Vmax/A

Medium voltage vacuum circuit breaker ANSI:

4.76kV-15 kV; 1200-2000 A; 31.5 kA

Power and productivity for a better world™

Medium Voltage Products

Vmax/A
Medium voltage vacuum circuit breaker
ANSI: 4.76kV-15 kV; 1200-2000 A; 31.5 kA

Power and productivity
for a better world™

For your safety!

- Make sure that the installation room (spaces, divisions and ambient) is suitable for the electrical apparatus.
- Check that all the installation, putting into service and maintenance operations are carried out by qualified personnel with suitable knowledge of the apparatus.
- Make sure that the standard and legal prescriptions are complied with during installation, putting into service and maintenance, so that installations according to the rules of good working practice and safety in the work place are constructed.
- Strictly follow the information given in this instruction manual.
- Check that the rated performance of the apparatus is not exceeded during service.
- Check that the personnel operating the apparatus have this instruction manual to hand as well as the necessary information for correct intervention.
- Pay special attention to the notes indicated in the manual by the following symbol:

RESPONSIBLE BEHAVIOUR SAFEGUARDS YOUR OWN AND OTHERS' SAFETY!

FOR ANY REQUESTS, PLEASE CONTACT THE ABB ASSISTANCE SERVICE.

Safe Practices

Vmax/A circuit breakers are equipped with high energy/high speed mechanisms. The design includes several interlocks and safety features which help ensure safe and proper operating sequences. To ensure safety of personnel associated with installation, operation and maintenance of these breakers, the following recommendations must be followed:

Only qualified persons, as defined in the National Electric Safety Code, who are familiar with the installation and maintenance of medium voltage circuits and equipment should be permitted to work on these breakers.
Read these instructions carefully before attempting any installation, operation or maintenance of these breakers.

DO NOT work on an energized breaker.
DO NOT work on a breaker unless all components are disconnected by means of a visible break and securely grounded.
DO NOT work on a breaker with power supplied to the secondary control circuit.
DO NOT defeat safety interlocks. This may result in bodily injury, death and/or equipment damage.
DO NOT work on a closed breaker.
DO NOT work on a breaker with a charged closing spring.
DO NOT use a circuit breaker by itself as the sole means of isolating a high voltage circuit.
DO NOT leave a breaker in an intermediate position in a cell. Always place the breaker in the disconnect/test or connected position.

1. Foreword

1.1 Introduction

This publication contains the information needed to install medium voltage Vmax/A circuit breakers and put them into service. For correct use of the product, please read it carefully. Like all the apparatus we manufacture, the Vmax/A circuit-breakers are designed for different installation configurations. However, they do allow further technical and construction modifications (at the customer's request) to adapt to special installation requirements.

For this reason, the information given below may sometimes not contain instructions concerning special configurations.
Apart from this manual, it is therefore always necessary to consult the latest technical documentation (circuit and wiring diagrams, assembly and installation drawings, any protection coordination studies, etc.), especially regarding any variants requested in relation to the standardized configurations.

For example, the racking and interlock sections do not apply to the fixed mount breaker styles. All information in this booklet was current at the time of printing. Unless otherwise noted, all references in this booklet are determined by viewing the circuit-breaker from the front.
Only use original spare parts for maintenance operations.
For further information, please also see the technical catalogue of the circuit breaker.

1.2 Environmental protection program

The Vmax/A circuit breakers are manufactured in accordance with the ISO 14000 Standards (Guidelines for environmental management).

The production processes are carried out in compliance with the Standards for environmental protection in terms of reduction in energy consumption as well as in raw materials and production of waste materials. All this is thanks to the medium voltage apparatus manufacturing facility environmental management system.

1.3 Vacuum interrupter quenching principle

Due to the extremely low static interrupter chamber pressure of 10^{-4} to 10^{-8} mbar, only a relatively small contact gap is required to achieve a high dielectric strength. The vacuum arc is extinguished on one of the first natural current zeroes. Due to the small contact gap, high conductivity of the metal vapor plasma, and short arcing time, the associated arc energy is extremely low, which has advantageous effects on the life of the contacts and thus on that of the vacuum interrupters.

⚠WARNING

THE CIRCUIT BREAKERS DESCRIBED IN THIS BOOK ARE DESIGNED AND TESTED TO OPERATE WITHIN THEIR NAMEPLATE RATINGS. OPERATION OUTSIDE OF THESE RATINGS MAY CAUSE EQUIPMENT TO FAIL, RESULTING IN PROPERTY DAMAGE, BODILY INJURY AND/OR DEATH.
ALL SAFETY CODES, SAFETY STANDARDS AND/OR REGULATIONS AS THEY MAY BE APPLIED TO THIS TYPE OF EQUIPMENT MUST BE ADHERED TO STRICTLY.

1.4 Information in this booklet

This booklet provides information for the Vmax/A circuit breakers as described below. Not all sections of the bulletin apply to all types of Vmax/A circuit breakers. All information in this booklet was current at the time of printing. Unless otherwise noted, all references in this booklet are determined by viewing the circuit-breaker from the front.

Table 1. Circuit Breaker Rating

Style	Voltage Rating	Continuous current rating	Interruption ratings (symmetrical RMS)	Configurations available
Vmax/A	4.76 kV – 15 kV	1200 A – 2000 A	25 kA – 31.5 kA	Drawout, roll on the floor

1.5 Drawout

A drawout circuit breaker is a breaker that may be removed from a cell without unbolting connections or mounting supports. It contains primary and secondary disconnects and provides two operating positions: Disconnect and Connect.

1.6 Application of the X-ray emission standards

One of the physical properties of vacuum insulation is the possibility of X-ray emission when the interrupter contacts are open.
The specific tests carried out at the PTB laboratories (Physikalisch-Technische Bundesanstalt, in Brunswick - Germany) show that local emission at a distance of 10 cm from the interrupter or pole surface does not exceed 1 mSv/h.

It follows that:
- at the rated service voltage the use of vacuum interrupters is absolutely safe;
- application of the withstand voltage at industrial frequency, according to the IEC 62271-100, VDE 0670 and IEEE C37.04 Standards, is safe;
- application of a voltage higher than the withstand voltage at industrial frequency or of a direct current test voltage in direct current, specified in the IEC, VDE and ANSI/IEEE Standards, cannot be used;
- Limitation of the above-mentioned local phenomena, with interrupters with open contacts, depends on keeping the specified distance between the contacts.

This condition is intrinsically guaranteed by correct operation of the operating mechanism and by adjustments of the transmission system.

2. Introduction and safe practices

2.1. Introduction

The purpose of this manual is to provide instructions for unpacking, storage, installation, operation, and maintenance for Vmax/A vacuum circuit breakers. This manual should be carefully read and used as a guide during installation, initial operation, and maintenance.

The specific ratings of each model circuit breaker are listed on the individual nameplates. The Vmax/A circuit breakers are protective devices. As such, they are maximum rated devices. In no event should they be applied outside of their nameplate ratings.

2.2. Safe practices

Vmax/A circuit breakers are equipped with high energy / high speed mechanisms. The design includes several interlocks and safety features which help ensure safe and proper operating sequences. To ensure safety of personnel associated with installation, operation, and maintenance of these circuit breakers, the following recommendations must be followed.

Only qualified persons, as defined in the National Electric Safety Code, who are familiar with the installation and maintenance of medium voltage circuits and equipment should be permitted to work on these circuit breakers

Read these instructions carefully before attempting any installation, operation, or maintenance of these power circuit-breakers.

- Do not work on an energized circuit breaker.
- Do not work on a circuit breaker unless all components are disconnected by means of a visible break and securely grounded.
- Do not work on a circuit breaker with power supplied to the secondary control circuit.
- Do not defeat safety interlocks. This may result in bodily injury, death and/or equipment damage.
- Do not work on a closed circuit breaker.
- Do not work on a circuit breaker with charged energy (springs charged).
- Do not use a circuit breaker by itself as the sole means of isolating a high voltage circuit.
- Do not leave a circuit breaker in an intermediate position in a cell. Always place the circuit breaker in the disconnect or connect position.

⚠WARNING

FAILURE TO OBSERVE THE REQUIREMENTS OF OSHA STANDARD 1910.269 CAN CAUSE DEATH OR SEVERE BURNS AND DISFIGUREMENT. THIS STANDARD SPECIFICALLY PROHIBITS THE WEARING OF POLYESTER, ACETATE, NYLON, OR RAYON CLOTHING BY EMPLOYEES WORKING WITH EXPOSURE TO ELECTRIC ARCS OR FLAMES.

2.3. Standard and regulations

2.3.1. Fabrication

The Vmax/A circuit breakers conform to the following standards:

- IEEE C37.04
- DIN VDE 0670, part 104, and IEC 62271-100
- DIN VDE 0847, part 4, and IEC 61000-4

2.3.2. Installation and operation

For assembly and operation, please refer to the relevant regulations, and in particular to:

- ANSI / NFPA70
- NEC

2.3.3. Service conditions

Normal service conditions

Follow the recommendations in the IEC 62271-1 and 62271-100 Standards. In more detail:

IEEE C37.09

IEEE C37.54 – C37.20.2.

Ambient temperature

Maximum	+ 40 °C / 104 °F
Average maximum over 24 hours	+ 35 °C / 95 °F
Minimum for indoor installation	- 30 °C/ -22 °F

Humidity

The average value of the relative humidity, measured for a period longer than 24 hours, must not exceed 95%

The average value of the pressure of the water vapor without condensation, measured for a period longer than 24 hours, must not exceed 2.2 kPa.

The average value of the relative humidity, measured for a period longer than 1 month, must not exceed 90%.

The average value of the pressure of the water vapor, measured for a period longer than 1 month, must not exceed 1.8 kPa.

Altitude

≤ 1000 (3300 ft.) m above sea level.
For application above 1000m (3300 ft.) C37.20.2 is applicable

Climate

To avoid the risk of corrosion or other damage in areas:

– with a high level of humidity, and/or
– with rapid and large temperature variations, take appropriate steps (for example, by using suitable electric heaters) to prevent condensation phenomena.

For special installation requirements or other operating conditions, please contact ABB.

3. Receiving, handling, and storage

Vmax/A circuit breakers are subject to complete factory production tests and inspection prior to packaging and shipment. The shipping package is designed to provide reasonable protection during shipment and to provide convenient handling. Accessories such as opening handles and racking handles are shipped separately from the circuit breaker. The circuit breaker is shipped in special packing, in the open position. Each piece of apparatus is protected by a plastic cover to prevent any infiltration of water during the loading and unloading stages and to keep the dust off during storage.

3.1. Receiving

On receipt, check the state of the apparatus, integrity of the packing and correspondence with the nameplate data with what is specified in the order confirmation and in the accompanying shipping notes.

Also make sure that all the materials described in the shipping notes are included in the supply.

Should any damage or irregularity be noted in the supply on unpacking, notify ABB (directly or through the agent or supplier) as soon as possible and in any case within five days of receipt. The apparatus is only supplied with the accessories specified at the time of ordering and validated in the order confirmation sent by ABB.

The accompanying documents inserted in the shipping packing are:
- Instruction manual (this document)
- Test certification
- Identification label
- Copy of the shipping documents
- Electric wiring diagram.

Other documents which are sent prior to shipment of the apparatus are:
- Order confirmation
- Original shipping advice notes
- Any drawings or documents referring to special configurations/conditions.

Immediately upon receipt of the circuit breaker(s), examine the carton(s) to determine if any damage or loss was sustained during transit. If damage or indication of rough handling is evident, file a damage claim at once with the carrier and promptly notify the nearest district office. ABB is not responsible for damage to goods which occur after delivery. However, ABB will lend assistance if notified of claims. Use care in unpacking the circuit breaker to avoid damaging any circuit breaker parts.

Unpack circuit breakers as soon as possible after receipt. If unpacking is delayed, difficulty may be experienced in making a claim for damages not evident upon receipt. Check the contents of each carton against the packing list before discarding any packing material. If any discrepancy is discovered, promptly notify the nearest district office. Information specifying the purchase order number, carton number, and part numbers of damaged or missing parts should accompany the claim.

⚠CAUTION

Do not stack crated breakers more than 3 high.
Containers will collapse causing damage to breakers!

3.2. Handling

Vmax/A circuit breaker shipping containers are designed to be handled by fork lift (not supplied). To lift and handle the circuit breaker, proceed as follows (Figure 1):

– use a special lifting tool (1) (supplied as accessory) fitted with a safety chain and hooks (2);
– insert the hooks (2) in the special holes in the circuit breaker frame and lift;
– Upon completion of the operation, (and in any case before putting into service) unhook the lifting tool.

During handling, take great care not to stress the insulating parts and the terminals of the circuit breaker.

Figure 1: Lifting Circuit Breaker

Once removed from the shipping container, the circuit breaker wheels are designed to move the circuit breaker across a smooth, paved surface.

Care must be taken not to damage the secondary plug (item 3, Figure 2) when transporting, rolling, or handling the Vmax/A circuit breakers.

Figure 2: Circuit Breaker Secondary Plug

DO NOT pull the circuit breaker by the front handles with the circuit breaker in any position other than full Disconnect to avoid injuries at the hands.

DO NOT move the circuit breaker by pushing on the pole box or primary leads of the embedded poles. Damage and misalignment of the poles and contact arms assemblies will occur if force is applied to them.

3.3. Storage

On receipt the apparatus must be carefully unpacked and checked as described in Checking on receipt. If immediate installation is not possible, the packing must be replaced, using the original material supplied. Insert special hygroscopic substances inside the packing, using at least one standard packet per piece of apparatus. Should the original packing not be available and immediate installation is not possible, store in a covered, well-ventilated, dry, dust-free, non-corrosive ambient, away from any flammable materials and at a temperature between – 30°C (-22°F) and + 45°C (+113°F).

Circuit breakers should be installed in their permanent location as soon as possible. If the circuit breakers are not placed in service for some time, it is advisable to provide adequate means of environmental protection. This may be done by keeping the circuit breaker in its original shipping container and storing it in a warm, dry, and uncontaminated atmosphere. The circuit-breakers should be stored to minimize condensation. Moisture can cause deterioration of metal parts and high voltage insulation.

Prior to storage of the circuit breaker, verification should be made that it is free from shipping damage and is in satisfactory operating condition.

4. Description

4.1. General

The Vmax series of circuit breakers are pieces of apparatus under vacuum for indoor installation; for the electrical performances, please refer to the corresponding technical catalogue. For special installation requirements, please contact ABB. The following version is available:

Withdrawable for ABB RELIAGEAR ND Switchgear

4.2. Reference Standards

The Vmax circuit breakers conform to the IEC 62271-100, IEEE C37.04 – C37.54 – C37.09 – C37.55 standards and those of major industrialized countries.

4.3. Withdrawable Circuit Breaker

4.3.1. Vmax/A circuit breaker

The withdrawable circuit breaker Vmax/A (see figure 3) is available for ABB RELIAGEAR ND Switchgear.
It consists of a truck on which the supporting structure of the circuit breaker is fixed.

The cord with the connector (2) (plug) for connection of the operating mechanism electrical accessories comes out of the connection (3).

The shutter actuators (5) for operating the shutters of the medium voltage enclosure are fixed on the sides of the circuit breaker.
On the front part of the circuit breaker truck, the front channel is mounted with the handles that actuate tabs (6) for inserting and securing the circuit breaker.

A lock prevents racking-in and racking-out with the circuit- breaker closed. With the truck in an intermediate position between isolated and racked-in, a further lock prevents circuit breaker closing (either mechanical or electrical). The circuit breaker is completed with the primary contacts (4).

1. RACKING TRUCK
2. CONNECTOR (PLUG)
3. CABLING CONNECTION
4. PRIMARY CONTACTS (CLUSTERS)
5. SHUTTER ACTUATOR
6. TRUCK FRONT CHANNEL TABS
7. ROF WHEELS (OPTIONAL)
8. RATING PLATE
9. CLOSE PUSHBUTTON
10. OPEN PUSHBUTTON
11. SPRING CHARGE INDICATOR
12. OPEN CLOSE INDICATOR
13. CHARGING LEVER
14. OPERATION COUNTER
15. UNDERVOLTAGE RELEASE MECHANICAL OVERRIDE
16. LIFTING PROVISION

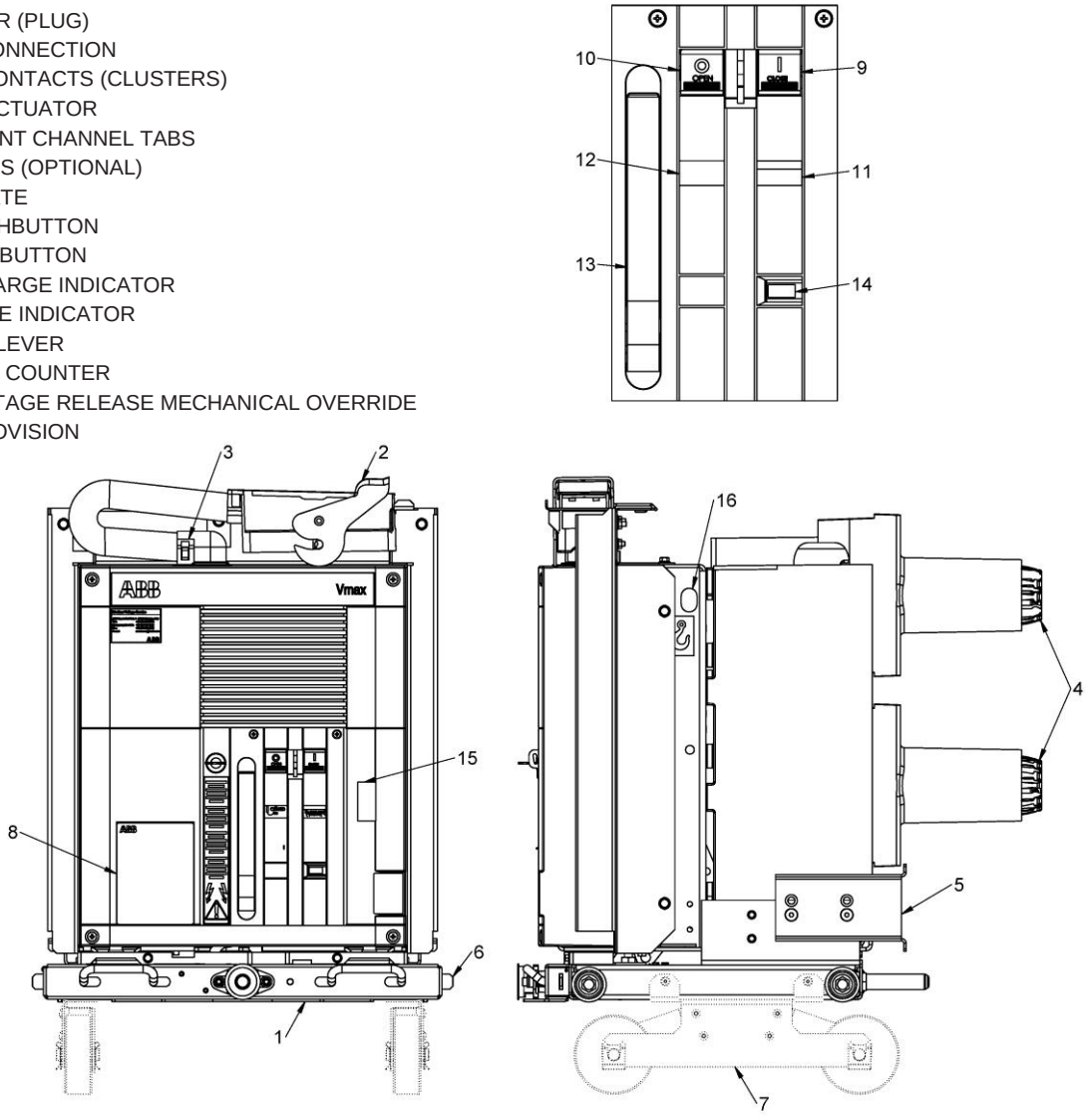


Figure 3: Circuit Breaker Parts

4.3.2. General characteristics of withdrawable circuit breakers for RELIAGEAR ND Switchgear

The basic versions of the withdrawable circuit breakers are three-pole and fitted with:

- EL type manual operating mechanism
- Mechanical signaling device for closing springs charged/ discharged
- Mechanical signaling device for circuit breaker open/closed
- Closing and opening pushbutton
- Operation counter
- Auxiliary circuit breaker open/closed contacts
- Lever for manually charging the closing springs
- Isolating contacts

Circuit Breaker		Vmax/A 4.76-15 kV
Use in switchgear/enclosure		ReliaGear ND
Standards		IEEE C37.54 - C37.09 - C37.04 - C37.55 UL Listed (on request)
Rated voltage	U_r [kV]	4.76 … 15
Rated insulation voltage	U_s [kV]	4.76 … 15
Withstand voltage at 50 Hz	U_d (1 min) [kV]	36 (at 60 Hz)
Impulse withstand voltage	U_p [kV]	95
Rated frequency	Fr [Hz]	60
Rated normal current (40˚C)	I_r [A]	1200 … 2000
Rated breaking capacity (rated symmetrical short-circuit current)	I_{sc} [kA]	25 … 31.5 (3 cycles)
Rated-short time withstand current (2s)	I_k [kA]	31.5
Making capacity	I_p [kA]	82
Operation sequence		[O - .3” – CO – 3’ CO]
Opening time	[ms]	27 … 32.5
Arc duration	[ms]	10 … 17.5
Total interruption time	[ms]	<50
Closing time	[ms]	45 … 80
Weight	[kg/lb]	98/215.60

4.4. Characteristics of the electrical accessories

TRIP COIL (52TC1) *Shunt opening release (-MBO1)*

2nd TRIP COIL (52TC2) *Additional shunt opening release (-MBO2)*

CLOSE COIL (52X) *Shunt closing release (-MBC)*

UNDERVOLTAGE COIL (27UV) *Undervoltage release (-MBU)*

TRUCK BLOCKING MAGNET (52BM) *Locking Magnet (RLE2)*

Nominal Voltage		24,48,125,250 VDC (60 Hz)
		120, 240 VAC (60 Hz)
Operating Limits	-MO1-MO2-MC	65 … 120 % V_{nom}
	-MU	35 … 85 % V_{nom}
Operating Time	-MO1-MO2	27 … 32.5 ms
	-MC	45 … 80 ms
	-MU	60 … 60 ms
Power on inrush (Ps)		< 150 W
Inrush duration		150 ms
Continuous power (Pc)		3 W
Insulation Voltage		2000 V 50/60 Hz (for 1 min)

AUXILIARY CONTACTS (52a, 52b) (-BGB1)

General characteristics	
Insulation voltage according to VDE 0110 standard, Group C	660 V AC 800 V DC
Rated voltage	24 V … 660 V
Test voltage	2.2 kV
Rated overcurrent	10 A
Number of contacts	5
Contact run	6 mm … 7 mm(0.236" … .276")
Activation force	26 N
Resistance	3 mΩ
Storage temperature	-20 ˚C … +120 ˚C (-4°F … 248°F)
Operating temperature	-20 ˚C … +70 ˚C (-4°F … 158°F)
Contact overtemperature	20 K
Number of cycles	30,000
Unlimited breaking capacity if used with 10A fuse in series	

Note: Application of the shunt opening release and/or additional shunt operating release foresees the use of one or two auxiliary make contacts (normally open), thereby reducing the number of auxiliary contacts available.

CHARGING MOTOR (88M) (-MAS)

V_{nom}	24, 48, 125, 250 VDC
V_{nom}	110, 220 VAC 50/60 Hz
Operating limits	85 … 110 % V_{nom}
Inrush power (Ps)	DC 600 W; AC = 600 VA
Rated power (Pn)	DC – 200 W; AC = 200 VA
Inrush time	0.2 s
Charging time	6-7 s
Insulation voltage	2000 V 50 Hz (for 1 min)

4.5. Preliminary operations

Clean the insulating parts with clean dry cloth.
Check that the top and bottom terminals are clean and free of any deformation caused by shocks received during transport or storage.

4.5.1. Insertion and removal of withdrawable circuit breaker

This section describes the process for inserting the breaker into the disconnect position of the switchgear and the removal of the circuit breaker from the disconnect position. Racking of the circuit breaker to and from the connect and disconnect position is covered in the following section.

INSERTION (Refer to Fig. 4 and 5)
(From Withdrawn Position to Disconnect Position)

1. Check rating label of circuit breaker and verify that it matches the rating of the switchgear.
2. Align breaker and ramp, dolly or lift truck with circuit breaker compartment.
3. Pull handles inwards to center; withdrawing cell interlock tabs.
4. Push breaker into breaker compartment with handles.
5. Align interlock tabs with circuit breaker compartment slots. If the circuit breaker tabs are prevented from reaching the compartment slots, check the rating label.
6. Push handles out to fully engage cell interlock tabs into circuit breaker compartment slots.
7. Visually check that cell interlock tabs are engaged in circuit breaker compartment slots (if cell interlock tabs are not fully extended, racking is prevented).
8. Breaker is now in the Disconnect Position.

REMOVAL
(From Disconnect Position to Withdrawn Position)

1. Visually check to see that the circuit breaker is racked fully to the disconnect position and the connector plug is disconnected.
2. In order to release the stored energy inside the circuit breaker: push the CLOSE pushbutton and then push the OPEN pushbutton.
3. Pull handles to center (this withdraws cell interlock tabs; allowing breaker to be removed).
4. Pull the breaker from circuit breaker compartment with the handles onto the required transportation device.

Figure 4: Circuit Breaker Tabs and Compartment Slots

Figure 5: Circuit Breaker in Disconnect Position

⚠CAUTION

THE CLOSING SPRING MUST BE MANUALLY DISCHARGED BEFORE THE BREAKER CAN BE REMOVED FROM THE CELL. THIS CAN BE ACCOMPLISHED BY CLOSING AND OPENING THE BREAKER WHILE IT IS IN THE DISCONNECT POSITION.

4.6. Putting into service

4.6.1. General procedures

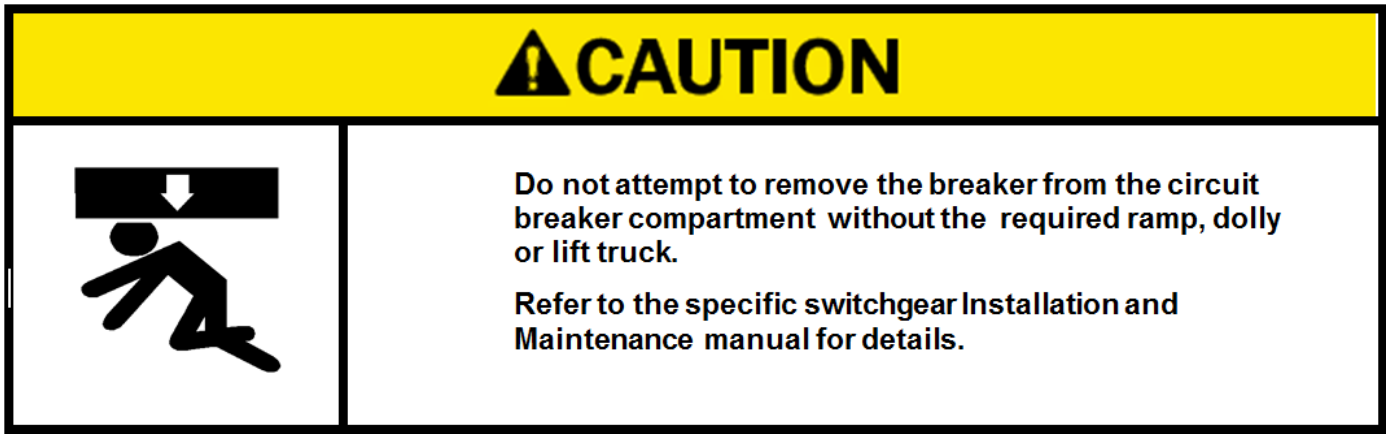
⚠CAUTION

ALL THE OPERATIONS REGARDING PUTTING INTO SERVICE MUST BE CARRIED OUT BY ABB PERSONNEL OR BY SUITABLY QUALIFIED CUSTOMER PERSONNEL WITH IN DEPTH KNOWLEDGE OF THE APPARATUS AND OF THE INSTALLATION.

- Check tightness of the power connections at the circuit-breaker terminals.
- Check that the value of the power supply voltage of the auxiliary circuits is within limits stated by IEEE C37.06.
- Check that no foreign bodies, such as bits of packing, have got into the moving parts.
- Check that there is a sufficient exchange of air in the installation place to avoid over temperatures.
- Supply the auxiliary circuits with power.
- Check the functionality and efficiency of the mechanical and electrical locks.
- Carry out a few circuit breaker opening and closing operations by means of the pushbuttons on the front of the circuit- breaker.
- Carry out the checks indicated in table below.
- Do not attempt to insert the circuit breaker into any compartment prior to inspection.
- Compare the circuit breaker name plate rating with the switchgear rating.
- Do not attempt to insert a closed circuit breaker.
- Always inspect the circuit breaker compartment to insure that it is free of obstructions, tools, or other equipment.

Item	inspected	Procedure	Positive check
1	Insulation resistance	Medium voltage circuit With a 2500 V megger, measure the insulation resistance between the phases and the exposed conductive part of the circuit.	The insulation resistance should be at least 50 Mohm and in any case constant over time.
		Auxiliary circuits With a 500 V megger (if the apparatus installed allows this), measure the insulation resistance between the auxiliary circuits and the exposed conductive part.	The insulation resistance should be a few Mohm and in any case constant over time.
2	Auxiliary circuits	Check that the connections to the control circuit are correct: proceed at the relative power supply.	Operations and signals are normal.
3	Manual operating mechanism	Carry out a few closing and opening operations (see cap. 6). N.B. Supply the undervoltage release and the locking magnet on the operating mechanism at the relative rated voltage (if provided).	The operations and the relative signals take place normally.
4	Motor operator (88M)	Supply the spring charging geared motor at the relative rated voltage.	The springs are charged normally. The signals are normal. With the springs charged, the geared motor stops.
		Carry out a few closing and opening operations. N.B. Supply the undervoltage release and the locking magnet on the operating mechanism at the relative rated voltage (if provided).	The geared motor recharges the springs after each closing operation.
5	Undervoltage Coil (27UV) (if provided)	Supply the undervoltage release at the relative rated voltage and carry out the circuit breaker closing operation.	The circuit breaker closes normally. The signals are normal.
		Cut off power to the release.	The circuit breaker opens. The signaling changes over.
6	Trip Coil (52TC1) and 2nd Trip Coil (52TC2) (if provided)	Close the circuit breaker and supply the shunt opening release at the relative rated voltage.	The circuit breaker opens normally. The signals are normal.

Item	inspected	Procedure	Positive check
7	Close Coil (52X)	With the circuit breaker open and charged supply the shunt closing release at the relative rated voltage.	The circuit breaker closes normally. The signals are normal.
8	Key lock (if provided)	Open the circuit breaker, keep the opening pushbutton depressed, then turn the key and remove it from the housing. Attempt the circuit breaker closing operation.	Neither manual nor electrical closing takes place.
		Put the key back in and turn it 90°. Carry out the closing operation.	Both electrical and manual closing takes place normally; in this position the key cannot be removed.
9	Auxiliary contacts in the operating mechanism. (52a and 52b)	Insert the auxiliary contacts in suitable signaling circuits. Carry out a few closing and opening operations.	Signals take place normally.
10	Undervoltage override (33UVa) (if provided)	With the circuit breaker open, springs charged, override not connected and undervoltage release not supplied with power, attempt circuit breaker closing.	Closing is not possible.
11	Locking electromagnet on the truck circuit breaker (52BM) (if provided)	With the circuit breaker open, in the isolated for test position and the locking electromagnet not supplied, attempt circuit-breaker racking-in.	Racking-in is not possible.
		Supply the locking electromagnet and carry out the racking-in operation.	Racking-in takes place correctly.



4.6.2. Safety indications

- Vmax circuit breakers provide a minimum IP2X degree of protection when installed in the following conditions:
    - Withdrawable circuit breaker, installed in switchgear (this will vary depending on switchgear design)
- Under these conditions the operator is protected against accidental contact with circuit breaker moving parts.
- Should mechanical operations be carried out on the circuit- breaker outside the switchgear, be very careful of the moving parts.
- If the operations are prevented, do not force the mechanical interlocks and check that the operating sequence is correct.
- Racking the circuit breaker in and out of the switchgear must be done gradually to avoid shocks which may deform the mechanical interlocks.

4.6.3 Racking Vmax/A

Vmax/A circuit breakers are designed with three distinct positions: **Disconnect, Test, and Connect**.

DISCONNECT POSITION

- In the disconnect position the shutters are closed and the control plug is not connected.
- Only manual charging, manual closing and manual opening operations are allowed.
- The circuit breaker is interlocked to not be able to rack from the disconnect position.

TEST POSITION

- In order to rack the circuit breaker, the control plug must be connected to the switchgear which puts the circuit breaker into the test position.
- In the test position, electrical operation of the circuit breaker is allowed with control power supplied through the secondary contacts with the shutters closed.
- Racking is allowed from the test position to the connect position.

CONNECT POSITION

- In the Connect position, the primary disconnects are fully engaged and the shutters are open.
- Electrical operation of the circuit breaker through the secondary contacts remains enabled.
- Racking to and from the connect position should be done with the door closed.

Figure 6: Circuit Breaker in Disconnect Position

Figure 7: Circuit Breaker in Test Position

Figure 8: Circuit Breaker in Connect Position

4.6.4 Racking from Test to Connect

Perform a visual inspection of the circuit breaker:

1. Verify Close/Open indicator and signaling provisions show OPEN. If not, OPEN the circuit breaker. Racking to connect position is prevented by interlocking when the breaker is closed.
2. Verify switchgear door is closed.

Racking-in operation:

1. Using the racking handle, engage the screw collar and push in to unlock the screw.
2. Begin racking by rotating the racking handle in the CLOCKWISE direction.
3. Twenty (20) revolutions (200 mm/7.89”) will move the circuit- breaker between the test and connect positions.
4. As the circuit breaker approaches the connect position, an increase in racking force is required to lift the shutters and to engage the primary contacts.
5. The connect position is indicated by a positive lock, preventing further racking screw rotation.

Electrical and mechanical closing operation of the circuit-breaker is prevented between test and connect positions. Circuit breaker racking-in/-out must be carried out gradually to avoid shocks which may deform the mechanical interlocks and the end-of-runs. The torque normally required to carry out racking-in and racking-out is <25 Nm. This value must not be exceeded. If operations are prevented or difficult, do not force them and check that the operating sequence is correct.

4.6.5 Racking from Connect to Test

Perform a visual inspection of the circuit breaker:

1. Verify Close/Open indicator and signaling provisions show OPEN. If not, OPEN the circuit breaker. Racking to test position is prevented by interlocking when the breaker is closed.
2. Verify switchgear door is closed.

Racking-out operation:

1. Using the racking handle, engage the screw collar and push in to unlock the screw.
2. Begin racking by rotating the racking handle in the COUNTER-CLOCKWISE direction.
3. Twenty (20) revolutions (200 mm/7.89”) will move the circuit-breaker between the connect and test positions.
4. The test position is indicated by a positive lock, preventing further racking screw rotation.

Table 2. Summary Racking Data

	DISCONNECT / TEST	CONNECT
Distance from Disconnected	0 mm / 0 revolutions / 0 inches	200 mm / 20 revolutions / 7.89 inches
Manual opening	Yes	Not recommended unless necessary
Electrical Operation	Yes, while control plug is connect (Test Position)	Yes
Control Power Available	Yes, while control plug is connect (Test Position)	Yes
Shutter	CLOSED	OPEN
Primary Contacts Engaged	No	Yes
Requirements to rack breaker from position	Breaker Open / Control plug connect	Breaker Open / Control plug connect

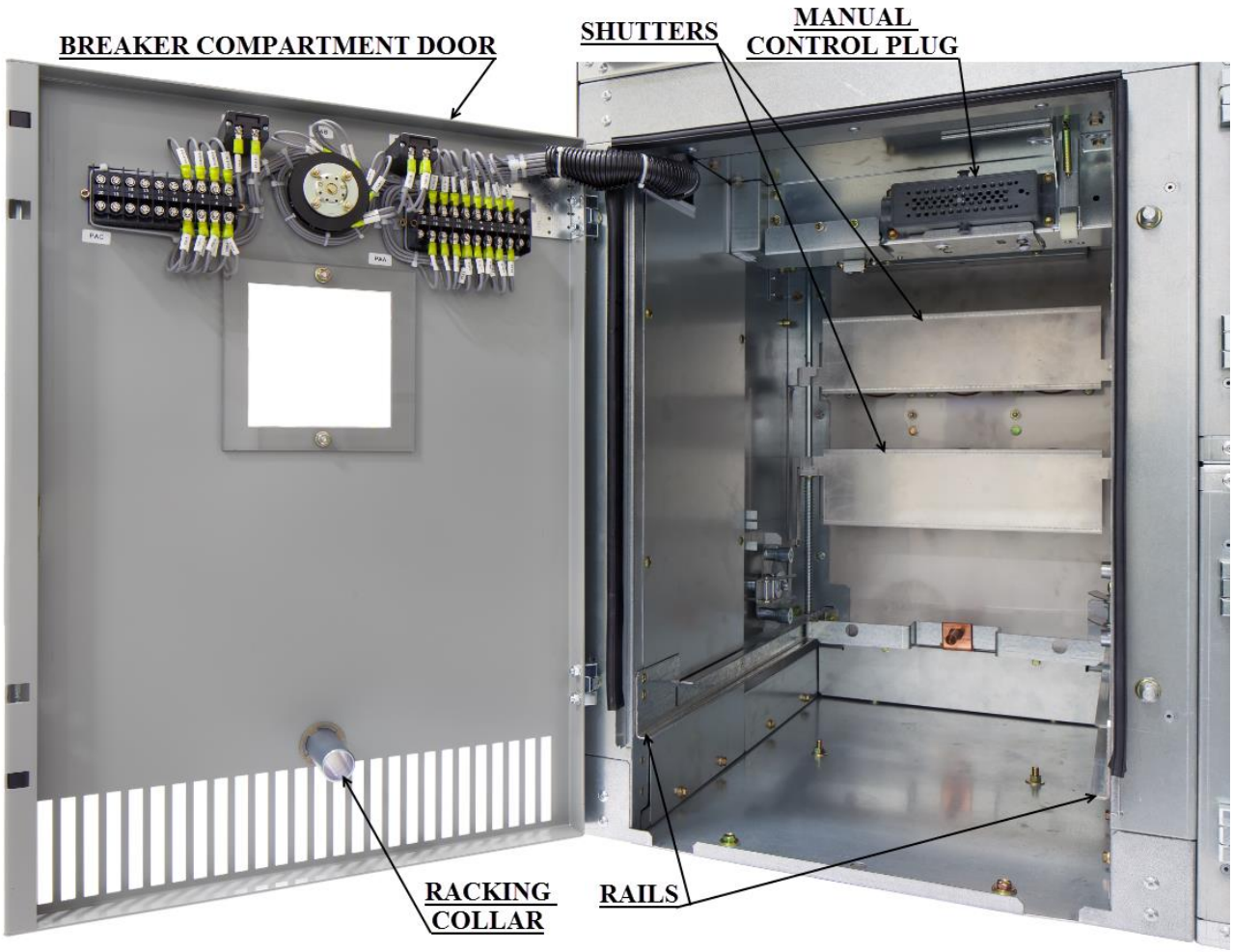


Figure 9: Circuit Breaker Compartment

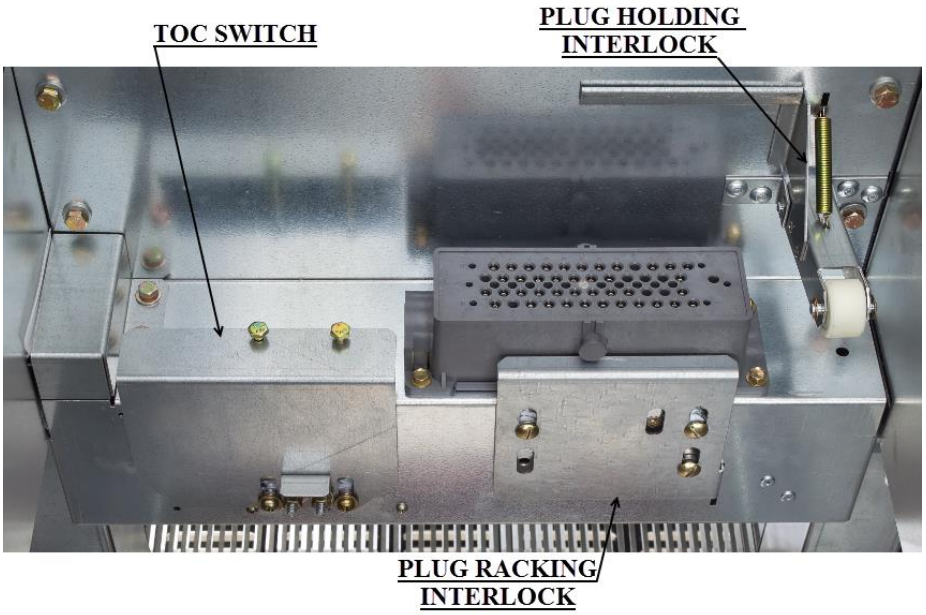


Figure 10: Circuit Breaker Interface

4.6.8. Circuit breaker closing and opening operations

Circuit breaker operation can be either manual or electrical (figure 11).

MANUAL SPRING CHARGING OPERATION

To manually charge the closing springs, it is necessary to repeatedly activate the charging lever (2) (maximum rotation angle of the lever: about 90°) until the yellow signaling device (7) appears; indicating completion of charging. The maximum force which can normally be applied to the lever is < 250 N.

ELECTRICAL SPRING CHARGING OPERATION

The Vmax/A is equipped with an electric charging motor. When the control plug is connected and power is supplied to the motor charging circuit (see electric circuit diagram section 9), the charging motor will charge the closing spring until the yellow signaling device appears. The circuit is designed such that the charging motor will turn on whenever the closing spring is discharged.

If the power is cut off during charging, the geared motor stops and will automatically start recharging the springs when the power returns. In any case, it is always possible to complete the recharging operation manually.

CIRCUIT BREAKER CLOSING

- This operation can only be carried out with the closing spring completely charged.
- For manual closing, press the pushbutton (5).
- The circuit breaker must be in the test or disconnect position to close.
- The operation can also be carried out remotely by means of control circuit delivering power to the close coil.
- The closing operation is signaled by the OPEN/CLOSE indicator.

CIRCUIT BREAKER OPENING

- This operation can be carried out with the closing spring charged or discharged.
- For manual opening, press the pushbutton (4).
- The operation can also be carried out remotely by means of control circuit delivering power to the trip coil or optional second trip coil.
- The opening operation is signaled by the OPEN/CLOSE indicator.

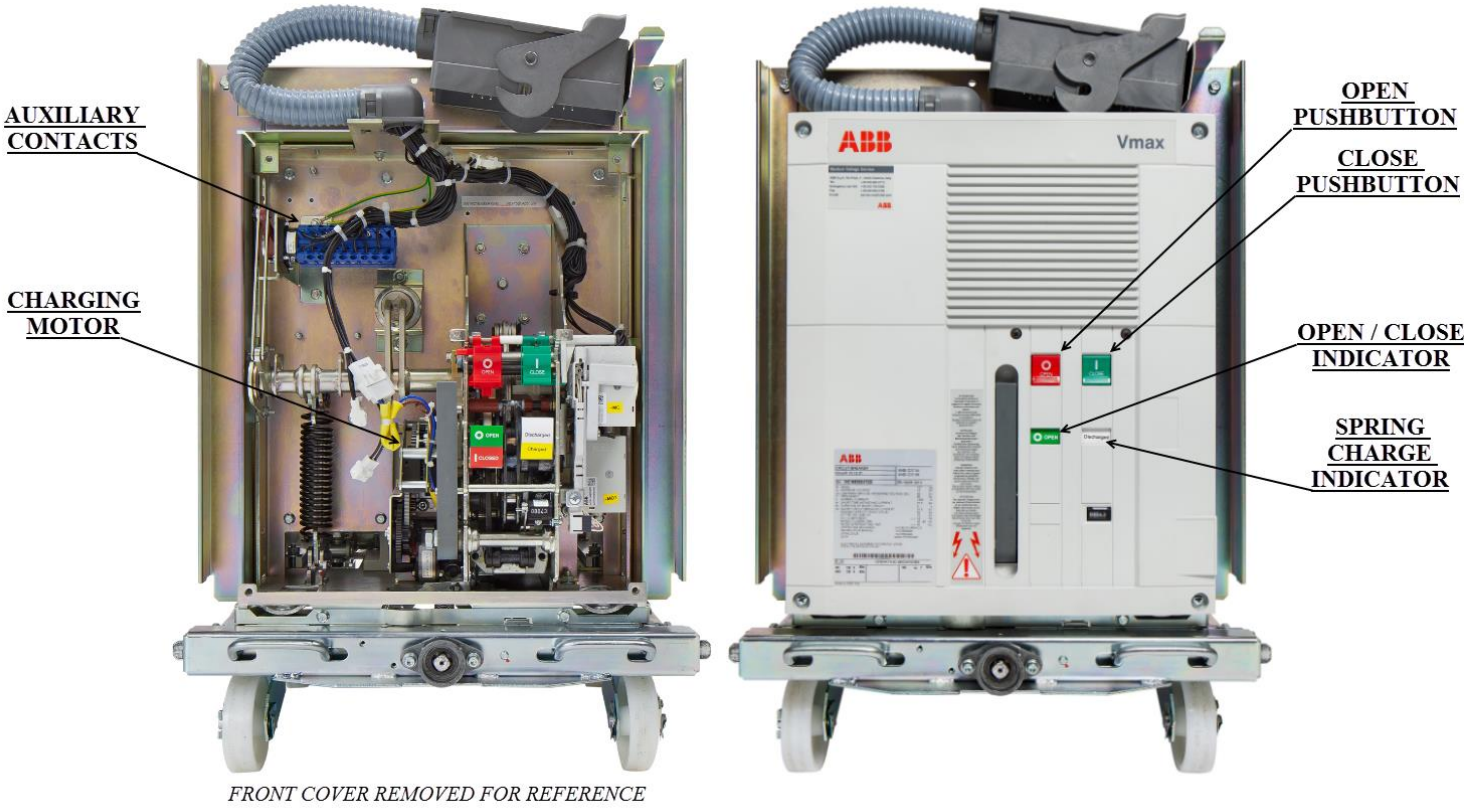


Figure 11: Circuit Breaker Operation

5. Operation, installation and maintenance

5.1. Interlocks

These interlocks are provided to prevent incorrect operations and/or malfunctions. The interlocks are the following:

5.1.1. Interference blocking

A mechanical interference blocking in the circuit breaker compartment prevents under rated circuit breakers from being inserted into higher rated compartments. The code plate rating includes continuous current, interrupting current, and maximum voltage.

5.1.2. Racking Interlocks

- The withdrawable truck can only be moved from the test/
- Isolated position to the connected position (and vice versa) if the circuit breaker is open (this means that first of all the circuit- breaker must be opened).
- The circuit breaker can only be closed if the withdrawable truck is exactly in the defined disconnected, test or in the connected position.
- The circuit breaker can only be racked when the breaker is OPEN.
- The switchgear is provided with devices which only allow connection and disconnection of the plug connector in the test position.
- The circuit breaker can only be racked when the control plug is connected.
- The handles in the front channel of the truck can only be pulled in when the circuit breaker is in the disconnect position.

5.1.3. Spring Charge Interlock

- When the circuit breaker is racked to the test position and then the plug is disconnected, the handles in the front channel of the truck are blocked because the closing spring is charged.
- In order to remove the circuit breaker from the compartment, the closing spring must be discharged by manually pushing the CLOSE pushbutton.
- After closing, there is still stored energy in the opening spring. So the breaker should be opened by pushing the OPEN pushbutton. Otherwise, the pulling of the handles will OPEN the circuit breaker.

⚠WARNING

MODIFICATION TO INTERLOCKS CAN RESULT IN HAZARDOUS CONDITIONS TO PERSONNEL AND EQUIPMENT.

DO NOT OVERRIDE, BY-PASS OR ADJUST INTERLOCKS

5.2. Maintenance

Vmax circuit breakers are designed for a minimum amount of maintenance. Circuit breakers in a clean, non-corrosive environment require only annual inspection. Dusty or corrosive environments require inspection more often at the discretion of the user. Following each interrupted fault inspection is required.

DO NOT work on an energized circuit breaker.

DO NOT work on a circuit breaker unless all of the components are disconnected by means of a visible break and securely grounded.

DO NOT work on a circuit breaker with power supplied to the secondary control circuit.

DO NOT defeat safety interlocks. This may result in bodily injury, death and/or equipment damage.

DO NOT work on a closed circuit breaker.

DO NOT work on a circuit breaker with charged energy. (Springs)

DO NOT use a circuit breaker by itself as the sole means of isolating a high voltage circuit.

DO NOT leave a circuit breaker in an intermediate position in a cell. Always have the circuit breaker in the Disconnect or Connect position.

DO NOT put a circuit breaker of a lower rating into a switchgear compartment of a higher rating.

5.2.1. General

Vacuum circuit breakers are characterized by simple, sturdy construction and long life.

The drive is maintenance-free for its whole operating life and only requires functional inspections.

The vacuum interrupters are maintenance-free for their whole operating life.

Vacuum interruption does not produce harmful effects even when there are frequent trips at the rated and short-circuit current.

The servicing interventions and their aim depend on the environmental conditions, on the sequence of operations and on the trips under short-circuit.

Note
For maintenance work, respect the following Standards:
- the relative specifications indicated in the “Standards and Specifications” chapter;
- regulations for safety in the workplace indicated in the “Putting into service and operations” chapter;
- Regulations and specifications of the country where the apparatus is installed.

The maintenance operations can only be carried out by trained personnel who respect all the safety regulations. Furthermore, is recommended that ABB service personnel should be called in, at least to check the service performances, and for any repair work. During maintenance work, turn the power supply off and put the apparatus under safe conditions.

⚠WARNING

THE CIRCUIT BREAKERS DESCRIBED IN THIS BOOK ARE DESIGNED AND TESTED TO OPERATE WITHIN THEIR NAMEPLATE RATINGS. OPERATION OUTSIDE OF THESE RATINGS MAY CAUSE EQUIPMENT TO FAIL, RESULTING IN PROPERTY DAMAGE, BODILY INJURY AND/OR DEATH.
ALL SAFETY CODES, SAFETY STANDARDS AND/OR REGULATIONS AS THEY MAY BE APPLIED TO THIS TYPE OF EQUIPMENT MUST BE ADHERED TO STRICTLY.

5.2.2. Mechanism

The mechanism requires visual inspection of hardware, lubrication and operation during routine inspection.

Remove the front cover by unfastening the screws and set the front cover aside, securing the hardware.

Always lubricate the working surface of the moving parts. Verify lubrication on the connections of the actuator and lever arm. Remove any grease on the circuit breaker frame. Use only grease Isoflex Topas NB52 (ABB No GCE0007249P100 1Pt. can). If the grease becomes caked and dirty, remove with a clean cloth and reapply lubrication.

Maintenance operations are aimed at ensuring trouble-free operation of the apparatus for the longest possible time.
In accordance with what is specified in IEEE C37.04 - C37.54 - C37.09 - C37.55 Standards and NETA Standards, the following operations must be carried out:

Inspection:	Determination of the actual conditions
Servicing:	Measures to be taken to maintain the specification conditions
Repairs:	Measures to be taken to restore the specification conditions.

.

5.2.3. Operating life

All vacuum circuit breakers are characterized by simple, sturdy construction and long useful life. Frequent operation of the service and short-circuit currents does not negatively affect the degree of vacuum of the interrupters.

Typical useful life expectancy of a Vmax vacuum circuit breaker is determined by the following factors:

- Vacuum interrupter, maintenance free up to 10,000 mechanical operating cycles.
- drive with mechanical actuator, maintenance free under normal service conditions
  - up to 10,000 operating cycles for all the circuit breakers with breaking capacity up to 31.5 kA and rated current up to 2000A
- indication of ON/OFF position up to 10,000 operating cycles
- Withdrawable truck: up to 500 handling operations can be carried out in the case of normal activation and with regular inspections.

The data on the useful life are in principle applied to all the components which are not directly affected by the operator.
The useful life of the manually activated components (movement of the withdrawable truck, etc.) can vary according to the type of handling.

The time intervals and amount of maintenance are determined by environmental agents, by the frequency of operation and by the number of trip operations under short-circuit.

5.2.4. Inspections and functional tests

Interruption devices in general

- Carry out regular inspections to check that the interruption devices are in good condition.
- Inspection at fixed intervals can be waived when the apparatus is permanently monitored by qualified personnel.
- Above all, the checks must include a visual inspection to check for any contamination, traces of corrosion and electrical discharge phenomena.
- Carry out more frequent inspections when there are unusual operating conditions (including adverse climatic conditions) and in the case of environmental pollution (e.g. heavy contamination or an atmosphere with aggressive agents).
- Visual examination of the isolating contacts:
  Turning the system of contacts alternately is recommended, in order to keep the internal surface of the contact areas clean. The contact areas must be cleaned if there are signs of overheating (discolored surface).
- If any conditions are found, appropriate servicing measures must be taken (see the paragraph on “Servicing).

Functional test

- With the circuit breaker in the test position or in a withdrawn position with power supplied through a breaker test cabinet, carry out 3 closing and 3 opening operations by means of the opening and closing coils and 3 closing and 3 opening operations by means of the manual pushbuttons.
- Verify that the CLOSE/OPEN indicator changes positions with each operation.
- Further tightening operations during the operating life of the circuit breaker are not foreseen. However, if it should be necessary to tighten the nuts or screws again following any trips, refer to the values indicated in figures 13 and 14.

Stored energy operating mechanism Carry out the functional test of the operating mechanism every 5,000 operations or every 4 years.

Note: Insulate the working area and make it safe, following the safety regulations specified in IEEE C37.04 – C37.54 – C37.09 – C37.55 standards.

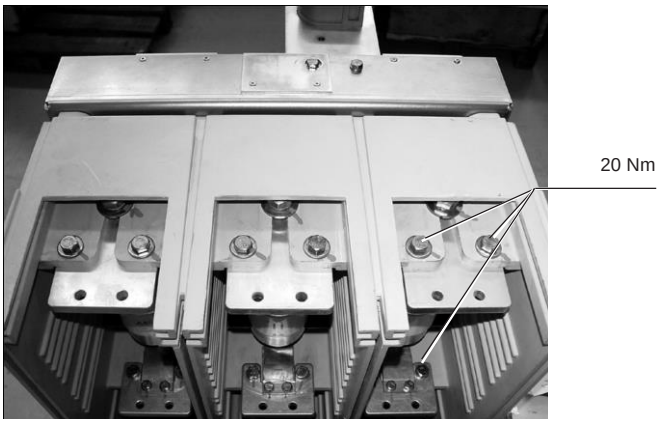


Figure 12: Terminals Torque Requirements

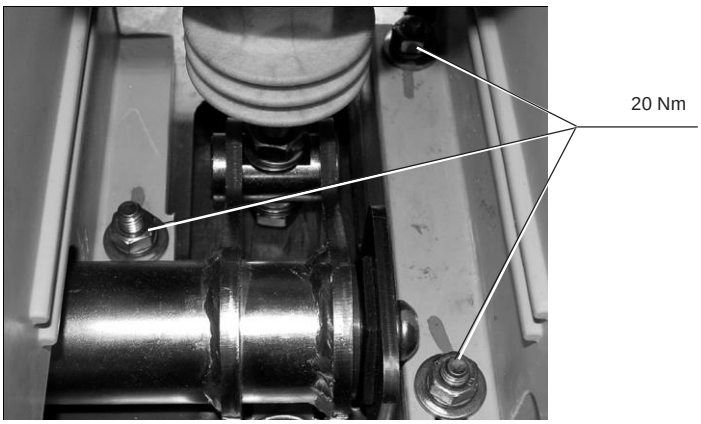


Figure 13: Base Frame Torque Requirements

5.2.5. Servicing

If cleaning is found to be necessary during the inspections, as specified in par. “Operations before putting into service”, use the following procedure:

- Insulate the working area and make it safe by following the safety regulations specified in the ANSI/NFPA70/NEC Standards.
- General cleaning of the surfaces:
  - Dry and eliminate any light deposits of dirt using a soft dry cloth;
  - More resistant deposits of dirt can be removed using a slightly alkaline household cleanser or Rivolta BWR 210 type detergent.
- Cleaning the insulating surfaces and conductive components:
  - Light dirt: with Rivolta BWR 210 detergent;
  - Resistant dirt: with cold 716 type detergent.

After cleaning, rinse thoroughly with clean water and dry carefully

Note: Only use halogen-free detergents and never trichloroethane, trichloroethylene or carbon tetrachloride!

5.2.6. Actuator and transmission system

A functional test of the drive must be carried out:

- when the number the number of operating cycles indicated has been exceeded, (after 10,000 operation) or
- During maintenance operations.

Before carrying out the functional test, open the circuit breaker and

- Take it to the test position
- Discharge the closing or opening springs
- Visually inspect the lubrication conditions of the tulip isolating contacts, of the sliding surfaces, etc.
- Check correct electrical and mechanical operation of the various devices, with particular attention to the interlocks.
- The screws and nuts are tightened in the factory and correct tightening is marked with a collared sign. No further tightening operations are foreseen during the operating life of the circuit-breaker.

Functional test:

- Connect the power supply voltage.
- Carry out several no-load operations. This test particularly applies to circuit breakers which are rarely activated under normal conditions.

Note: These operations can only be carried out by ABB personnel or suitably qualified and specially trained personnel.

5.2.7. Servicing details

- If provided, turn off the spring charging motor power supply and manually discharge the operating mechanism springs by closing and opening the circuit breaker.
- Replace parts subject to high climatic or mechanical stresses (contact an ABB service center).

Note: These operations can only be carried out by ABB personnel or suitably qualified and specially trained personnel.

5.2.8. Vacuum interrupters

The vacuum interrupters are maintenance-free up to the maximum number of electrical operations.

The operating life of the vacuum interrupter is defined by the sum of the ultimate currents corresponding to the specific type of interrupter: when the sum of the ultimate currents is reached, the complete VI must be replaced, for electrical life, ask ABB.

Note: Dismantling and replacement of the interrupter assembly can only be carried out by ABB personnel or by qualified and specially trained personnel, especially for the necessary adjustments.

5.2.9. Repairs

Replacement of spare parts and accessories must only be carried out by ABB personnel or suitably qualified and specially trained personnel.

Always work with the circuit breaker open and locked so that it cannot be closed again, with the work area insulated and made safe.

The drive springs must be discharged.

All power supply sources must be disconnected and made safe against any reclosing during removal and installation work.

NOTICE

IF MAINTENANCE IS CARRIED OUT BY THE CUSTOMER'S PERSONNEL, THE RESPONSIBILITY FOR THE INTERVENTIONS REMAINS WITH THE CUSTOMER.

THE REPLACEMENT OF PARTS NOT INCLUDED IN THE "LIST OF SPARE PARTS/ ACCESSORIES" MUST ONLY BE CARRIED OUT BY ABB PERSONNEL. FOR EXAMPLE:

- COMPLETE POLE WITH BUSHINGS/ CONNECTIONS
- ACTUATOR
- TRANSMISSION SYSTEM.

5.3. Truck

The truck (figure 14) requires visual inspection of hardware, lubrication, and operation during routine maintenance. With the circuit breaker outside the cell, verify all visible hardware tightness, including handles and wheels. Wheels should rotate freely by hand movement. Replace or tighten any missing or loose hardware.

With the circuit breaker outside the cell, rotate the racking screw as though racking the circuit breaker to the Connect position. This process will expose surfaces inside the truck that need to be inspected and lubricated. Lubricate the exposed parts; specifically the entire racking screw. Inspect the circuit breaker locking tabs for any damage. Return truck to the Disconnect position. As a precaution, do not operate the circuit breaker outside the cell unless the truck is in the full Disconnect position.

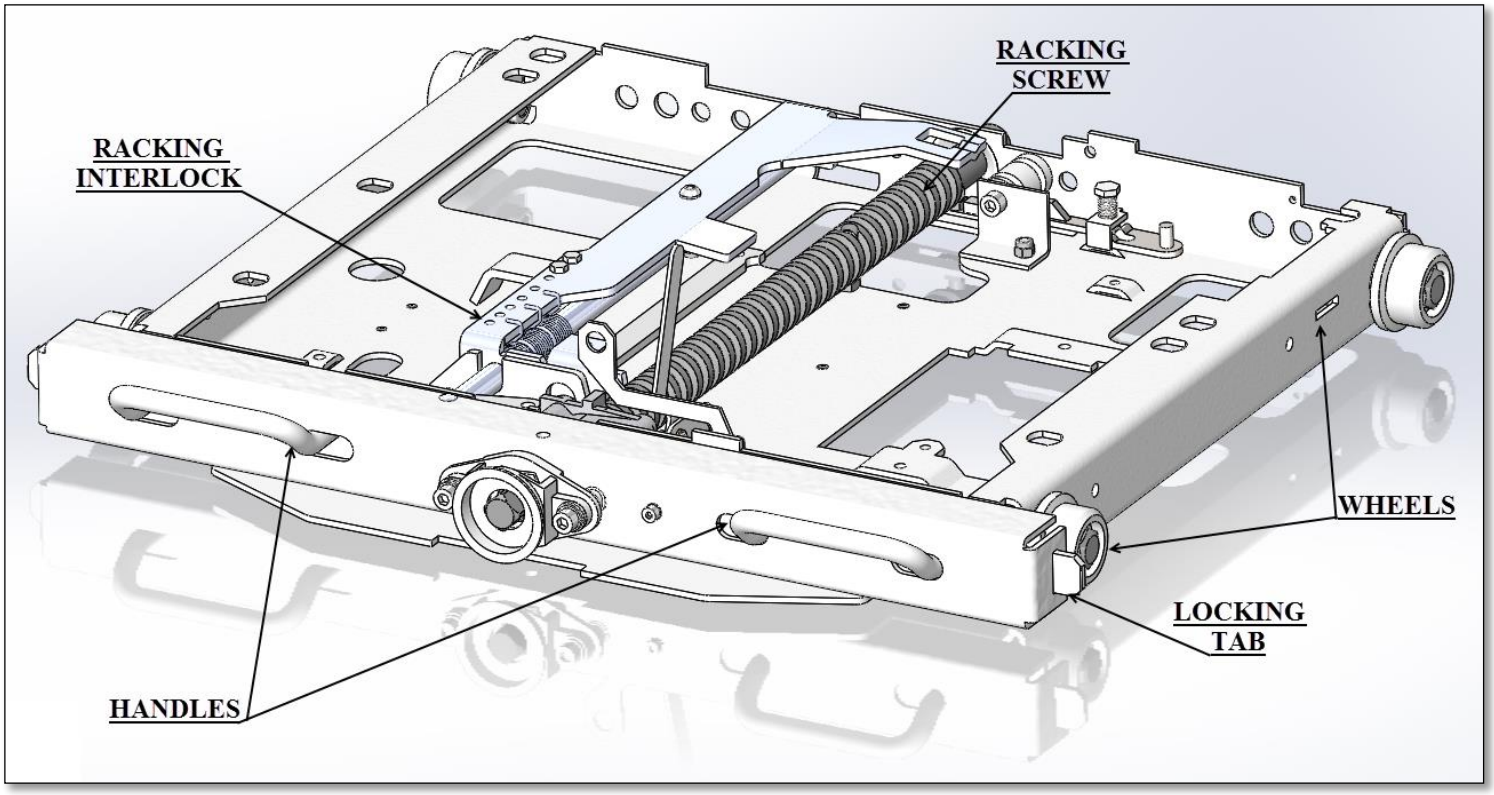


Figure 14: Circuit Breaker Truck

⚠ WARNING

Applying abnormally high voltage across a pair of open contacts in vacuum may produce X-radiation. The radiation may increase with the increase in voltage and/or decrease in contact spacing. It is recommended that all operating personnel stand at least one meter away and in front of the circuit bre during testing

⚠ DANGER

The internal shield of a vacuum interrupter can acquire an electric charge which CAN BE retained even after the voltage is removed. Discharge the mid-band ring with a grounding stick before working on any part of the circuit breaker.

6. Spare parts and accessories

To order circuit breaker spare parts/accessories, refer to the ordering sales codes indicated in the technical catalogue and always state the following:

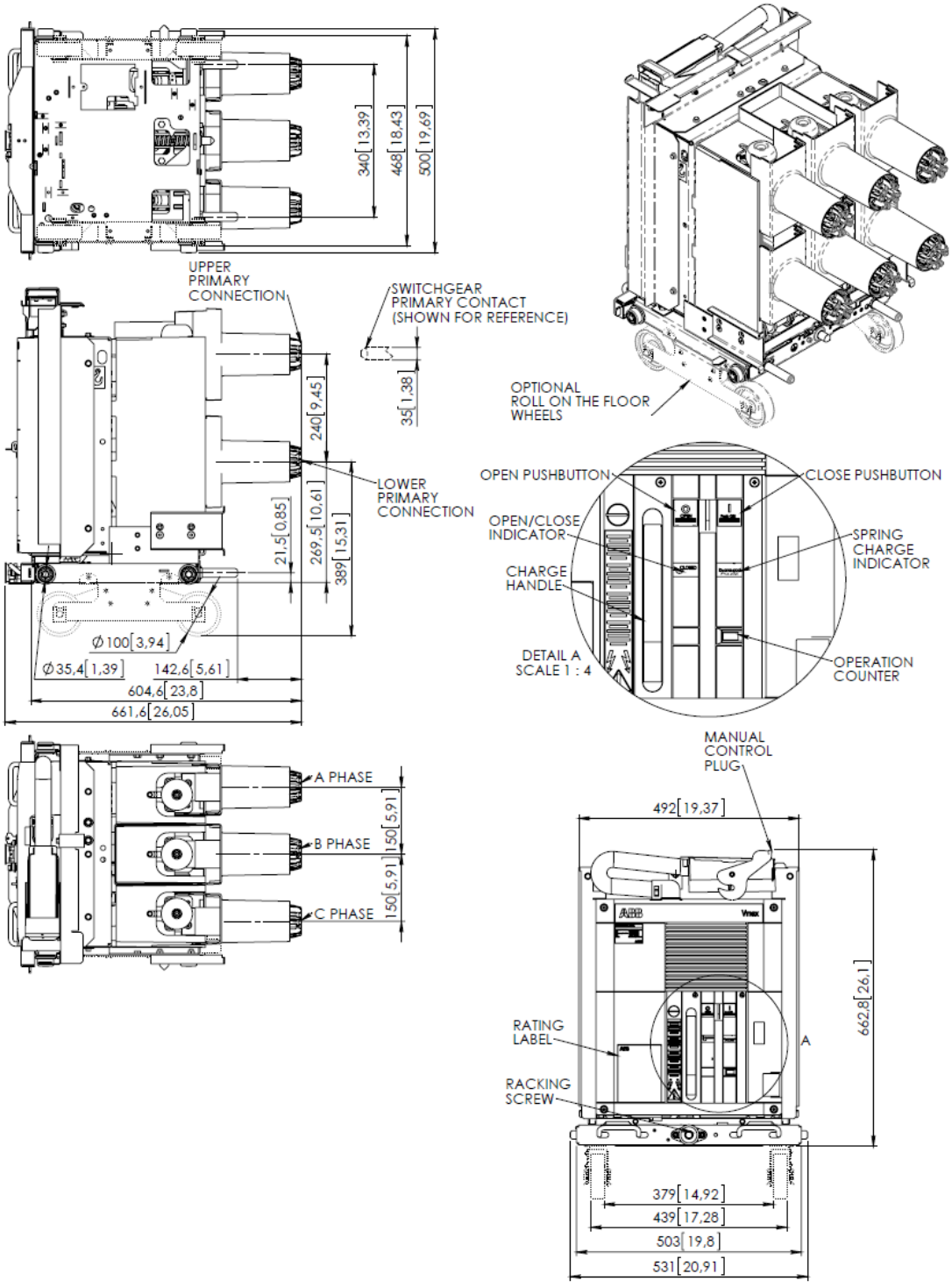
– Type of circuit breaker
– Rated voltage of the circuit breaker
– Rated normal current of the circuit breaker
– Breaking capacity of the circuit breaker
– Serial number of the circuit breaker
– Rated voltage of any electrical spare parts. For availability and to order spare parts, please contact our service office.

6.1. List of spare parts

– Shunt opening release
– Additional shunt opening release
– Undervoltage release
– Time delay device for undervoltage release
– Mechanical override for undervoltage release
– Shunt closing release
– Spring charging geared motor with electrical signaling of springs charged
– Contact signaling geared motor protection circuit breaker open/closed
– Contact signaling closing springs charged/discharged
– Circuit breaker auxiliary contacts
– Locking electromagnet on the operating mechanism
– Position contact of the withdrawable truck
– Contacts signaling racked-in/isolated
– Key lock in open position
– Isolation interlock with the door
– Protection for opening pushbutton
– Protection for closing pushbutton
– Locking electromagnet on the withdrawable truck
– Set of six tulip contacts

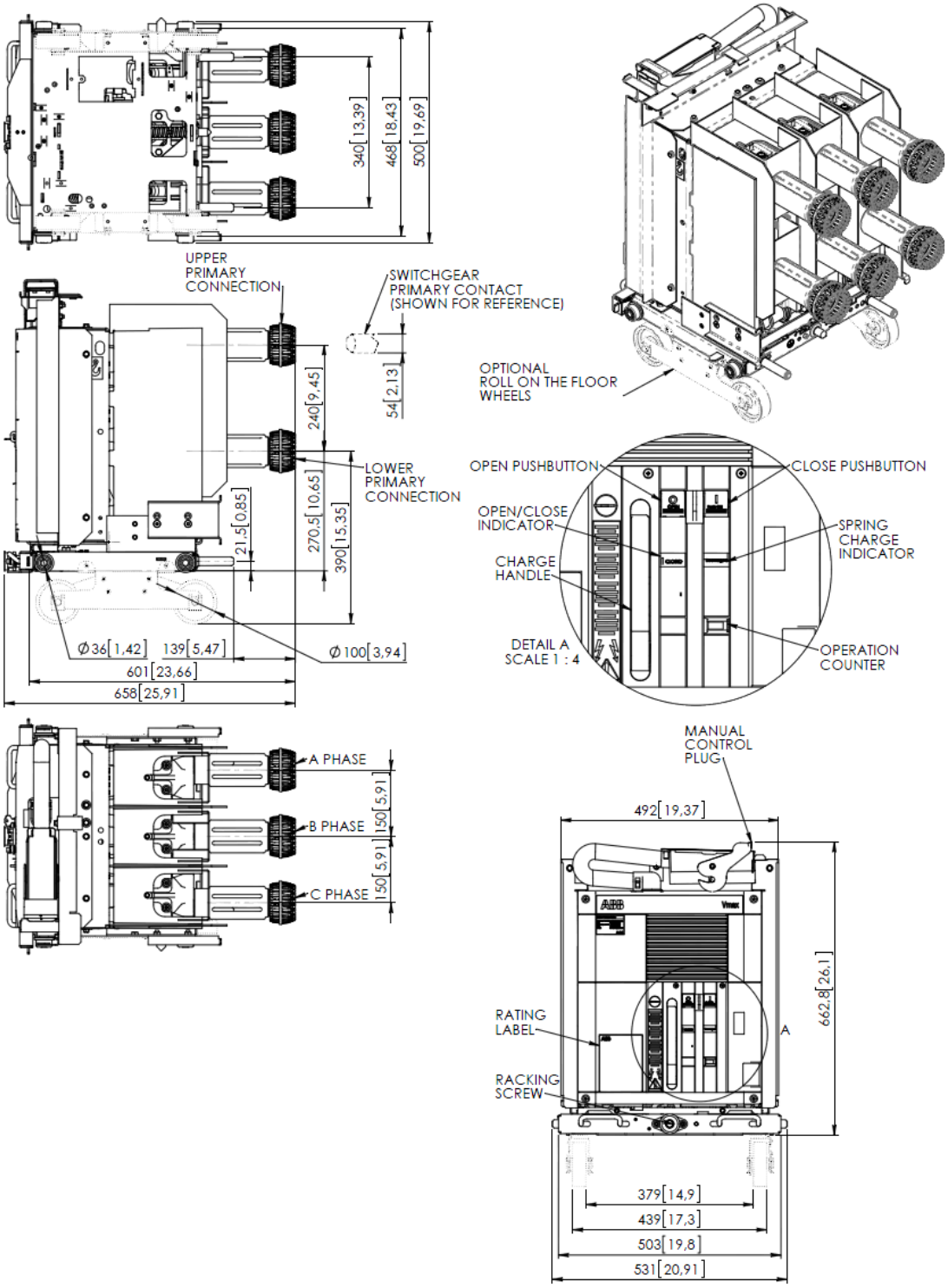
7. Overall dimensions

Vmax/A - Withdrawable circuit breaker for RELIAGEAR ND SWITCHGEAR
ANSI: 4.76kV – 15kV, 1200A, 25kA - 31.5kA



Dimensions are in “mm” and in “inches”.

Vmax/A - Withdrawable circuit breaker for RELIAGEAR ND SWITCHGEAR
ANSI: 4.76kV – 15kV, 2000A, 25kA - 31.5kA

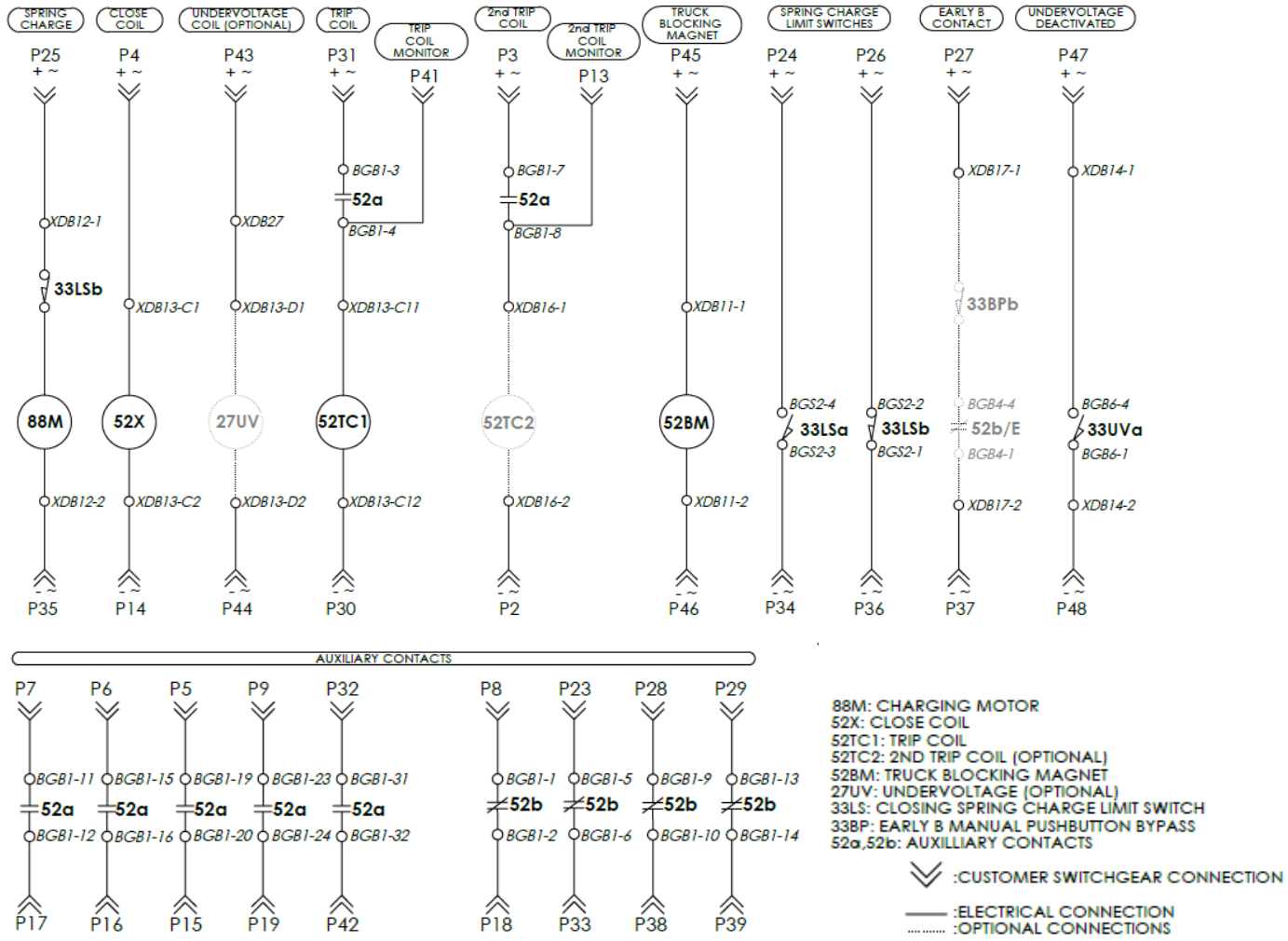


Dimensions are in “mm” and in “inches”.

8. Electric circuit diagram

Circuit-diagram of Vmax/A circuit breaker in withdrawable and Roll on the Floor versions for ReliaGear ND Switchgear.

The diagram indicates the following conditions:
– Circuit breaker off and connected
– Circuits de-energized
– Closing springs discharged



9. Product quality and environmental protection

The apparatus are produced in compliance with the requirements of international standards for the quality management system and environmental management system. In these fields, the excellent level is proved by quality certificates according to ISO 9001 and by the EMS according to ISO 14001.

End of life of product

The ABB company is committed to complying with the relevant legal and other requirements for environment protection according to the ISO 14001 standard.
The duty of company is to facilitate subsequent recycling or disposal at the end of product life. During disposal of the product, it is always necessary to act in accordance with local legal requirements in force.

Methods of disposal

Disposal can either be carried out thermally in an incineration plant or by storing on a waste site.

RAW MATERIAL	RECOMMENDED METHOD OF DISPOSAL
Metal material (Fe, Cu, Al, Ag, Zn, W, others)	Separation and recycling
Thermoplastics	Recycling or disposal
Epoxy resin	Separation of metal material and the disposal of rest
Rubber	Disposal
Oil as dielectric (transformer oil)	Draining from equipment and further recycling or disposal
Packing material	Recycling or disposal
Packing material	Recycling or disposal

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