loose parts and tighten if needed per torque values in Table 6.

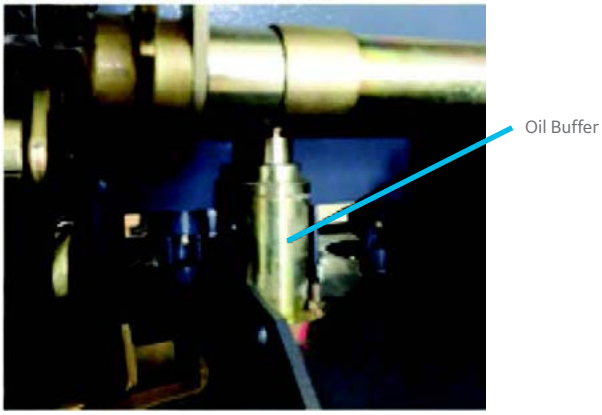


Figure 13: Oil Buffer Arrangement

Table 6: Recommended Torque Limits

BOLT SIZE	BOLT TORQUE (N-M)	BOLT TORQUE (FT-LBS)
M4	3	2.2
M5	5.9	4.4
M6	10	7.4
M8	26	19.2
M10	50	36.9
M12	86	63.4
M16	200	147.5
M20	300	221.3

Drawout Mechanism

- Check all the holders, pins and terminals. Pay attention to apply lubricant grease to all movable shafts & bearings.
- Check the racking operation and ensure the functions work properly.

Primary Circuit

- Check and clean the pole insulation and check the bolts for tightness to ensure good contact.
- Carry out mechanical operating test of the circuit breaker by closing and opening 5 times each, at rated operating voltage, high voltage and low voltage (refer to Table 7 for limits).

Table 7: Control Voltages

NORMAL VOLTAGE (V)	OPENING COIL		CLOSING COIL		MOTOR CHARGING	
	MIN (V)	MAX (V)	MIN (V)	MAX (V)	MIN (V)	MAX (V)
48 (DC)	28	56	38	56	38	56
125 (DC)	70	140	100	140	100	140
250 (DC)	140	280	200	280	200	280
120 (AC)	104	127	104	127	104	127
240 (AC)	208	254	208	254	208	254

- Carry out mechanical characteristics test of the circuit breaker. Measure the opening and closing time, average speed, synchronism of poles, bounce time, etc. using circuit breaker analyzer. Values should be within the limits as listed in Table 8. Opening distance is the gap between the contacts inside the Vacuum bottle. Results should be compared against the breaker values in the factory test procedure document.

Table 8: Circuit Breaker Mechanical Characteristics

NORMAL VOLTAGE (V)	CRITERIA	RESULT		
		PHASE A	PHASE B	PHASE C
Opening distance inches(mm)	0.35 ± 0.04 (9 ± 1)			
Closing bounce (ms)	≤2			
Simultaneity (ms)	≤2	close	open	open
Distance between phases inches(mm)	10.83 ± 0.06 (275 ± 1.5)	AB	BC	BC
Closing time (ms)	30 - 70			
Opening time (ms)	20 - 50			
Average closing speed (m/s)	0.5 - 0.9			
Average opening speed (m/s)	0.9 - 1.5			

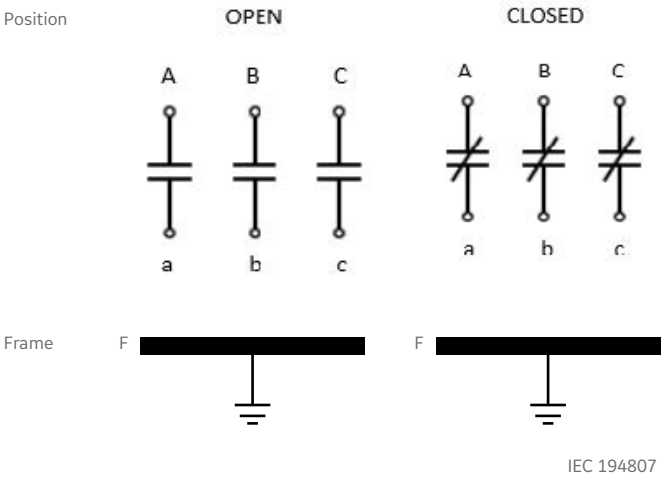
- Tighten the bolts and measure the resistance of main circuit at 100A dc as recommended per standard IEEE C 37.09. If field testers are used with current significantly less than (e.g., 10A) and result in abnormally high readings, it is recommended to retest at 100A to confirm.
- Carry out the power frequency withstand (Hi-Pot) ac voltage test: Apply 75% of the power frequency (Hi-pot) ac voltage as per Table 9 for 1 min for each test conditions as mentioned in Figure 14, including the vacuum bottle integrity test with contacts open.

NOTICE

The vacuum integrity tests performed using dc Hi-pot sets often result in false failures. If an interrupter fails a DC test, retest with an ac Hi-pot tester.

Table 9: Preferred Power Frequency Ratings for MC Switchgear

RATED MAXIMUM VOLTAGE (KV RMS)	POWER FREQUENCY WITHSTAND KV (MAX)
4.76	19
8.25	36
15	36



IEC 194807

TEST CONDITION	SWITCHING DEVICE	VOLTAGE APPLIED TO	CONNECTED TO EARTH
1	Closed	Aa	BCbcF
2	Closed	Bb	ACacF
3	Closed	Cc	AbabF
4	Open	A	BcabcF
5	Open	B	AcabcF
6	Open	C	AbabcF
7	Open	a	ABCacF
8	Open	b	ABCacF
9	Open	c	ABCabF

Figure 14: Test Conditions for Power Frequency Withstand

Acceptance criteria: No Flash over for any of the test conditions.

- **Vacuum Integrity Test:** Perform vacuum integrity test with the breaker in open condition, apply 75% of Power frequency withstand (Hi-pot) ac voltage from Table 9 across each phase for 1 min.

A-----a , B----b & C....c

Mechanical Tests

The value for mechanical characteristics should conform to technical data list. (Refer to Table 9).

Troubleshooting

Table 10: Troubleshooting

PROBLEM	SOURCE	SYMPTOM	POSSIBLE CAUSE	SOLUTION
Breaker will not close	Electrical	Closing coil won't energize	Coil has burned out	Replace the coil
			Fault in secondary circuit wiring	Recheck wiring and tighten connections
			Bad auxiliary switch contact	Check pins on auxiliary switch and replace if needed
		Closing coil energized but breaker won't close	Closing voltage too low	Measure control voltage to confirm
			Loose/disconnected secondary wiring	Check secondary wiring and connectors
			Breaker is not in connected or test position	Confirm the position of the breaker
			Under voltage release coil is not energized	Check under voltage release connection and energize the coil. Check to see if the control voltage has dropped to less than 70% of the rated voltage of the coil
Breaker will not open	Electrical	Tripping coil won't energize	Coil has burned out	Replace the coil
			Fault in secondary circuit wiring	Recheck wiring and tighten connections
			Bad auxiliary switch contact	Check pins on auxiliary switch and replace if needed
		Tripping coil energized but breaker won't open	Closing voltage too low	Measure control voltage to confirm
			Loose/disconnected secondary wiring	Check secondary wiring and connectors
	Mechanical	Breaker cannot be opened manually	Breaker is not in connected or test position	Confirm the position of the breaker
Other		Electrical position indicator not functioning	TOC in undercarriage is damaged or connecting linkage mechanism deformed	Replace the TOC or repair the connecting linkage mechanism
		Charging motor inoperable	Secondary wiring not connected or motor has failed	Recheck secondary wiring and tighten connections or replace motor
		Charging motor will not turn off	Wiring connected incorrectly or fault in position switch	Recheck secondary wiring and tighten connections or replace position switch

12. Removal and Replacement of Components and Parts

The pole and closing & tripping module requires detailed time checks as required by IEEE C 37.09 production tests, so these must be replaced by GE service technician. The replacement of other parts should be in accordance to this manual.

Removal and Replacement of Trip and Close Coils

As shown in Figure 15, disconnect the secondary wire (feature 1) of close & trip coils and unscrew the bolts at both sides (feature 2). Take out the support bracket of the trip & close coils and remove screws (feature 3) for removing the coils.

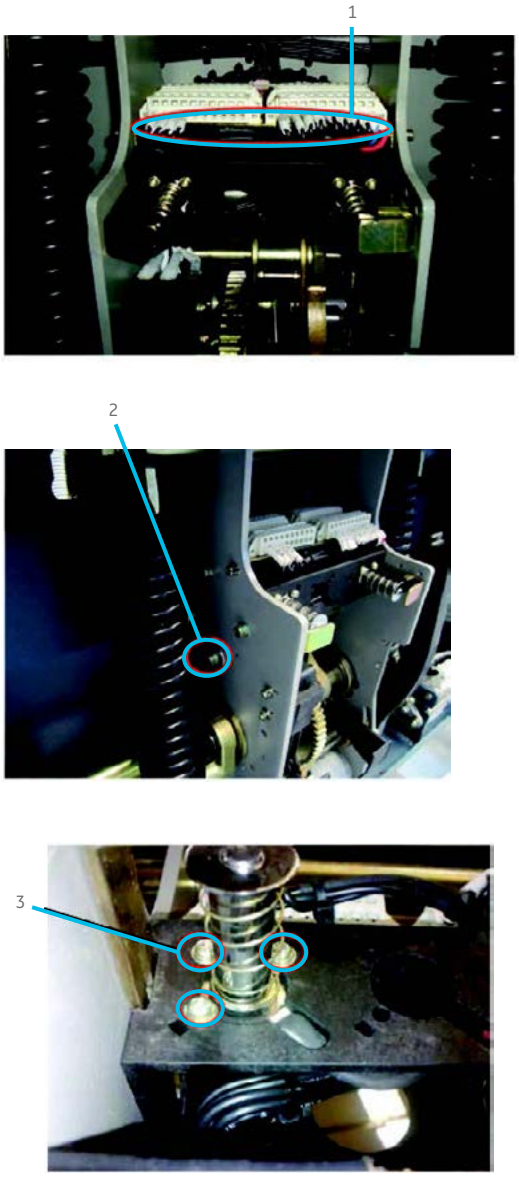


Figure 15: Replacement of Coils

Removal and Replacement of Operations Counter

As shown in Figure 16, disconnect tension spring (feature 2) and remove screw (feature 1), the counter can be removed.

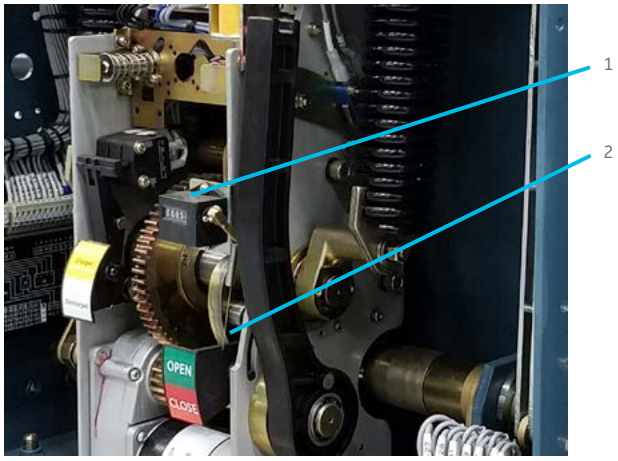


Figure 16: Removal of Operations Counter

Removal and Replacement of Auxiliary Switch (MOC, S5)

As shown in Figure 17, loosen clamp bolt and remove the operating arm (feature 2). Remove mounting bolt (feature 1), take off the auxiliary switch and the secondary wiring as required.

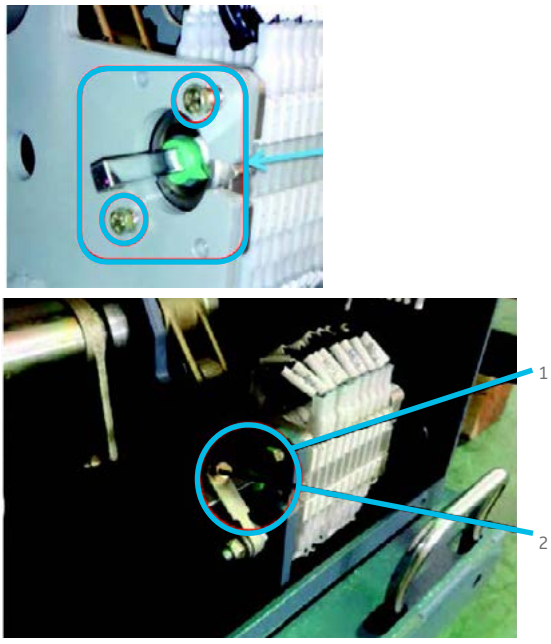


Figure 17: Removal of Breaker Auxiliary Switch

Removal and Replacement of Spring Charge Indication Switch

As shown in Figure 18, first remove the secondary wiring (feature 1) and loosen the bolts (feature 2), then remove the indication switch.

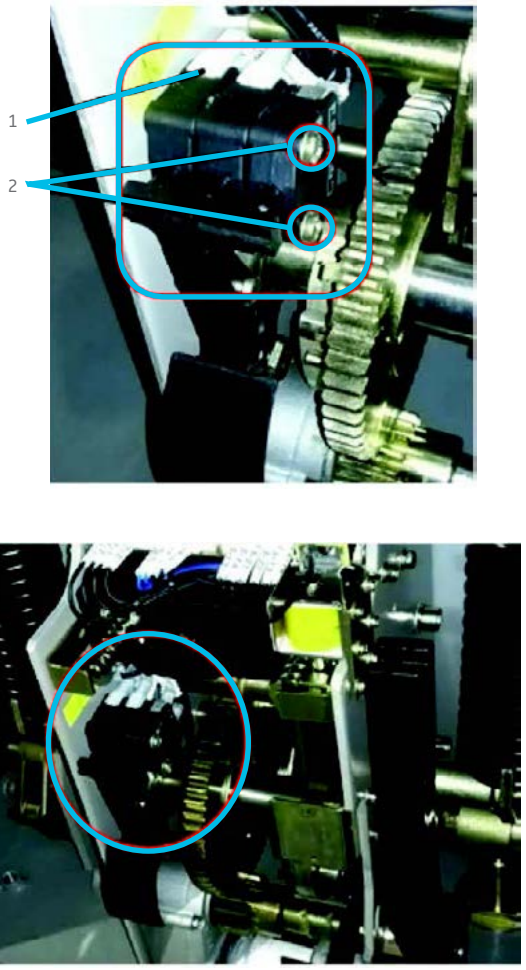


Figure 18: Removal of Spring Charge Indicator

Spare Parts

For ordering, please contact GE.

Table 11: Spare Parts List

NAME	REF. CAT NO
Close Coil 48V DC	P-C6X
Open Coil 48V DC	P-C6X
UV Coil 48V DC	**P-UVCOIL5**
Charge Motor 48V DC	P-MOTOR6
Truck Interlock Electromagnet 48V DC	P-L6
Close Coil 125V DC	P-C8X
Open Coil 125V DC	P-C8X
UV Coil 125V DC	**P-UVCOIL1**
Charge Motor 125V DC	P-Motor8
Truck Interlock Electromagnet 125V DC	P-L8
Close Coil 250V DC	P-C10X
Open Coil 250V DC	P-C10X
UV Coil 250V DC	**P-UVCOIL2**
Charge Motor 250V DC	P-Motor9
Truck Interlock Electromagnet 250V DC	P-L9
Close Coil 120V AC	P-C8X
Open Coil 120V AC	P-C8X
UV Coil 120V AC	**P-UVCOIL1**
Charge Motor 120V AC	P-Motor8
Truck Interlock Electromagnet 120V AC	P-L8
Close Coil 240V AC	P-C10X
Open Coil 240V AC	P-C10X
UV Coil 240V AC	**P-UVCOIL2**
Charge Motor 240V AC	P-Motor9
Truck Interlock Electromagnet AC240VAC	P-L10
Breaker Front cover	8GE770308
Replace Shutter wheel	8VBB069030
Replacement Charging Handle	5GE060421
Breaker Charging Handle Spring	8GE.288.410
1200A Primary Cluster	**5VB069152**
2000A Primary Cluster	5VBB069147
Auxilliary Switch Operator Linkage	8GE233450
Blocking Coil	P-COIL1
Trip Free Limit Switch	LXW16-11A
Push Lever	8PVB070321
Breaker Manual racking handle	5VBB069034-EX
Breaker Charging Handle Spring	8GE.288.410

Optional Accessories

SecoVac Test Box (BMBC1)

The test box, catalog number BMBC1 Figure 19, is used to operate a SecoVac circuit breaker that has been removed from the metal-clad equipment. It provides a convenient means of assessing the electrical close and trip circuits of the breaker during maintenance and inspection procedures.

SecoVac Test Jumper (BMBJ1)

An optional test jumper catalog number BMBJ1 can be ordered, that will allow a breaker placed on the floor outside the cubicle to be tested utilizing the lineup control circuit and the breaker control switch on the compartment door. This jumper will connect the secondary disconnect plug on the breaker to the secondary disconnect coupler in the breaker compartment. Normal open and close operation can be verified by use of the control switch.

Remote Racking System

The optional electrically operated remote racking device provides a convenient means for racking a breaker between the CONNECTED and DISCONNECTED positions from a remote location. It is easily mounted to the breaker unit front door and is designed for quick transfer between units.

Figure 19: SecoVac Test Box

13. Documents

DEH-50009	SecoGear Installation, Operation and Maintenance Manual
DET-882	SecoGear Application and Technical Guide
DEH-500011	SecoVac Test Box Installation, Operation and Maintenance Manual
DEH-50008	Remote Racking System Installation, Operation and Maintenance Manual

14. SecoVac Nomencalture

SECOVAC VB2+ BREAKER	DEVICE TYPE	STRUCTURE	PHASE DISTANCE & VOLTAGE	RATED CURRENT	BREAKING CURRENT (KA)	OPEN COIL	CLOSE COIL	CHARGING MOTOR	ANTI PUMP & MOC/TOC CONFIGURATION	CLOSE INTERLOCK	TRUCK INTERLOCK	DOOR INTERLOCK & PADLOCK	UNDER VOLTAGE	SECOND OPEN COIL	MOTORIZED RACK IN/OUT	SECONDARY WIRING & EARTHING CONTACTS	MEANING OF CODE
SV																	SecoVac VB2+
	E																IEEE SecoVac VB2+
	C																SecoVac VB2+G for IEEE Markets
		W															Withdrawable
		F															Fixed
			A														4.76kV, Type IEEE
			B														8.25kV, Type IEEE
			C														15kV, Type IEEE
			D														15kV Type G IEC/IEEE Pole Distance 210mm
			E														15kV Type G IEC/IEEE Pole Distance 275mm
			F														15kV IEEE, Pole Distance 150mm
			G														15kV IEEE, Pole Distance 210mm
				3													2000A
				A													600A
				B													1200A
				C													3000A
					1												31.5kA
					2												40kA
					3												50kA
											0	0	0	0	0		None
						6	6	6		6	6		6	6			DC48V
						A	A	A		A	A		A	A	A		AC/DC120-125V
						B	B	B		B	B		B	B	B		AC/DC240V-250V
									Z								Antipump Provided, IEEE, No (MOC/TOC)
									1								Antipump Provided, No MOC, TOC 4A+4B
									2								Antipump Provided, No MOC, TOC 8A+8B
									3								Antipump Provided, MOC 4A+4B, No TOC
									4								Antipump Provided, MOC 8A+8B, No TOC
									5								Antipump Provided, MOC 4A+4B, TOC 4A+4B
									6								Antipump Provided, MOC 8A+8B, TOC 4A+4B
									7								Antipump Provided, MOC 4A+4B, TOC 8A+8B
									8								Antipump Provided, MOC 8A+8B, TOC 8A+8B
																2	Withdrawable breaker - Through secondary plug with socket & Earthing on the Bottom

Not Available Yet

Notes

Notes

Imagination at work

GE
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