CBSMAGVAC

ITE-5HK250-MAG-VAC, 1200A, 2000A
Medium-Voltage Vacuum Circuit Breaker Retrofit

Instruction Manual 5HKMGV250B1110

Table of Contents

Figure 2 - CBS MAGVac™ Type 5HK-MGV-250™

Figure 3 - ITE Type 5HK-250 Air Circuit Breaker

Introduction

This manual covers the description, installation, operation, and maintenance of CBS MAGVac™ type 5HK-MGV-250 medium voltage circuit breakers. The 5HK-MGV-250 vacuum circuit breaker (Fig. 2) is designed as a direct replacement for the ITE type 5HK-250 air circuit breaker (Fig. 3). Personnel responsible for the operation of this equipment should be familiar with the procedures for both the CBS MAGVac type 5HK-MGV-250, and the ITE type 5HK-250 circuit breaker it replaces.

Safety

Each user is responsible for maintaining a safety program to ensure the protection of personnel and equipment from the hazards associated with electrical equipment.

The following basic industrial safety requirements apply to all major electrical equipment such as switchgear or switchboards. 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.

CBS MAGVac assumes no responsibility for practices that deviate from the following:

1. ALL CONDUCTORS MUST BE ASSUMED TO BE ENERGIZED UNLESS THEIR POTENTIAL HAS BEEN MEASURED TO GROUND AND ADEQUATE CAPACITY GROUNDING ASSEMBLIES HAVE BEEN APPLIED TO PREVENT ENERGIZING. Many accidents have been caused by unplanned energization from unforeseen back feeds, equipment malfunctions, and other sources.

2. VACUUM CIRCUIT BREAKERS ARE NOT TO BE CONSIDERED AS AN ISOLATING MEANS FOR PROVIDING SAFETY TO PERSONEL UNLESS FULLY WITHDRAWN TO THE "TEST/DISCONNECT" POSITION. In the "CONNECTED" position with the breaker open, small leakage current with high voltage can flow across the open contacts. Also, leakage current can flow across the vacuum bottle or interrupter assembly if dirt or high humidity provides a path for tracking.

3. 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 performing any maintenance or troubleshooting. The grounding cable assemblies must be able to withstand energizing fault levels such that protective equipment may clear the circuit safely. See Chapter 20 of ANSI/ NFPA 70B, Electrical Equipment Maintenance, for further information.

Specific hazards throughout this instruction manual are presented in red danger call-outs, such as the following example:

DANGER!

RED DANGER boxes contain information that point out potential hazards to personnel and equipment.

While personnel should pay particular attention to the hazards presented in red danger call-outs, it would be impossible to alert the operator to every potential hazard. It is the responsibility of knowledgeable operators to rely on safe work practices to protect them from the inherent risks associated with electrical equipment and industrial environments.

Important information throughout this instruction manual is emphasized with green attention call-outs, such as the following example:

ATTENTION

GREEN ATTENTION boxes contain useful information to which the reader will want to pay particular attention.

MAGVac™ circuit breakers are equipped with high-speed mechanisms and are designed to operate at high current / voltage levels. The design includes several interlocks and safety features which help to ensure safe and proper operating sequences. To ensure the safety of personnel associated with the installation, operation, and maintenance of these circuit breakers, the following recommendations MUST be followed:

DANGER!

Only qualified persons who are familiar with the installation and maintenance of medium-voltage circuit breakers should be permitted to work on these circuit breakers.

DANGER!

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

DANGER!

DO NOT work on an energized circuit breaker.

DANGER!

DO NOT work on a circuit breaker unless all components are disconnected by means of a visual break and secure ground.

DANGER!

DO NOT work on a circuit breaker while power is applied to the control power receptacle.

DANGER!

DO NOT DEFEAT SAFETY INTERLOCKS. Defeating interlocks may result in property damage, bodily injury, and/or death.

DANGER!

DO NOT work on a closed circuit breaker;doing so may result in bodily injury.

DANGER!

DO NOT use a circuit breaker as the sole means of isolation of a high-voltage circuit.

DANGER!

DO NOT install or remove circuit breakers without adequate personal protective equipment and/or a specifically designed remote racking device (contact CBS for remote racking solutions).

DANGER!

The ISM is a sealed unit. There are no user serviceable parts inside the ISM; any attempt to repair, modify or otherise adjust the ISM could result in severe injury or death when re-connected to primary power.

Section 1 - Receiving, Handling and Storage

1.1 Receiving and Handling

Every circuit breaker is carefully tested and inspected then packaged securely to ensure the breaker arrives safely. Immediately upon receipt, the circuit breaker should be examined to ascertain if any damage was sustained during transit. If damage or evidence of rough handling is present, or the "Tip 'n' Tell" indicator is missing or disturbed, file a damage claim immediately with the transportation company and contact the CBS MAGVac™ sales office.

Remove all traces of packing, crating, and foreign material carefully. Exercise care while uncrating the circuit breaker so that no damage will occur from careless or rough handling or from exposure to moisture or dirt. Save the shipping material for storing the circuit breaker when not in use.

Verify the order with the packing list to ensure that no components have been overlooked or misplaced, such as racking tools, test reports, and instruction booklets.

The circuit breaker is normally shipped in the OPEN position to prevent damage from occurring to the vacuum interrupter during shipment. Verify the indicator flags (Fig. 11, Fig. 13) on the front of the circuit breaker display OPEN prior to uncrating, moving, installing, or removing.

When lifting the circuit breaker, use of a specifically designed rigging is recommended. If it is necessary to lift the circuit breaker without the designed rigging, two lift locations are provided on the right and left sides of the circuit breaker housing (Fig. 4). When liftng, ensure a properly rated lifting apparatus is used, lift and lower the circuit breaker slowly, and avoid abrupt movements.

DANGER!

DO NOT improperly lift the breaker via the primary disconnects.

1.2 Storage

After inspection it is recommended that the circuit breaker be put into service in its permanent location immediately. If the circuit breaker cannot be placed into service ensure the following storage criteria are met:

1. Store the breaker unpacked and OPEN.
2. The breaker should be carefully protected against condensation, preferably by storing it in a warm, dry room of moderate temperature such as 5–37°C (41–98°F). An environment high in humidity may have an adverse effect on the circuit breaker insulation and should be avoided.
3. The breaker should be stored in a clean location, free from corrosive gases or fumes; particular care should be taken to protect the equipment from moisture and cement/mineral dust, as this combination has a very corrosive effect on many breaker components.
4. Cover the circuit breaker with a plastic sheet to protect from dust, dirt and small animal or insect infestation.
5. Outdoor storage is not recommended. When no other option is available, the breaker must be completely covered and protected from rain, snow, dirt and all other contaminants.

If the breaker is stored for any length of time, it should be inspected periodically to ensure that rust is not present and that the breaker is in good mechanical condition. Should the breaker be stored under unfavorable atmospheric conditions, it should be cleaned and dried out prior to being placed into service.

If stored for longer than a year, prior to putting in to service follow this procedure to ensure correct operation of the control module:

1. Connect to auxiliary power supply for 20 seconds.
2. Disconnect auxiliary power for one minute.
3. Repeat this two times.
4. Connect to auxiliary power for at least 8 hours.

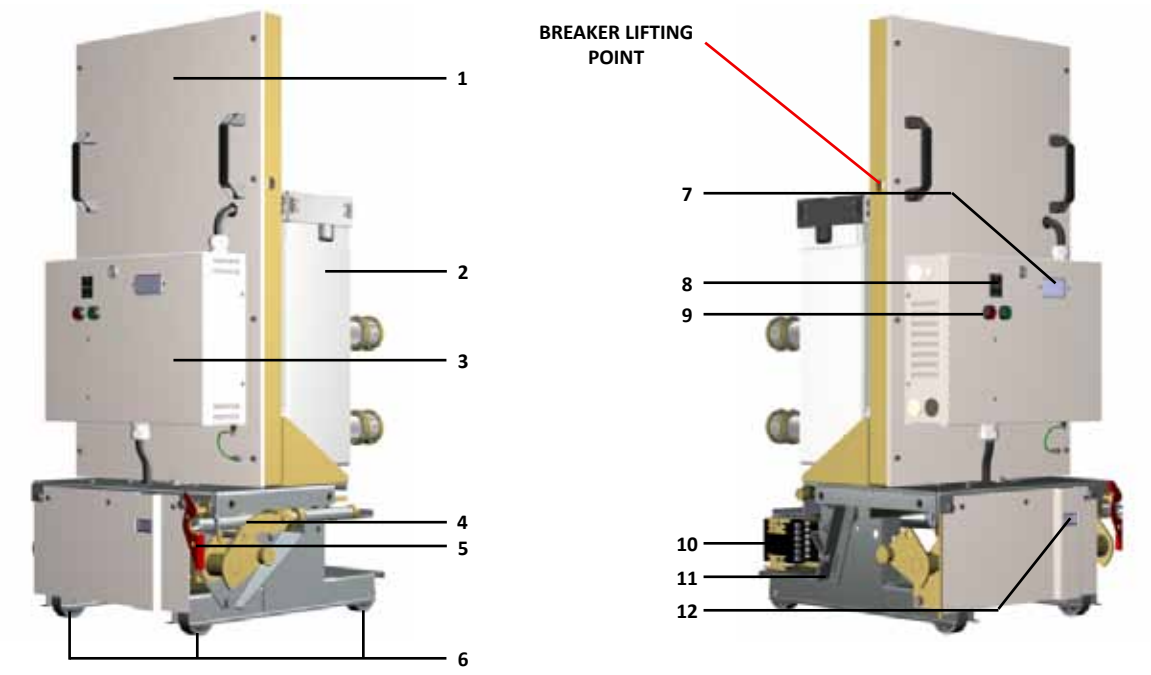

Figure 4 - Circuit Breaker and Frame Components

1. Blast shield
2. ISM breaker element
3. Auxiliary circuit control box (ACCB)
4. Racking mechanism
5. Manual trip / interlock release lever
6. Truck wheels
7. Control module viewing window
8. Mechanical counter
9. Local open / close pushbuttons
10. Secondary disconnect
11. MOC actuator
12. Contact position indicator

Section 2 - Description and Operation

2.1 Introduction

The CBS MAGVac™ type 5HK-MGV-250™ vacuum circuit breaker is designed as a direct replacement for the ITE type 5HK-250 circuit breaker. This section provides basic descriptions of the circuit breaker components and its operation. A thorough understanding of 5HK-250 circuit breaker hardware must be reached prior to installation, operation, and maintenance of the equipment.

DANGER!

The circuit breakers described in this manual are designed and tested to operate within their nameplate ratings. Operation outside of the ratings may cause equipment to fail, resulting in property damage, bodily injury, and/or death.

2.2 Description

The 5HK-MGV-250 circuit breaker is comprised of a movable frame (truck), on which is mounted the ISM breaker element (Fig. 4-2), the ACCB (Fig. 4-3), blast shield (Fig. 4-1), and the interlock / racking assembly (Fig. 4-4, 4-5).

ATTENTION

All descriptions of circuit breaker operationsand component locations assume the operator/reader is viewing the circuit breaker from the front unless otherwise stated.

2.2.1 Movable Frame

The 5HK-MGV-250 circuit breaker is built on a sturdy steel frame (Fig 5). This movable frame is constructed of heavy-gauge steel and is the main support structure of the circuit breaker. The frame consists of the racking mechanism (Fig. 5-4), circuit breaker rejection bracket (Fig. 5-2), the frame ground disconnect (Fig. 5-1), and steel wheels (Fig. 5-3).

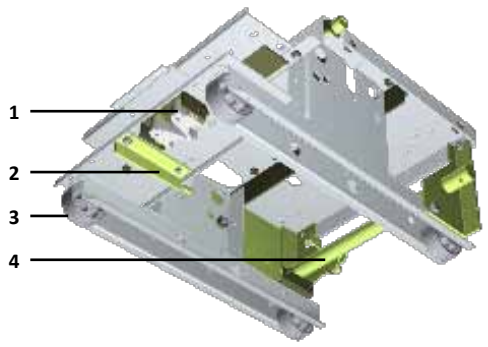

Figure 5 - Movable Frame

1. Frame ground disconnect
2. Circuit breaker rejection
3. Steel wheels (x4)
4. Racking mechanism

DANGER!

Use the handles provided on the blast shield to move the circuit breaker. NEVER handle or transport the circuit breaker via the primary disconnects.

Circuit Breaker Rejection (Fig. 5-2) – The circuit breaker rejection is comprised of an angled, steel bracket that will interfere with the interlock stop angle installed in the switchgear unless the ratings of the circuit breaker and switchgear are identical.

DANGER!

Reconfiguring the circuit breaker rejection can lead to installing the breaker into an incorrect cubicle. The rejection is configured at the factory, NEVER tamper with the circuit rejection.

Frame Ground Disconnect (Fig. 5-1) – All metal parts of the circuit breaker except those that are part of the high-voltage or control circuitry, are grounded through a high-current clamping contact. The frame ground disconnect grounds the frame when the breaker is installed in the TEST/DISCONNECT or OPERATE position in the breaker compartment.

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VACUUM CIRCUIT BREAKER CONVERSION
5HK-MGV-250

AIR CIRCUIT BREAKER RATINGS			
Rated maximum voltage	4.76 kV	Interrupting time	<3 Cycles
Rated voltage	4.16	Rated impulse voltage	60 kV
Rated continuous current	1200 A	Rated dielectric withstand	19 kV
Rated short circuit current	30.3 kA	Trip voltage	125 VDC
K-factor	1.2	Close coil voltage	125 VDC
Rated symetrical mva	250 MVA	Charging voltage	125 VDC

VACUUM CIRCUIT BREAKER RATINGS			
Rated maximum voltage	4.76 kV	Rated impulse voltage	60 kV
Power frequency	60 Hz	Rated dielectric withstand	19 kV
Rated continuous current	1200 A	Auxiliary voltage	125 VDC
Rated short circuit current	30.3 kA	Trip, close, charge voltage	125 VDC
Short time current - 4s	31.5 kA	Tested to ANSI	C37.50, 09, 09a
Close and Latch	76 kA	Rated operating sequence	O-0.3s-CO-15s-CO
Rated symetrical MVA	250 MVA	Year manufactured	06/2010
Interrupting time	<3 Cycles	Weight	317 lbs
MOC actuation delay	<200 ms	Manual	5HK250MVG

SERIAL NO. 52510-14653-1

281-479-4555
www.cbsalesandrepair.com

Figure 6 - Circuit Breaker Ratings Nameplate

Steel Wheels (Fig. 5-3) – The four non-pivoting steel wheels provide a means repositioning the circuit breaker in the switchgear and removing the breaker form the cubicle for circuit isolation and maintenance.

Blast Shield (Fig. 4-1) – The blast shield is constructed from heavy-gauge steel and serves as a grounded barrier between the operator and the high-voltage present in the switchgear

ACCB (Fig. 4-3) - The auxiliary circuit connection box contains the electronic control module, wiring, terminals, local close / open controls, and mechanical counter.

2.2.2 ISM Breaker Element

The 5HK-MGV-250 utilizes a self-contained breaker element with a magnetic actuator driven mechanism. This highly innovative indoor switching module (ISM, Fig. 4-2) is designed specifically for high switching duty cycles, where traditional spring charged mechanisms would require significant maintenance.

Each pole is enclosed in a molded support insulator (Fig. 7-1) with fixing point inserts (Fig. 7-16). The vacuum interrupters in each pole (Fig. 7-3) are connected to drive insulators (Fig. 7-6), which in turn are connected to magnetic actuators (Fig. 7-7) inside the base of the module.

The three magnetic actuators (one per pole) are linked together via a synchronizing shaft (Fig. 7-11). When driven by a pulse from the control module (Fig. 12-1) through the actuator coils (Fig. 7-9), the armatures of the actuators (Fig. 7-10) rise and become magnetically latched to the stators (Fig. 7-7), closing the primary contacts.

This in turn rotates the synchronizing shaft, engaging six NO and six NC auxiliary contacts (Fig. 7-12).

DANGER!

The ISM is a sealed unit. <u>There are no user serviceable parts inside the ISM</u>; any attempt to repair, modify or otherise adjust the ISM could result in severe injury or death when re-connected to primary power.

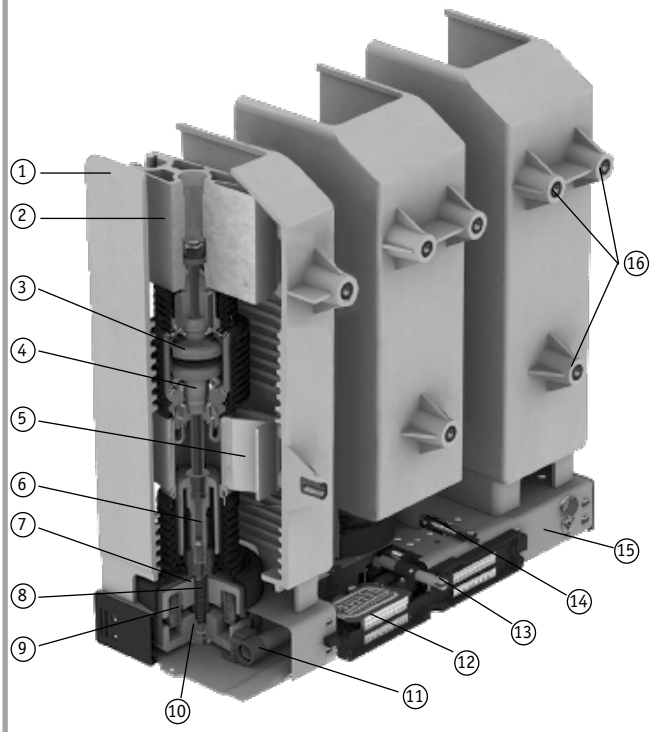


Figure 7 - ISM Breaker Element

1. Support insulator
2. Upper terminal
3. Vacuum interrupter
4. Movable contact with bellows
5. Lower terminal
6. Drive insulator
7. Actuator stator
8. Opening springs
9. Actuator coil
10. Actuator armature
11. Synchronizing shaft
12. Auxiliary contacts
13. Interlocking shaft
14. Position indicator link
15. Frame
16. Fixing points

A reverse pulse from the control module disrupts the magnetic latching, allowing an opening spring (Fig. 7-8) in each actuator to open the contacts at high speed.

During the close / open operations, a position indicator link (Fig. 7-14) drives a semaphore (Section 2.2.3) to give visible indication of the breaker status.

An interlocking shaft (Fig. 7-13) provides manual trip and simultaneous electrical / mechanical blocking of close operations. In the 5-HK-250 this shaft is connected directly to the interlocking mechanisms of the truck.

The ISM breaker element is built with compact 4th generation vacuum interrupters (Fig. 8). These interrupters use a welded steel disc bellows (Fig. 9) to both reduce the size and dramatically increase the lifetime of the interrupters.

Figure 8 - Compact 4th Generation Vacuum Interrupters

Figure 9 - Traditional Bellows (Left); Welded Disc Bellows (Right)

2.2.3 Semaphore Operation

The ISM breaker element utilizes a mechanical semaphore (contact position indicator) for primary contact indication. This semaphore is connected to the ISM breaker element via a tension cable (Fig. 10). On rotation of the interlocking shaft during close or open, the semaphore changes state to indicate “Open” (Fig. 11) or “Closed” (Fig. 12).

The semaphore is visible through the viewing window located at the bottom right hand side of the circuit breaker (FIg. 4-12).

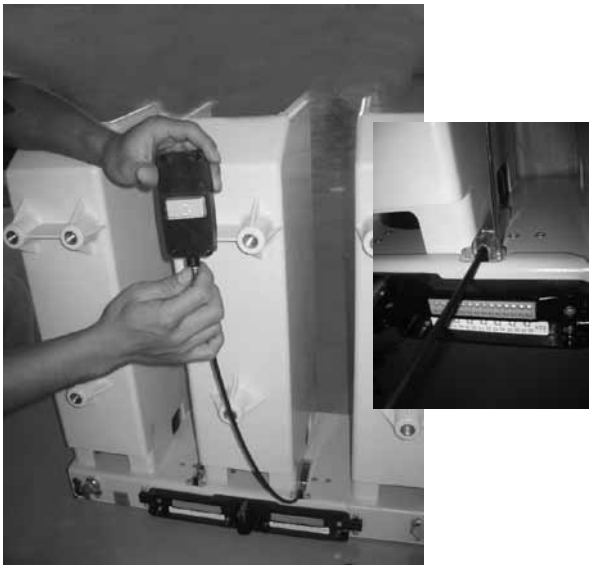


Figure 10 - ISM Breaker Element with Semaphore

Figure 11 - Open

Figure 12 - Closed

2.2.4 Auxiliary Circuit Control Box (ACCB)

The ACCB houses the CM-12-02A controle module (Fig. 12-1). This module is purpose-designed to control the ISM breaker element and is further described in section 2.2.6.

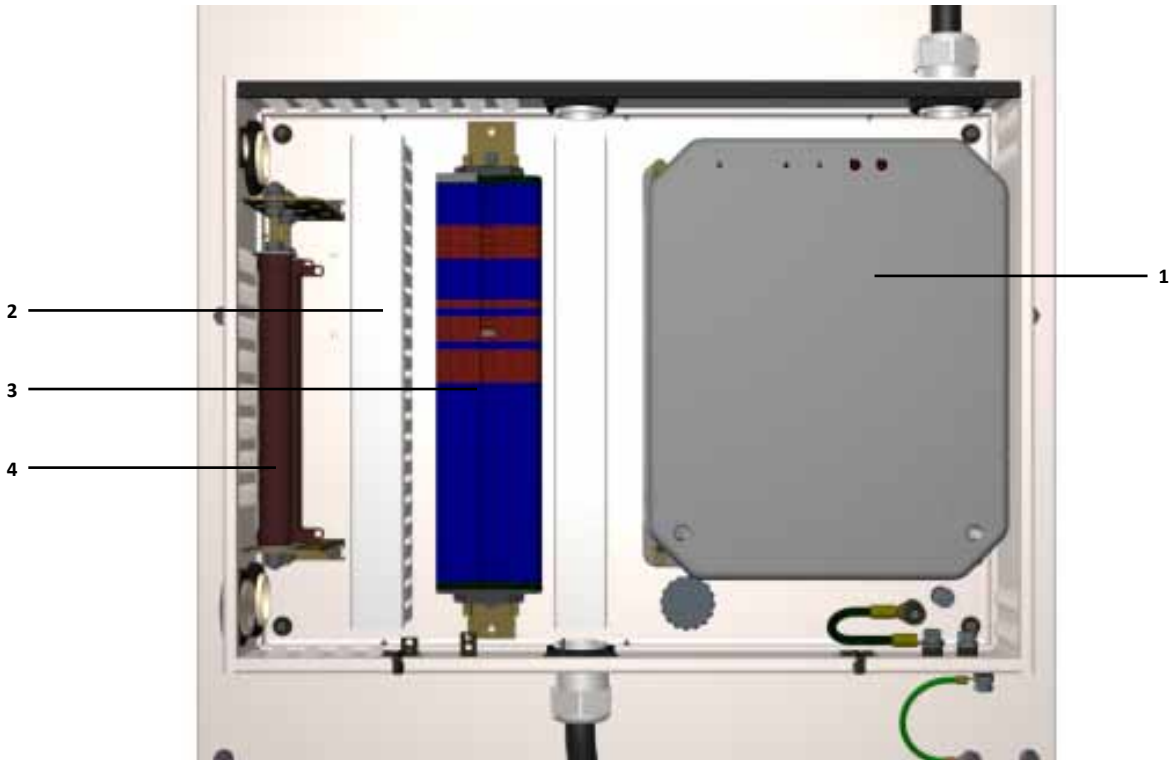
Along with the control module are the terminal blocks for interconnecting the devices (Fig. 12-3), wiring duct to route the cabling (Fig. 12-2), and power resistors (Fig. 12-4) that form the trip / close supervisory circuit.

The ACCB has a “coin-slot” cam lock that allows for easy access to the auxiliary circuits during configuration or servicing (Fig. 13).

DANGER!

The ACCB contains live points when connected to the auxiliary power supply that could cause severe injury or death. Disconnect all sources of power before opening the ACCB door.

Figure 13 - Cam Lock



1. Control module CM-12-02A
2. Wiring duct
3. Terminal blocks
4. Power Resistors

Figure 12 - ACCB with Cover Removed

2.2.5 MOC Actuator

The 5HK-MGV-250 utilizes an electrically driven linear actuator (Fig. 14-1) linked to the original MOC actuation bracket (Fig. 14-3) via a four-to-one lever arm (Fig. 14-2). On breaker close, the linear actuator rotates the lever arm, causing the actuation bracket to rise. On breaker opening, the reverse action takes place.

A 24 VDC power supply and control (not shown) are mounted underneath the chassis to drive the linear actuator. On loss of auxiliary power, a capacitive storage device will allow the MOC to change from the “breaker closed” to “breaker open” state.

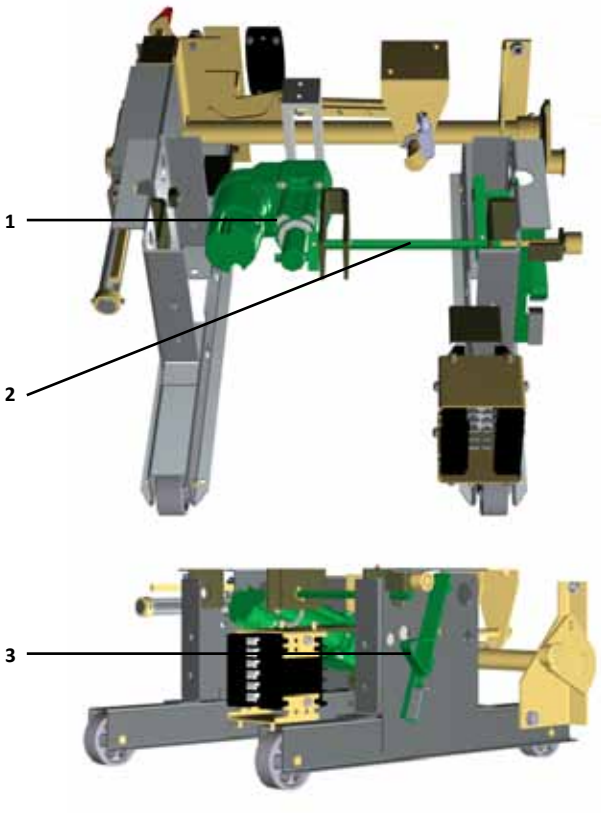


Figure 14 - MOC Components (Shaded Green for Illustrative Purposes Only)

2.2.6 Operation

The ISM breaker element is controlled and monitored by the CM-12-02A. This control module has the following functions:

1. Trip / close of the ISM breaker element
2. Monitoring of the magnetic actuator health
3. Monitoring of the actual breaker contact position vs the CM command position
4. Trip / close supervisory circuit emulation
5. Ready / malfunction indication
6. Anti-pumping duty

The CM-12-02A receives close or trip commands from the existing control system in the switchgear. On acceptance of a close command, the CM will send a ~300VDC pulse to the magnetic actuators of the ISM. This causes the permanent magnetic latching of the actuators, until a trip command is received. On acceptance of a trip command, the CM will send a much lower level pulse to the actuators, weakening the magnetic latch and allowing the pull down springs to open the contacts.

This entire operating sequence can be seen in the timing chart (Fig. 16).

The CM-12-02A has status indication provided through three LED’s (Fig. 15). The LED’s are visible through the control module viewing window (Fig. 4-7).

Figure 15 -CM-12-02A Status Indication

ATTENTION

Should a mis-operation occur, the “MALFUNCTION” LED will blink in a pattern to indicate the cause. See “Section 4 - Troubleshooting” for further information.

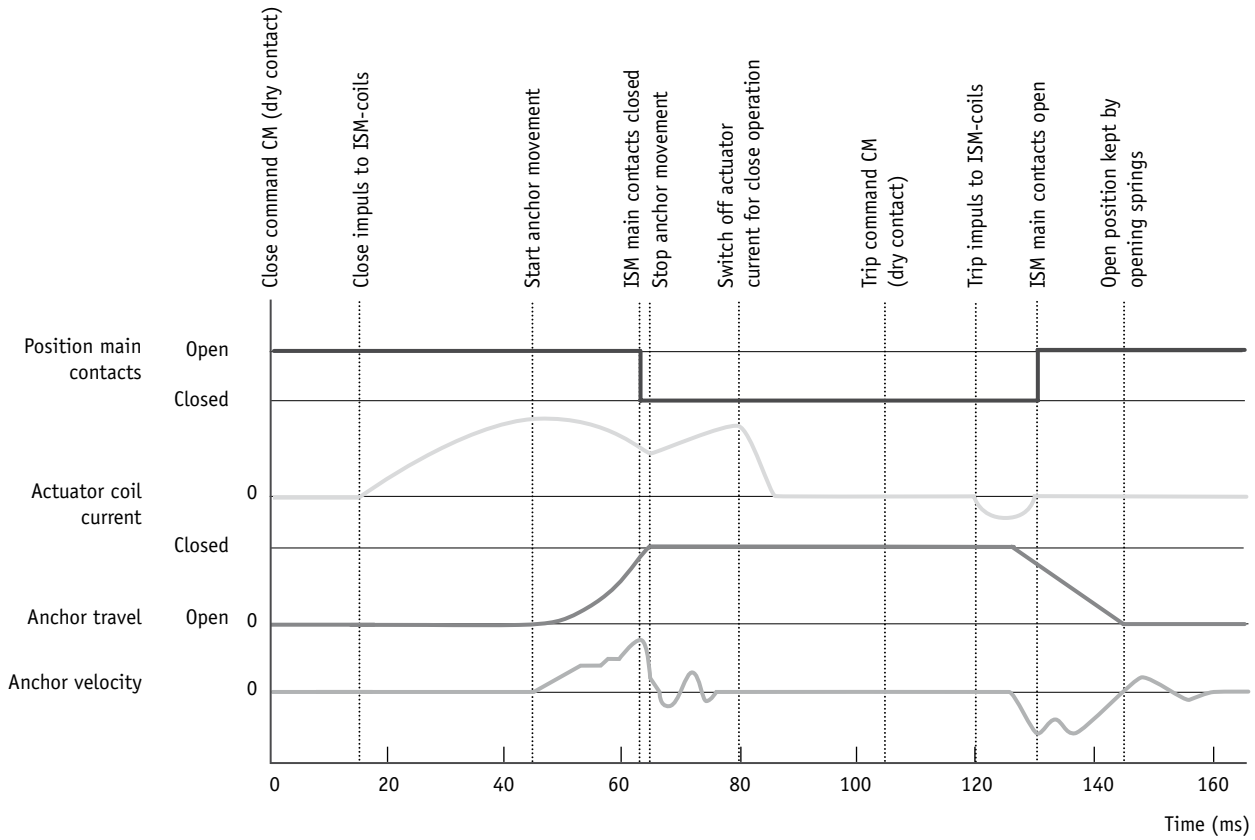


Figure 16 - ISM Timing Chart

When the breaker is first inserted into the test position in the cubicle (or attached to a dedicated testing device), the “POWER” LED will illuminate. After a few seconds, the “READY” LED will begin blinking. At this stage the CM is charging its internal capacitors in preparation for acceptance of a close command.

After approximately 10 seconds, the “READY” LED will remain continuously lit. At this stage the CM is ready to accept a “CLOSE” command. The capacitors ready for a “TRIP” command within 100ms of power-on.

On receipt of a “CLOSE” command from the switchgear or locally through the circuit breaker push button, the CM will close the ISM. The “READY “ light will remain illuminated. Throughout and after this stage the CM is ready for a “TRIP” command.

There are three special conditions in which a command will not be executed:

1. Anti-Pumping Duty - During close operation, if a trip instruction is received before the close instruction becomes passive then the close instruction will be blocked. For the next close operation the close instruction must be reapplied after the trip instruction has become passive.
2. Blocking Duty - For close and trip inputs the following rule is applicable: If a close instruction is received whilst a trip instruction remains active then the close instruction is blocked. For the next close operation the close instruction must be reapplied after the trip instruction has become passive.

3. Combined Blocking and Anti-Pumping Duty - A close command during a pending trip command is not executed (blocking duty) even if it is pending longer than the trip command (antipumping duty)

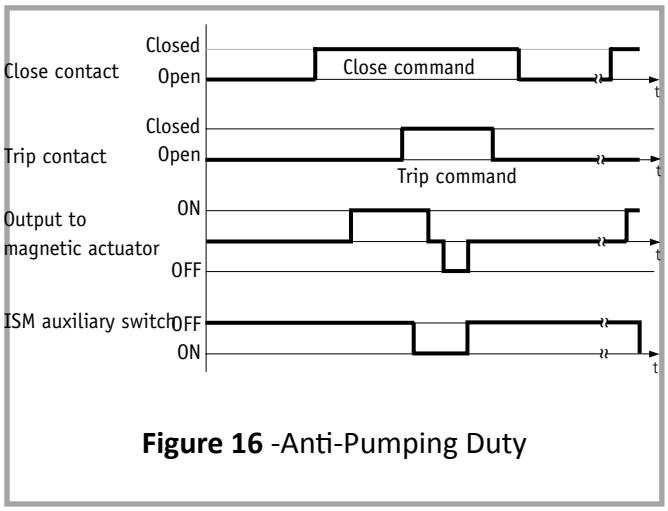


Figure 16 -Anti-Pumping Duty

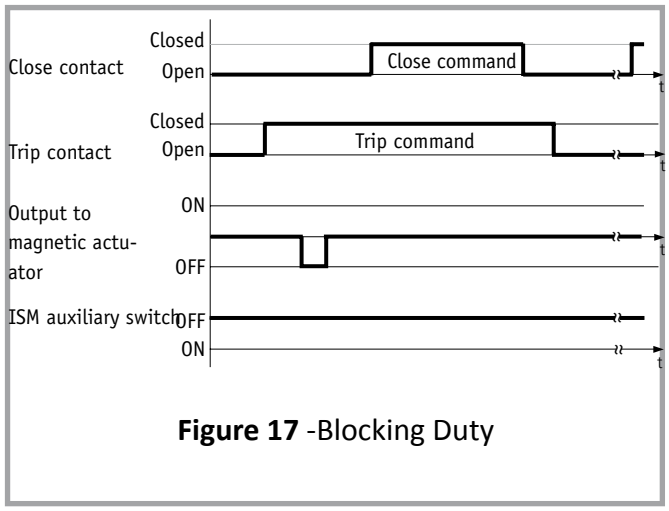


Figure 17 -Blocking Duty

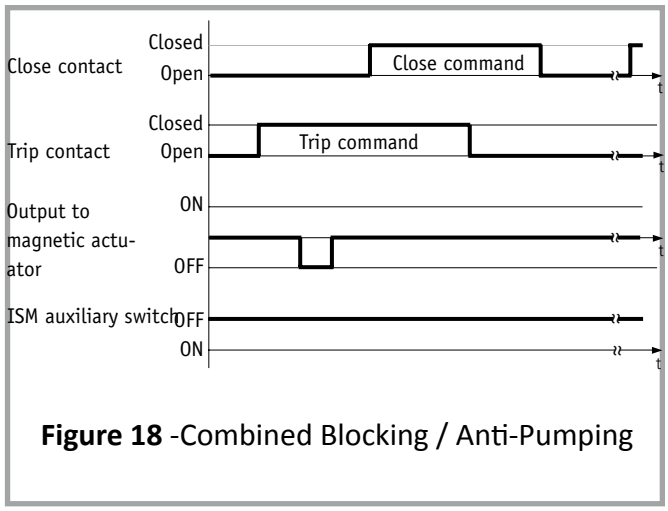


Figure 18 -Combined Blocking / Anti-Pumping

Section 3 - Commissioning and Breaker Installation

3.1 General

Prior to installation of the circuit breaker into a switchboard, certain preliminary inspections are made to ensure proper operation.

3.2 Installation Inspection

Inspect condition of contact and electrical connections prior to installing the circuit breaker into the switchboard. Even though each circuit breaker is completely adjusted and tested at the factory, shipping and handling conditions could cause defects.

3.3 Installing Breaker into Compartment

NOTE: CLOCKWISE ROTATION of racking crank for inserting breaker. COUNTERCLOCKWISE rotation of racking crank for removal of the breaker.

1. Engage racking crank and push racking unlocking lever to left, then rotate racking crank counterclockwise only until resistance to motion is felt. DO NOT FORCE. If breaker is in the closed position, it will automatically open.
2. Grasp circuit breaker by the handles and push into compartment until stopped.
3. Engage racking crank and rotate clockwise until racking mechanism automatically stops at “DISCONNECT” position (breaker now held captive in compartment).
4. To rack circuit breaker to “TEST” position, push release lever (Fig. 4-5) to left, rotate racking crank approximately ¼ turn clockwise, then release the lever. Continue cranking until racking mechanism automatically stops at “TEST” position.
5. With the circuit breaker racked to “TEST” position, check for proper operation by operating all possible means of opening and closing. This includes control switches, relays, local pushbuttons, etc. See “Section 2.2.5 - Operation” for information on opening / closing the breaker.

FOR SAFETY: When racking circuit breaker to "Connected" position, close compartment door and insert racking crank through sliding panel (Fig. 19).

6. Push release lever to left and turn racking crank approximately ¼ turn clockwise, then release unlocking lever. Continue cranking until racking mechanism automatically stops at "Connected" position.

DO NOT ATTEMPT TO RACK ANY FURTHER
The circuit breaker may now be put in service and be operated as required.

Figure 19 - Racking Through Sliding Panel

3.4 Breaker Removal

To remove circuit breaker from "CONNECTED" position, open the breaker as required.

1. Open sliding door (Fig. 19) in front compartment door.
2. Engage racking crank and push release handle to left.
3. Rotate racking crank counterclockwise approximately 1/4 turn, then release the lever.
4. Continue racking counterclockwise until racking mechanism automatically stops at "TEST" position.

Repeat same operaton for "DISCONNECT" position.

To position the racking mechanism for withdrawal of the circuit breaker from the switchboard, again push release lever to the left and turn racking crank counterclockwise only until resistance to motion is felt (approximately 2-3 turns - DO NOT FORCE).

The circuit breaker can now be removed from the compartment by pulling on the handles located on the blast shield.

3.5 Safe Operation Recommendations

1. It is recommended that any circuit breaker be withdrawn and stored in the test position whenever it is to be maintained in the open position with no planned switching.
2. It is recommended that a ground test device be connected to the proper compartment when any work is to be done on any bus or feeder circuit.

Section 4 - Troubleshooting

The self-monitoring system inside the CM detects malfunctions and reports them via the MALFUNCTION LED using blink signals. The meaning of the blink codes and the variations per type of malfunction are shown in the following table.

As the CM monitors the majority of the functionality of the breaker, any troubleshooting should start with review of the trouble codes in Table 1.

DANGER!

The 5HK-MGV-250 has few parts that can be serviced by the end user. Information in this troubleshooting section is for reference only, and should be used when contacting CBS MAGVAC™ to isolate the malfunction.

Error group	Malfunction LED blinks	Function, type of malfunction	Description of malfunction variants	Recommendation for malfunction elimination
External error	1 blink signal, then 1.5 s pause, periodic (about 4 min)	The power supply has failed for >1.5s or has been outside the operating range.	The operating range of the power supply of the CM, depending on the type of voltage, its value and switch command, is between 65-70% and 125% (Trip commands) and 80-125% (Close commands) of the nominal voltage. With continuous failure of the power supply, the blink signals continue until the capacitors are unloaded.	- Check for cable break - Check terminal connections
	2 blink signals, then 1.5s pause, periodic	The Close or Trip command of the CM is carried out but the corresponding breaker position signal is missing.	Malfunction variant 1: The Close command of the CM is carried out by the ISM. The normally closed ISM auxiliary switch has been bridged already due to a malfunction before the Close command was given (despite the existing malfunction, the ISM can be switched off again by the CM. This deletes the malfunction indication although the malfunction still exists).	- Check for short circuit in the cable - Check for short circuited terminals
			Malfunction variant 2: The Trip command of the CM is carried out by the ISM. The ISM auxiliary switch has been interrupted due to a malfunction (the ISM can only be placed in the close position after the malfunction has been eliminated).	- Check for cable break - Check terminal connections
	2 blink signals, then 1.5 s pause, periodic	The Close command of the CM is not carried out as the ISM is electrically locked in OFF position.	Malfunction variant 3: The Close command of the CM is not carried out by the ISM as the closing lock-out contact in ISM S13 auxiliary switch circuit is open. The malfunction indication has been purposely taken into account.	Closing of the ISM is only possible if closing lock-out contact is closed.
	3 blink signals, then 1.5 s pause, periodic	The magnetic actuator coil circuit is interrupted	Malfunction variant 1: Possible causes: cable break, loose terminal connections, defect (open) internal electrical interlock contact at unlatched position of interlocking shaft, defect magnetic actuator coils.	- Check for cable break - Check terminal connections - Check internal electrical inter-locking contact

Table 1 - CM Trouble Codes

Error group	Malfunction LED blinks	Function, type of malfunction	Description of malfunction variants	Recommendation for malfunction elimination
External error	3 blink signals, then 1.5 s pause, periodic	The magnetic actuator coil circuit is interrupted	Malfunction variant 2: In ISM position „opened and mechanically locked“ the internal electrical interlock contact is opened. The malfunction indication has been purposely take into account.	Closing of the ISM is only possible if interlocking shaft is in „unlatched position“
		CM-internal malfunction	Malfunction variant 3: CM-defect.	- CM must be replaced
	4 blink signals, then 1.5 s pause, periodic	The magnetic actuator coil circuit is short circuited.	Possible causes: Short circuited cable strands, short circuited terminal connections.	- Check for short circuit in the cable - Check for short circuited terminals
	5 blink signals, then 1.5 s pause, periodic	without CM command, the ISM trips.	Malfunction variant 1: Mechanical emergency trip. Indication: After mechanical emergency trip the 3 blink signal instead of the 5 blink signal is indicated due to its higher priority.	Delete the malfunction indication at unlatched interlocking shaft position with the CM Trip command
		ISM is closed, a trip is simulated.	Malfunction variant 2: The ISM was properly closed by the CM and the close position feedback exists. Then a malfunction occurs in the ISM auxiliary switch S13 circuit in which the normally open switch S13 is bridged (the ISM can still be tripped again via the CM despite the existing malfunction. This deletes the malfunction indication but the cause of the indication is still there).	- Check for short circuit in the cable - Check for short circuited terminals - Check ISM position switch S13
Internal error	17 or more blink signals, then 1.5 s pause, periodic	Various internal malfunction of the CM.		- CM must be replaced

Table 1 - CM Trouble Codes Continued

Section 5 - Maintenance

5.1 Maintenance Schedule

DANGER!

Tests and maintenance routines described in this document should only be carried out by qualified and experienced breaker maintenance personnel.

Certain procedures, such as dielectric withstand tests, can produce hazardous voltages as well as x-ray emmissions.

Additionally:

1. NEVER work on a breaker in the connected position
2. NEVER work on a breaker with secondary disconnects engaged.
3. NEVER defeat safety interlocks.
4. ALWAYS keep at least two meters away from breakers under dielectric test
5. ALWAYS follow safe discharge procedures after applying a dielectric test to a circuit breaker

Periodic maintenance and checks should be performed on the breaker to ensure safe and continued service.

A maintenance schedule should be developed that takes into consideration the conditions of the site, including particulate accumulation, frequency of switching and routine switchgear maintenance.

In a clean environment, the MAGVac breaker should not require more than periodic cleaning and inspection. Table 2 can serve as a guide to establish the best protocol of tests and frequency for your site.

Procedure	Frequency	Notes
Inspection and cleaning	Every time the circuit breaker is withdrawn from service, or every three years if in a continuous duty environment.	The inspection and cleaning frequency should be increased commensurate with the site environment.
Contact Resistance Test	After every five fault events, regardless of fault level	See section 5.3 for further details
Dielectric withstand test - primary	Every three years or if a repair has been performed on the primary circuits	
Dielectric withstand test - auxiliary	Every three years or if a repair has been performed on the secondary circuits	
Timing test	After replacement of the ISM element or control module	
Lubrication	Only if racking or MOC mechanism is not operating smoothly, or contamination of the lubricants is observed.	In a clean environment the breaker should not need lubrication over its lifetime.

Table 1 - Maintenance Schedule

Inspection and cleaning are part of the routine maintenance of the circuit breaker and can be performed by qualified site personnel. Contact, dielectric, and timing tests require specialized equipment and knowledge, and should only be performed by quallified breaker service personnel.

Any maintenance of the breaker should be undertaken only by qualified breaker service personnel.

5.2 Inspection and Cleaning

The breaker should be inspected routinely. This includes anytime the breaker is fully withdrawn from the cell, or during regular maintenance intervals.

The inspection is primarily visual:
- Check primary contacts for signs of damage, such as broken fingers, burn marks or pitting.
- Check secondary self-coupling contacts for signs of damage, such as burn marks or pitting
- Check mechanical connections for loose or missing bolts, binding of parts, deformation or physical damage
- Check racking mechanism for smooth operation without binding or noise indicative of a lack of lubrication
- Open auxiliary cabinet on the breaker and inspect for loose wires, evidence of burn marks on electrical connections or evidence of heat damage.
- Check insulation for cracks and damage

The breaker should be cleaned with a lint free, dry cloth to remove dust or other particulates that may interfere with operation of the breaker.

Any items that do not pass inspection should be logged and rectified prior to putting the circuit breaker back into service.

5.3 Contact Resistance Test

Contact wear of the circuit breaker follows a logarithmic scale as shown in Fig. 30. At full load, the ISM element is capable of 30,000 operations without maintenance. At higher current interruption, up to and including the rated value of 31.5 kA, the number of operations drops accordingly.

It is recommended to test the contact resistance of each phase of the breaker after five fault events. As some older relays are not capable of duplicating the curve in Fig. 30 for calculation and logging, any fault event should be taken as a full fault on the scale. A 100 amp DLRO is recommended to obtain the most accurate contact resistance measurement.

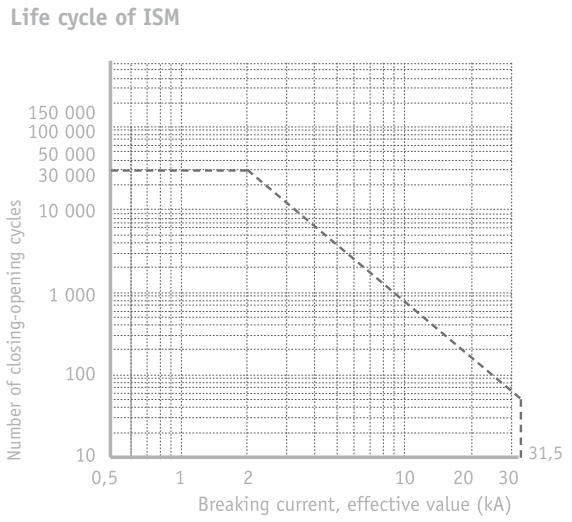


Figure 30

If the breaker has contact resistance which exceeds the specified limit of <40 uOhms, but is less than twice this limit (<80 uOhms), continuation of use is possible, if actual continuous current does not exceed the following value:

$$Ia<Ir*\sqrt{(Rr/Ra)}$$

Where:

Ia, Ra - Actual current and contact resistance respectively
Ir, Rr - Rated values

If the contact resistance is more than double the specified limit, the ISM must be replaced.

5.4 Dielectric Withstand - Primary

Dielectric tests of the primary paths of the circuit breaker are crtical to the safe operation of the device. These tests should take place any time a primary component is altered (replaced or repaired) or every three years.

There are three primary tests: Vacuum integrity, phase to phase insulation, and phase to ground insulation.

DANGER!

Dielectric tests of the primary path of the circuit breaker involve high voltages, and under certain circumstances can cause X-ray emmissions from the vacuum interrupters. This test should only be perfomred by qualified personnel with the appropriate safety equipment.

The test voltage levels listed in this document should not be exceeded during testing in order to mitigate the X-ray potential.

Vacuum Integrity:

This tests measures the relative level of vacuum present in the interrupters by applying a high voltage source across the all three poles, with the contacts open.

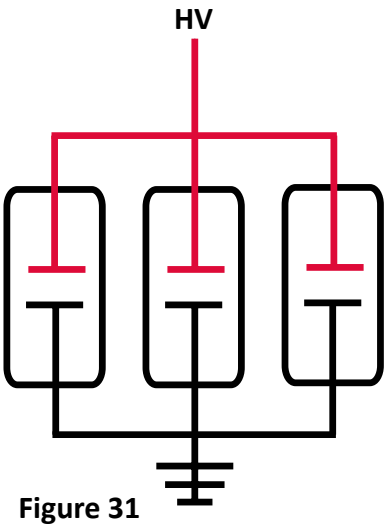


Figure 31

1. Tie the lower three phases to frame ground and to the dielectric tester ground.

2. Tie the upper poles together and connect to the dielectric tester lead.

3. Ensure personnel are at least six feet from the breaker under test and any high voltage connections.

4. Apply 15kV AC or 20kV DC, depending on the type of test equipment used.

5. If the test shows any more than 200 uA, the ISM element should be considered failed and taken out of service.

Note that vacuum interrupters can show restrikes when DC current is applied. If any reading is suspect, the breaker should be taken out of service until CBS MAGVac can be notified for further investigation.

Phase to Phase:

This tests measures the relative level of isolation between the poles by applying a high voltage source to the center pole, with the contacts closed and the two outer poles tied together to ground.

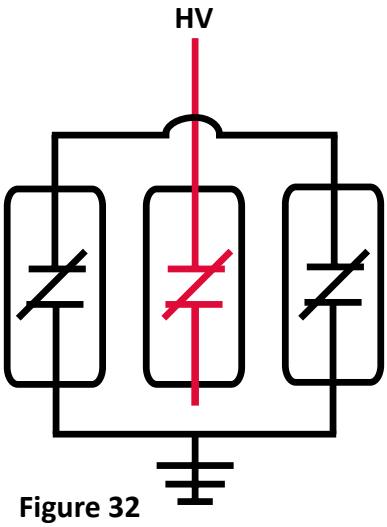


Figure 32

1. Tie the two outer poles to frame ground and to the dielectric tester ground.

2. Tie the center pole to the dielectric tester lead.

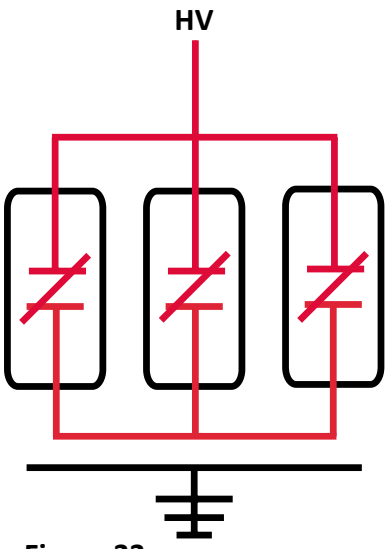
3. Ensure personnel are at least six feet from the breaker under test and any high voltage connections.

4. Apply 15kV AC or 20kV DC, depending on the type of test equipment used.

5. If the test shows any more than 200 uA, the breaker should be taken out of service until further analysis and repair has taken place.

Phase to Ground:

This tests measures the relative level of isolation between the poles and ground by tying all of the poles to the voltage source, with the contacts closed.



1. Tie the ground lead of the dielectric tester to the frame ground of the circuit breaker

2. Tie the upper and lower poles together and to the dielectric tester lead. Do not connect to ground.

Figure 33

3. Ensure personnel are at least six feet from the breaker under test and any high voltage connections.

4. Apply 15kV AC or 20kV DC, depending on the type of test equipment used

5. If the test shows any more than 200 uA, the breaker should be taken out of service until further analysis and repair has taken place.

5.5 Dielectric Withstand - Secondary

Dielectric tests of the secondary connections are also critical to safe operation of the device. These should be performed every three years, or after any service that required replacement of critical secondary components (such as resistors, control modules etc) or alteration of wiring.

Test should be performed in the following manner:

1. Breaker must be fully withdrawn from the cell and moved to a clear workspace.
2. Connect a jumper across power input terminals of the secondary contact block.
3. Connect one end of hi-pot tester to the input terminals.
4. Connect other end of hi-pot tester to a suitable ground on the breaker chassis.
5. Follow safe work practices to ensure all personnel are kept at least 6 feet away from the test area.
6. Run the hi-pot test at 1.5 kV AC.

5.6 Timing Test

Timing tests validate the contact opening and closing speed, and are an assurance that the circuit breaker is operating within specifications for fault clearing speed.

This test requires specialized, calibrated equipment and should be left to qualified service technicians. It should be performed after replacement of the control module or ISM breaker element or every three years.

From initiation of command, the total close time should be <77 ms (<5cycles), while trip time should be <42 ms (<2.8 cycles). Should the breaker be higher than these values, CBS MAGVac should be contacted for further determination of the remedial action required.

5.7 Lubrication of Moving Parts

During routine maintenance, the breaker should be checked for adequate lubrication of the moving parts shown in Fig. 34 through 43.

Should lubrication be required, clean the lubrication points first with dry rags to remove dirt buildup and other contaminants. Re-apply the correct lubricant for each point, taking care to follow the instructions of the lubricant manufacturer.

DANGER!

The current carrying components on the breaker can only be lubricated with NO-OX-ID Special Grade “A” manufactured by Sanchem. Use of any other lubricant for these areas could cause overheating and / or electrical malfunction.

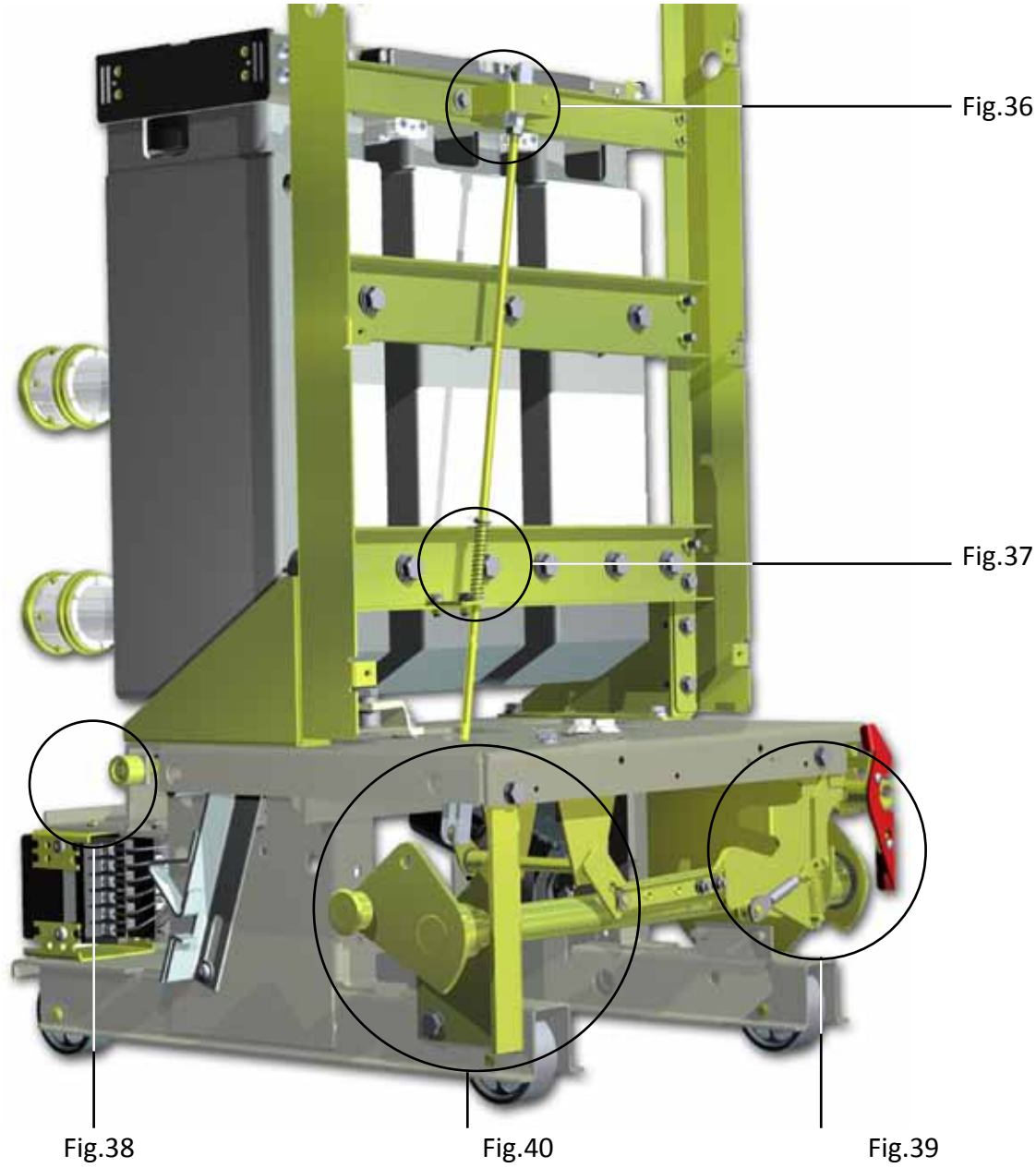


Figure 34 - Areas to be Greased with Anderol 757

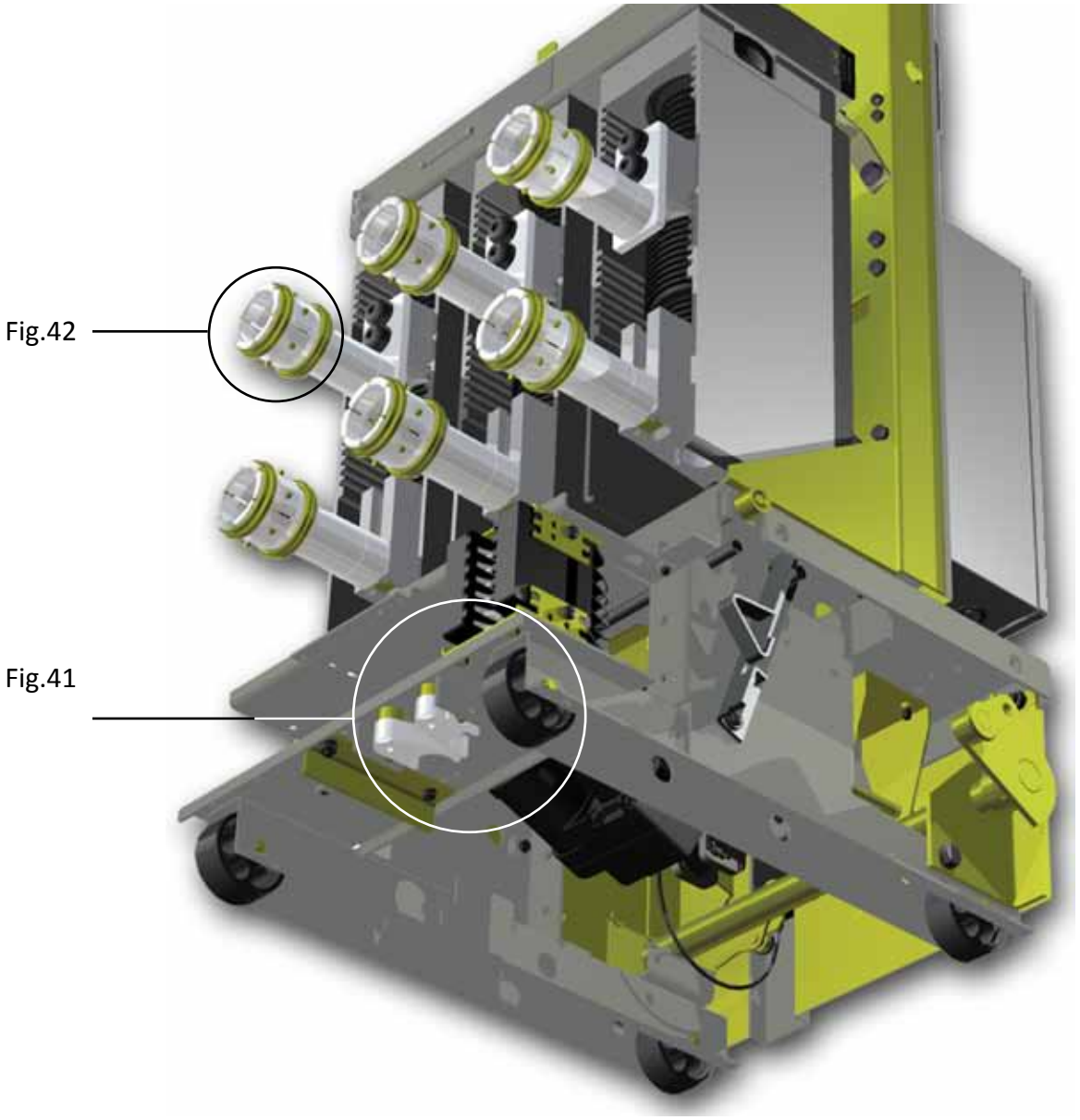


Figure 35 - Areas to be Greased with Anderol 757 and / or NO-OX-ID Special Grade “A”

In Figure 36 - Figure 43, the contact pairs and the components that need to be greased with ANDEROL 757 (Tenneco Chemical) are marked with the letter “A”.

In Figure 36 - Figure 43, the contact pairs and single contact surfaces that need to be greased with NO-OX-ID special “Grade A” (Sanchem), are marked with the letter “N”.

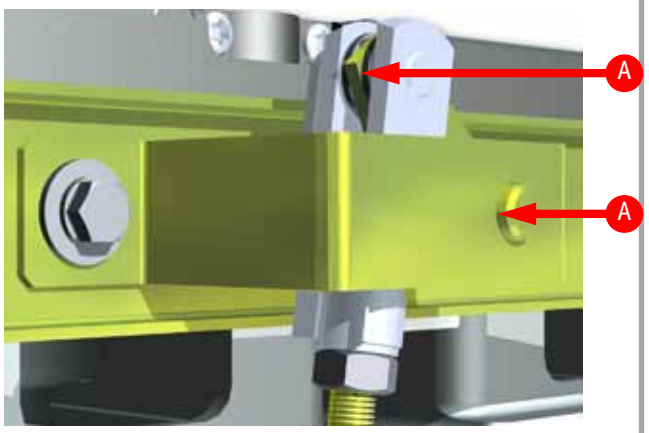


Figure 36

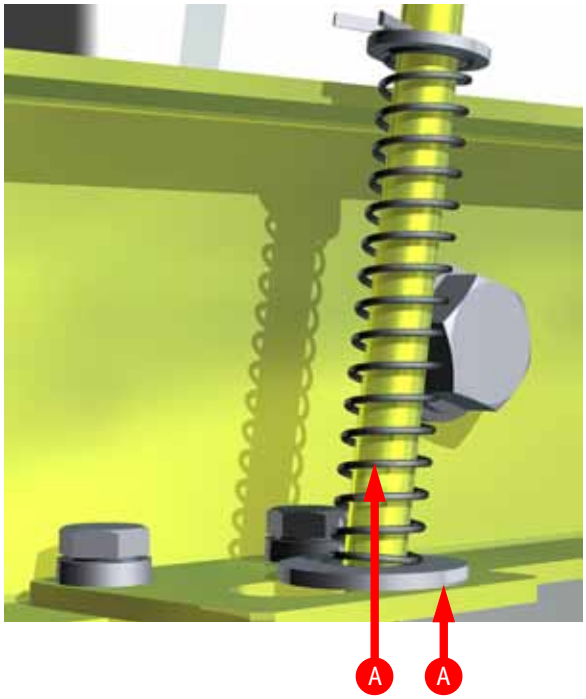


Figure 37

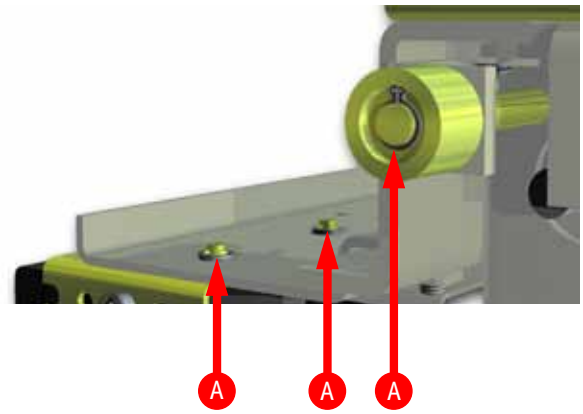


Figure 38

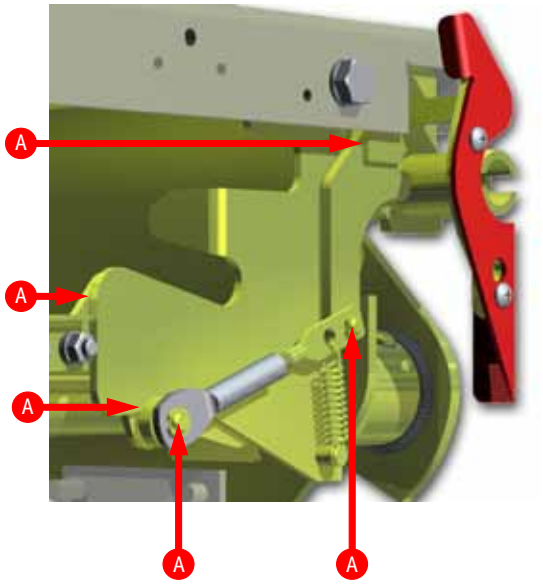


Figure 39

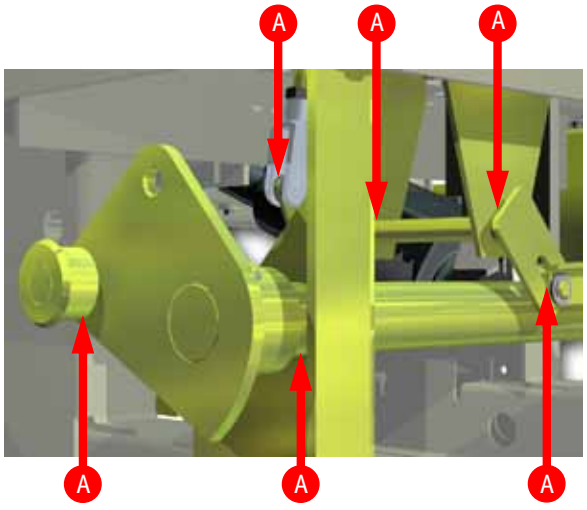


Figure 40

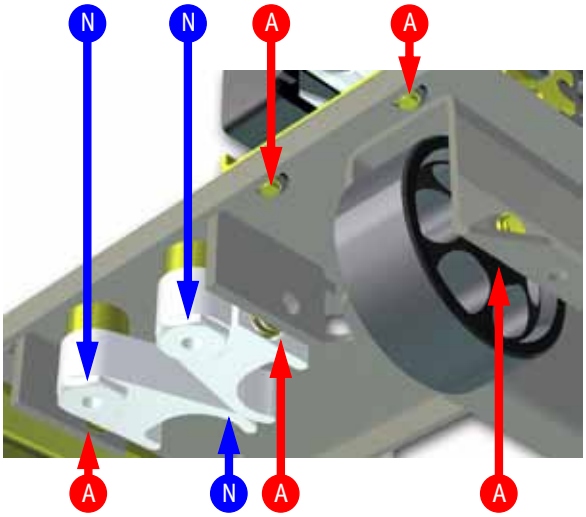


Figure 41

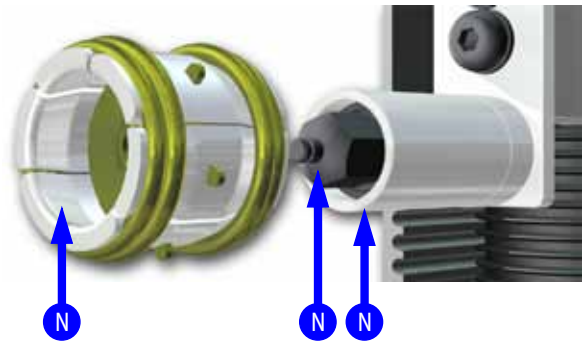


Figure 42

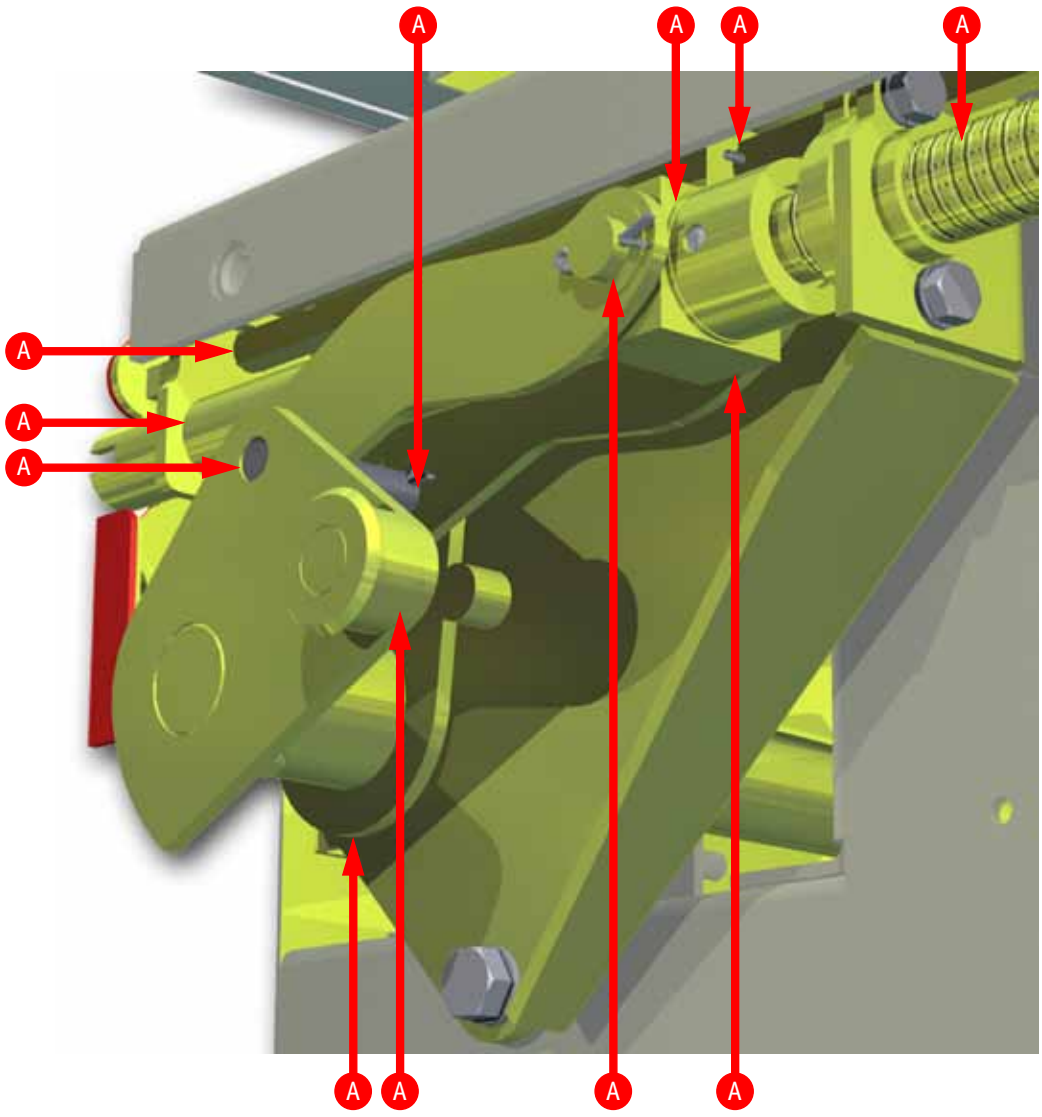
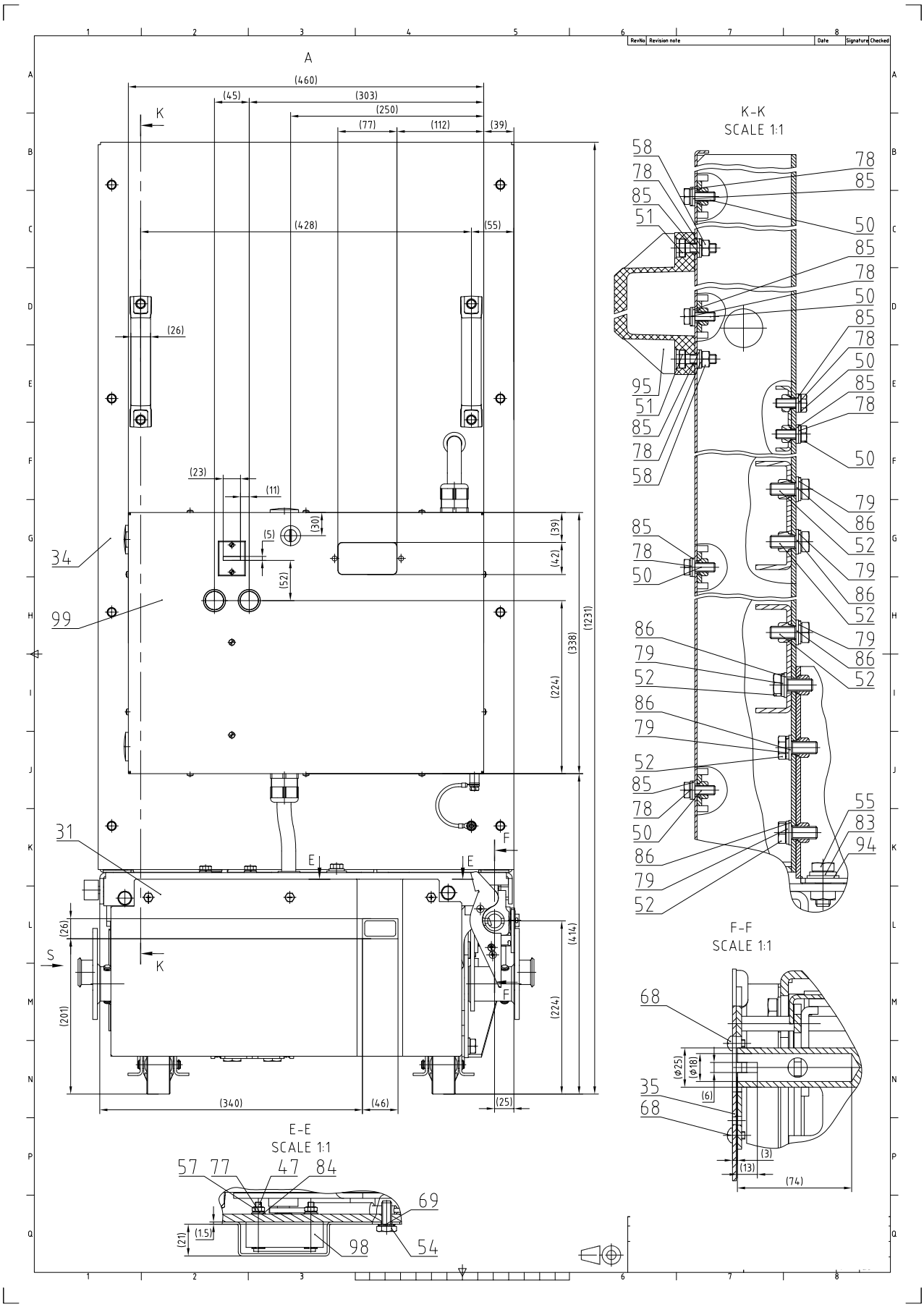


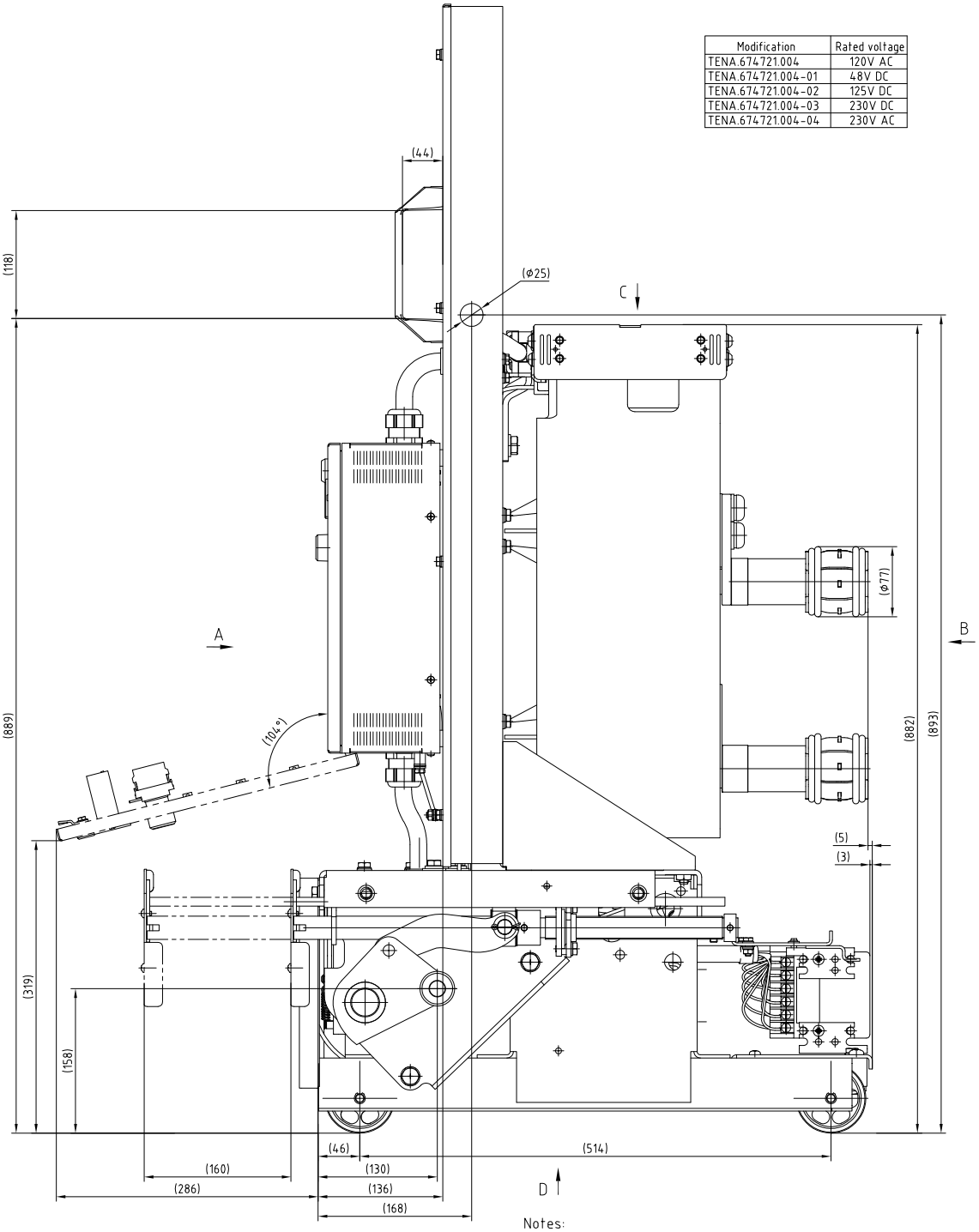
Figure 43

Section 6 - Mechanical Drawings



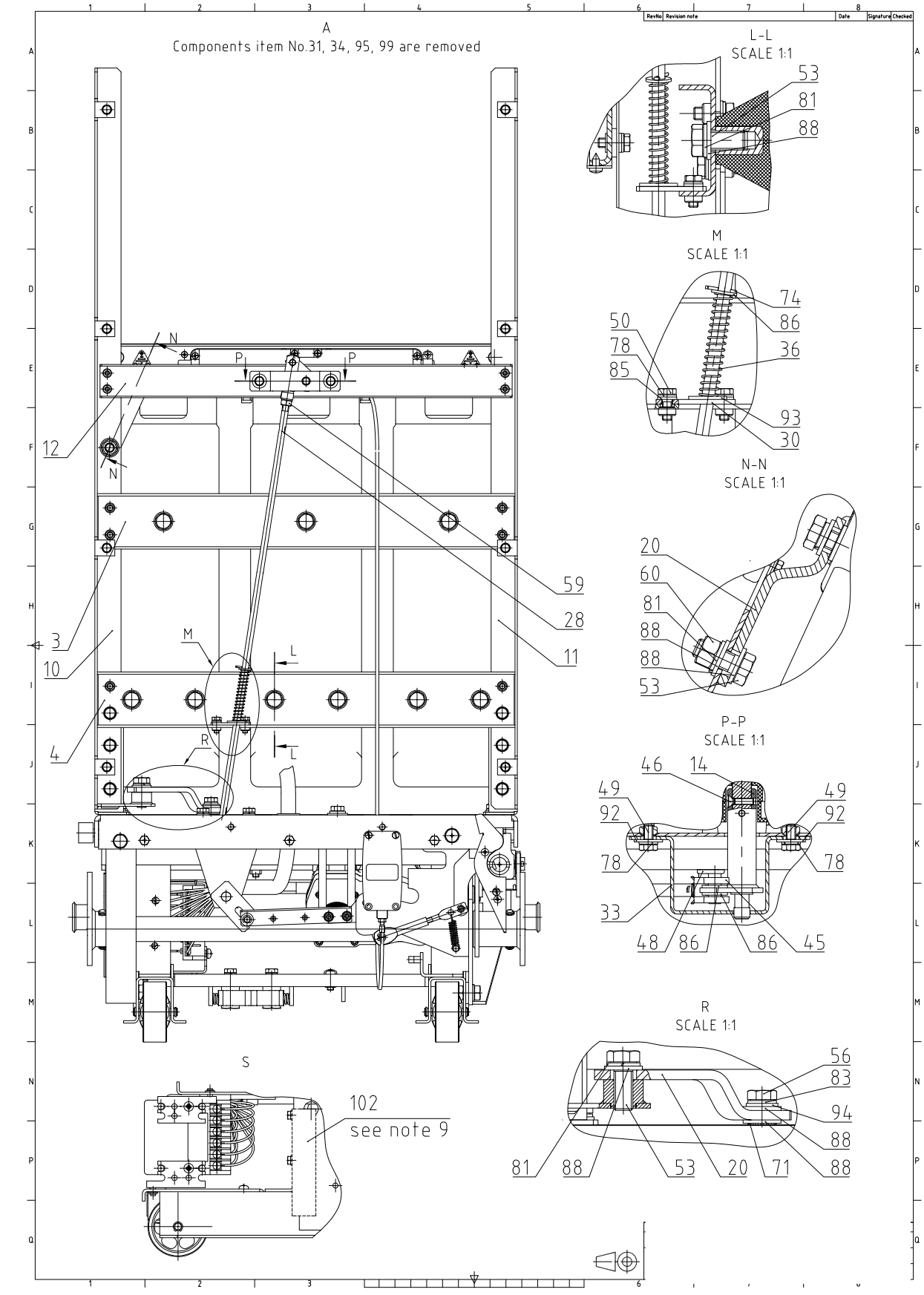
Rev.No	Revision note	Date	Signature	Checked

Modification	Rated voltage
TENA.674721.004	120V AC
TENA.674721.004-01	48V DC
TENA.674721.004-02	125V DC
TENA.674721.004-03	230V DC
TENA.674721.004-04	230V AC



6. Wiring and indicator connecting - according to the ISM/TEL user manual.
7. Lock screws item No.46 and item No.68 with LOCTITE 243.
8. Auxiliary circuit mounting kit item No.99 installation and wiring - according to the drawing TENA.468367.002.
9. If the MOC gear is not installed on the retrofitted draw-out unit, it is required to Install the MOC bracket kit item No.102 to prevent insertion of the retrofitted draw-out unit into non-retrofitted switchgear cubicle with MOC's still present.

Notes:
1. Grease friction surfaces of appropriate details before assembling.
2. Torque value for contact arm's pins and busbars junction fasteners - 60 N×m.
3. Torque value for contact arms junction fasteners - 80 N×m.
4. Torque value for ISM/TEL fixative fasteners M12 - 40 N×m.
5. Torque value for other fasteners: M4 fasteners - 1,5 N×m; N°10 fasteners - 2 N×m; M6 and 1/4" fasteners - 10,5 N×m; M8 fasteners - 20 N×m; 3/8" fasteners - 30 N×m; M12 fasteners - 50 N×m.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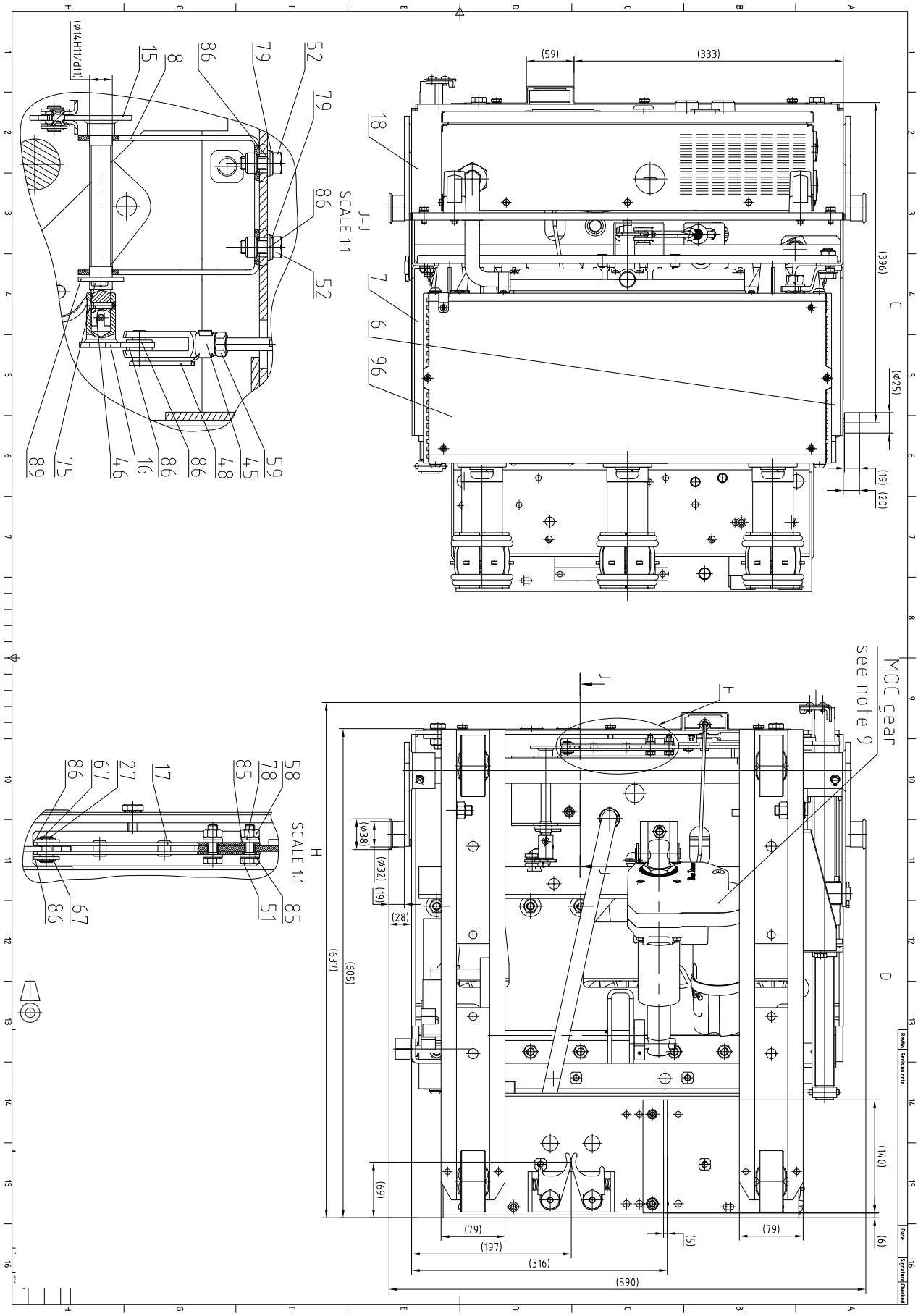
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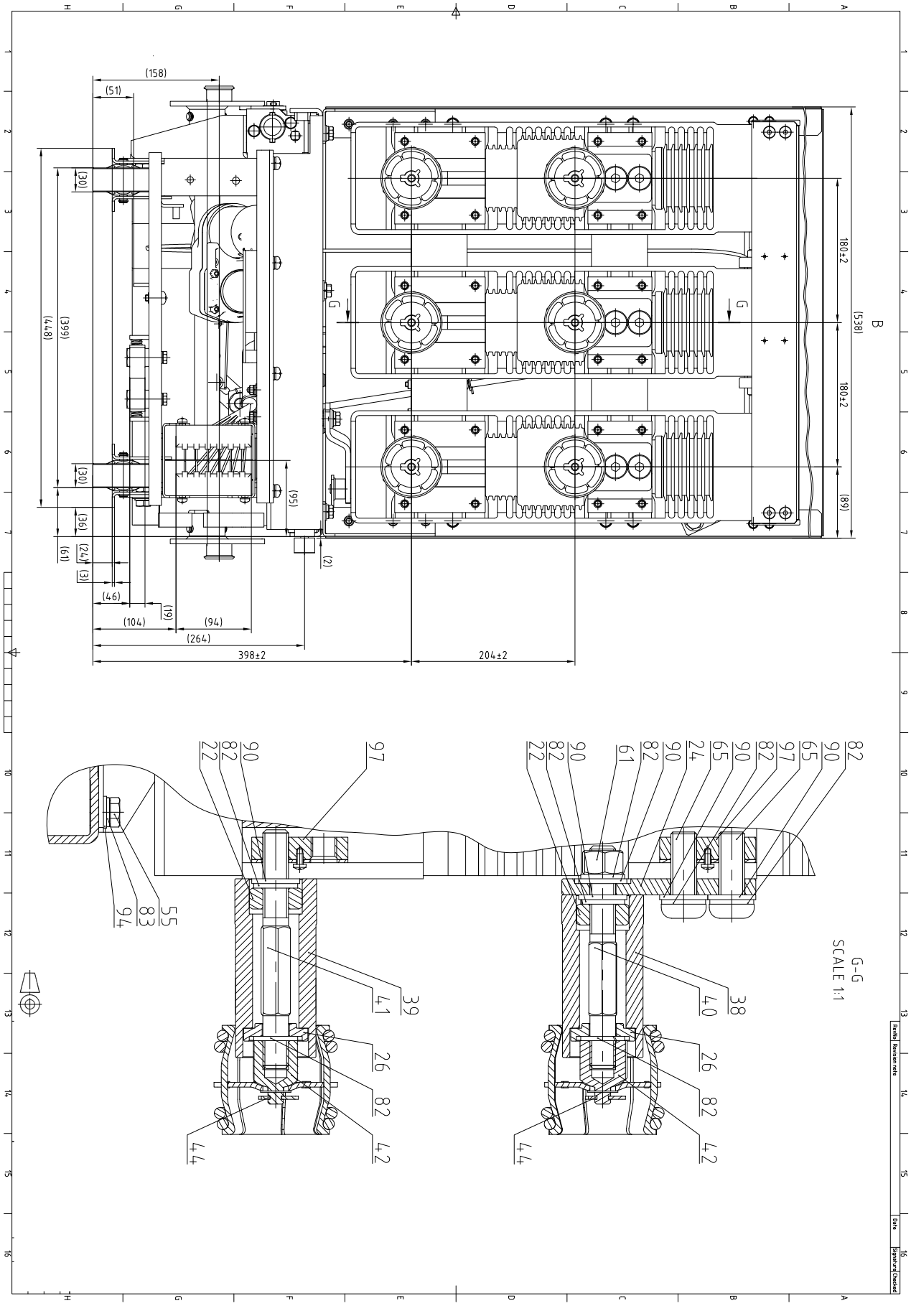
Revision note
Date
Signature/ Checked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Rev.No
Revision note
Date
Signature
Checked

RevNo	Revision note	Date	Signature	Checked

Itemref	Quantity	Title/Name, designation, material, dimension etc	Article No./Reference
3	1	Bar / AXCA.301568.041-04	
4	1	Bar / AXCA.301568.041-05	
6	1	Bracket / TENA.301568.003	
7	1	Bracket / TENA.301568.003-01	
8	1	Bracket / TENA.301568.004	
10	1	Stand / TENA.301568.006	
11	1	Stand / TENA.301568.006-01	
12	1	Bar / TENA.301568.007	
14	1	Lever / TENA.303733.002	
15	1	Shaft / TENA.303733.003	
16	1	Lever / TENA.303733.004	
17	1	Bar / TENA.304593.001	
18	1	Carriage / TENA.674721.003	
20	2	Bus / AXCA.685528.007-02	
22	6	Nut / AXCA.758441.002	
24	3	Bus / TENA.685528.001	
26	6	Washer / TENA.711351.001	
27	1	Pin / TENA.713611.001	
28	1	Rod / TENA.715214.001	
30	1	Plate / TENA.741218.001	
31	1	Panel / TENA.741238.001	
33	1	Bracket / TENA.745422.001	
34	1	Panel / TENA.745512.002	
35	1	Tripping lever / TENA.745512.009	
36	1	Spring / TENA.753513.001	
Itemref	Quantity	Title/Name, designation, material, dimension etc	Article No./Reference

Designed by	Checked by	Approved by - date	Filename	Date	Scale
A.Belozub	P.Voronezhsky	T.Davidson	TENA_674721_004_IL	08/10/08	

SWITCHING MODULE ISM/TEL-12-31,5/2000-112
ON DRAW-OUT UNIT I-T-E 5HK75

ITEM LIST TENA.674721.004 | Edition 5 | Sheet 1/4

RevNo	Revision note		Date	Signature	Checked

Itemref	Quantity	Title/Name, designation, material, dimension etc	Article No./Reference
38	3	Tube / TENA.757472.001	
39	3	Tube / TENA.757472.001-01	
40	3	Pin / TENA.758293.001	
41	3	Pin / TENA.758293.001-01	
42	6	Nut / TENA.758425.001	
44	6	Crimp ring retainer No.277-207, Spaenaur	
45	2	Clevis DIN 71752 - G8x32 - M8x1,25, Steel, Zinc plated	
46	2	Countersunk flat head screw ISO 2009 -	
		M4 x 16 - 5.8 - A3K	
47	2	Countersunk flat head screw ISO 2009 -	
		M4 x 30 - 5.8 - A3K	
48	2	Folding spring bolt DIN 71752 FKB 8x32, Zinc plated	
49	2	Hexagon head screw ISO 4017 - M6 x 12 - 5.6 - A3K	
50	14	Hexagon head screw ISO 4017 - M6 x 16 - 5.6 - A3K	
51	6	Hexagon head screw ISO 4017 - M6 x 20 - 5.6 - A3K	
52	14	Hexagon head screw ISO 4017 - M8 x 20 - 5.6 - A3K	
53	11	Hexagon head screw ISO 4017 - M12 x 30 - 5.6 - A3K	
54	3	Hex cap screw ANSI B18.2.1 - 1/4" - 20 UNC x 5/8",	
		SAE Grade 5, Steel, Zinc plated	
55	4	Hex cap screw ANSI B18.2.1 - 3/8" - 16 UNC x 7/8",	
		SAE Grade 5, Steel, Zinc plated	
56	1	Hex cap screw ANSI B18.2.1 - 3/8" - 16 UNC x 1 1/2",	
		SAE Grade 5, Steel, Zinc plated	
57	2	Hexagon nut ISO 4032 - M4 - 5 - A3K	
58	6	Hexagon nut ISO 4032 - M6 - 5 - A3K	
59	2	Hexagon nut ISO 4032 - M8 - 5 - A3K	
60	1	Hexagon nut ISO 4032 - M12 - 5 - A3K	
61	3	Hexagon nut ISO 4032 - M16 - A2-70	
65	6	Hexagon socket button head screw ISO 7380 -	
		M16 x 45 - 12.9 - A2-70	
67	2	Lock washer DIN 6799 - 5	
68	2	Cross recessed pan head machine screw - Type I	
		ANSI B18.6.3 - N°10 - 24 UNC x 5/16", SAE Grade 5,	
		Steel, Zinc plated	

Itemref	Quantity	Title/Name, designation, material, dimension etc	Article No./Reference

Designed by	Checked by	Approved by - date	Filename	Date	Scale
A.Belozub	P.Voronezhsky	T.Davidson	TENA_674721_004_IL	08/10/08	

SWITCHING MODULE ISM/TEL-12-31,5/2000-112
ON DRAW-OUT UNIT I-T-E 5HK75

ITEM LIST TENA.674721.004 | Edition 5 | Sheet 2/4

RevNo	Revision note	Date	Signature	Checked

Itemref	Quantity	Title/Name, designation, material, dimension etc	Article No./Reference
69	3	Serrated lock washer DIN 6798 - A 6,4 - FSt	
71	1	Serrated lock washer DIN 6798 - A 10,5 - FSt	
74	1	Split pin ISO 1234 - 2,0 x 14 - St - A3K	
75	1	Split pin ISO 1234 - 3,2 x 22 - St - A3K	
77	2	Spring washer DIN 128 - A4 - FSt	
78	22	Spring washer DIN 128 - A6 - FSt	
79	14	Spring washer DIN 128 - A8 - FSt	
81	11	Spring washer DIN 128 - A12 - FSt	
82	21	Spring washer DIN 128 - A16 - C3	
83	5	Helical spring lock washer ASME B18.21.1 -	
		3/8" Regular, Carbon steel	
84	2	Washer ISO 7089 - 4 - 140 HV - A3K	
85	22	Washer ISO 7089 - 6 - 140 HV - A3K	
86	21	Washer ISO 7089 - 8 - 140 HV - A3K	
88	14	Washer ISO 7089 - 12 - 140 HV - A3K	
89	1	Washer ISO 7089 - 14 - 140 HV - A3K	
90	15	Washer ISO 7089 - 16 - A 140	
92	2	Washer ISO 7093 - 6 - 140 HV - A3K	
93	1	Washer ISO 7093 - 8 - 140 HV - A3K	
94	5	Washer ANSI B18.22.1 - 3/8" - Narrow - Type A,	
		Steel, Zinc plated	
95	2	Dirak 6-1031 Bridge Handle, Part-No. 213-0203.03	
96	1	Indoor switching module ISM/TEL-12-31,5/2000-112	
97	6	Mounting assembly / AXCA.301600.001	
98	1	Position indicator / AXCA.305449.002	

Itemref	Quantity	Title/Name, designation, material, dimension etc	Article No./Reference

Designed by	Checked by	Approved by - date	Filename	Date	Scale
A.Belozub	P.Voronezhsky	T.Davidson	TENA_674721_004_IL	08/10/08	

SWITCHING MODULE ISM/TEL-12-31,5/2000-112
ON DRAW-OUT UNIT I-T-E 5HK75

ITEM LIST TENA.674721.004 | Edition 5 | Sheet 3/4

RevNo	Revision note	Date	Signature	Checked

Itemref	Quantity	Title/Name, designation, material, dimension etc	Article No./Reference
		VARYING DATA FOR MODIFICATIONS	
		TENA.674721.004	
99	1	Auxiliary circuit mounting kit / TENA.468367.002	
		TENA.674721.004-01	
99	1	Auxiliary circuit mounting kit / TENA.468367.002-01	
		TENA.674721.004-02	
99	1	Auxiliary circuit mounting kit / TENA.468367.002-02	
		TENA.674721.004-03	
99	1	Auxiliary circuit mounting kit / TENA.468367.002-03	
		TENA.674721.004-04	
99	1	Auxiliary circuit mounting kit / TENA.468367.002-04	
		INSTALLATION KITS	
102	1	MOC bracket kit / TENA.304275.001	
		SUPPORTING DOCUMENTATION	
		Switching module ISM/TEL-12-31,5/2000-112	
		on draw-out unit I-T-E 5HK75 / TENA.674721.004	Assembly Drawing
		Retrofitted draw-out unit for GOULD I-T-E 5HK75	
		metal clad switchgear, 5kV, 1200A, 29kA,	
		up to 60kV BIL / TENA.674721.004 AI	Assembly Instruction
Itemref	Quantity	Title/Name, designation, material, dimension etc	Article No./Reference

Designed by	Checked by	Approved by - date	Filename	Date	Scale
A.Belozub	P.Voronezhsky	T.Davidson	TENA_674721_004_IL	08/10/08	

SWITCHING MODULE ISM/TEL-12-31,5/2000-112
ON DRAW-OUT UNIT I-T-E 5HK75

ITEM LIST TENA.674721.004	Edition 5	Sheet 4/4

CBS MAGVac™
1502 Old Underwood
La Porte, Texas
77571
Phone: 281-479-4555
E-mail: rvogel@groupcbs.com
lheine@groupcbs.com
Website: www.cbsalesandrepair.com

Instruction Manual: 5HKMGV250B1110

Valid for types: 5HK-MGV-250 (1200A)

5HK-MGV-250 (2000A)