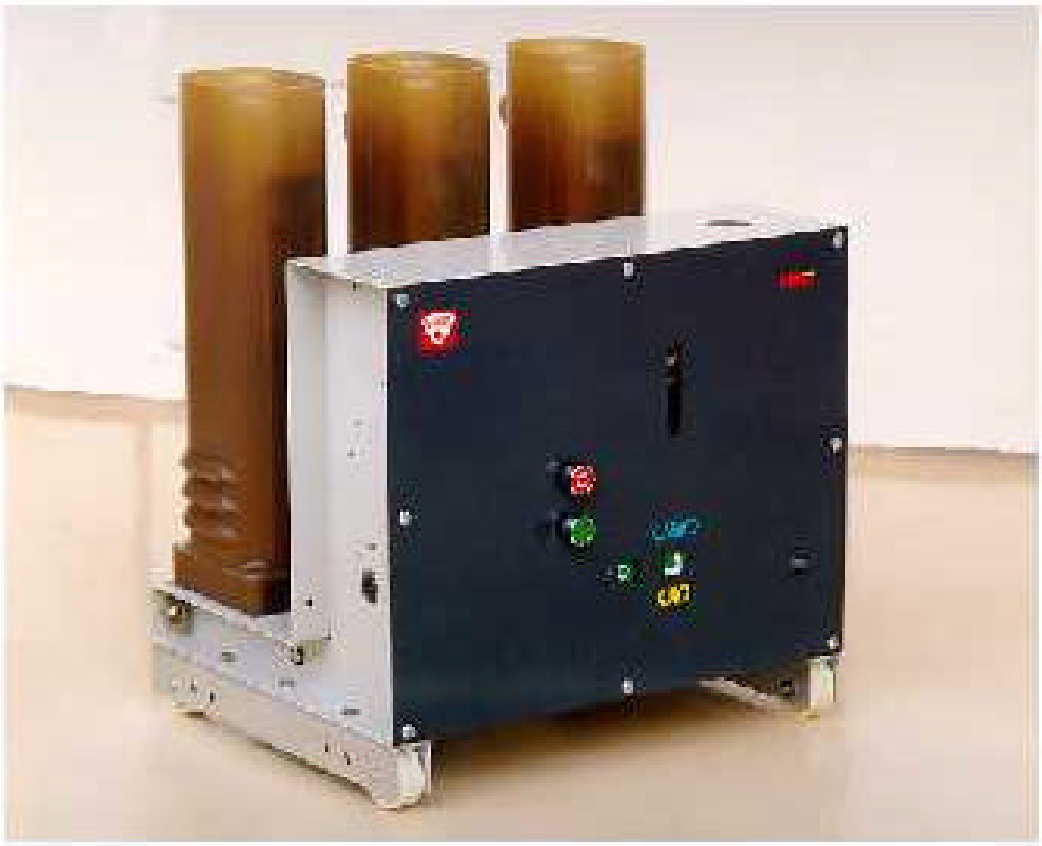
EFACEC ENERGIA, S.A.
Medium Voltage Switchgear

Divac
Vacuum circuit-breakers



Instruction Manual

MT823088

Reception
Installation
Setting into service
Operation
Maintenance

1. Safety practices

The equipment described in this manual could be remote controlled and contains high-voltage parts and high-speed operating mechanisms.

Disregarding the following safety instructions may result in severe physical and property damages.

- Carefully read this manual before attempting any installation, operation or maintenance action.
- The circuit-breakers described in this manual have been designed and tested to operate within their rated values. Operation outside these ratings may result in severe physical and property damages.
- Satisfactory performance and useful life of these breakers depend on their correct installation, and maintenance. Ensure that these procedures are carried out only by qualified personnel who are familiar with the installation and maintenance of medium voltage circuits and the contents of this manual.
- Do not work on a breaker with closing springs charged. The closing springs should be discharged and the breaker should be switched off (see Tab.I-A)
- For Normacel panels Withdrawable versions:
  - Always leave the circuit-breaker either on Service or Test position and never in an intermediate position in the cubicle.
  - Do not use a circuit-breaker by itself as the sole means of isolating a high voltage circuit. Place the breaker into Test position.
  - Always remove the breaker from the panels before performing any maintenance .
- Divac circuit-breakers are equipped with safety interlocks providing a simple and safe operation. Do not defeat them.
- This manual should be kept accessible to all persons concerned with installation, operation and maintenance of these equipment.

2. General

2.1 Introduction

The Divac type vacuum circuit-breakers are indoor equipment suitable for normal operating conditions as individual units for fixed installation or as Withdrawable units for air- insulated switchboards .

Due to their vacuum switching principle and simple and robust construction, Divac type circuit-breakers have high reliability and long life expectancy. The Divac range uses a stored energy spring operating mechanism. The basic version is fitted with a manual spring charging device or with an optional charging motor, making the breaker suitable for auto-reclosing and also for multishot auto-reclosing fast cycles.

2.2 Standards

Divac circuit-breakers were specially designed to comply with IEC 56 and IEC 694 standards.

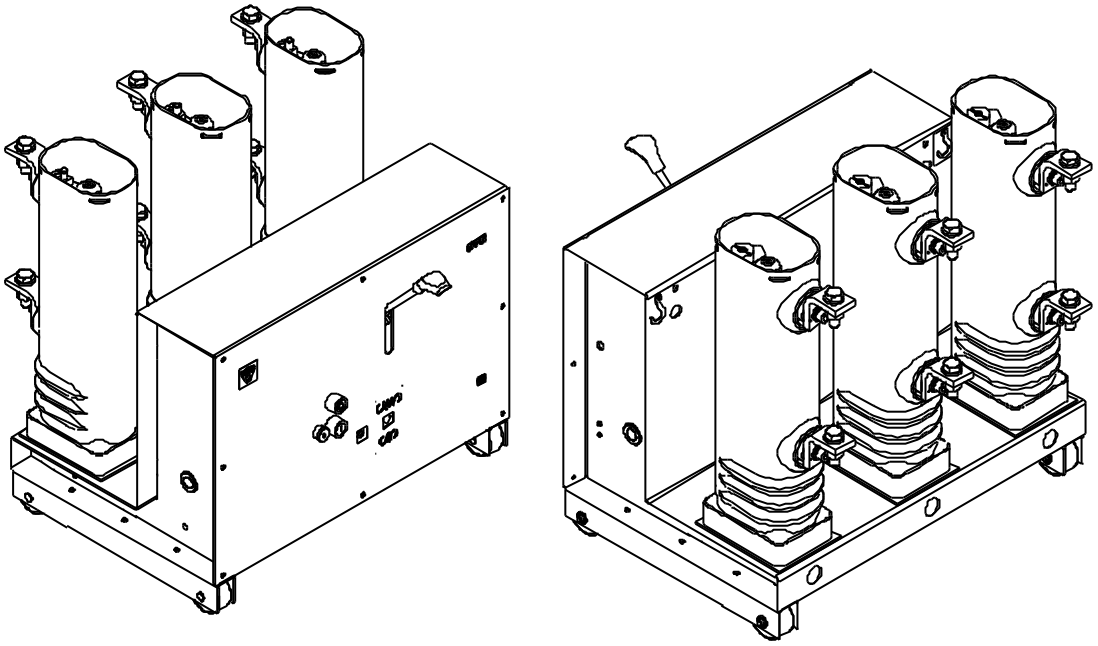
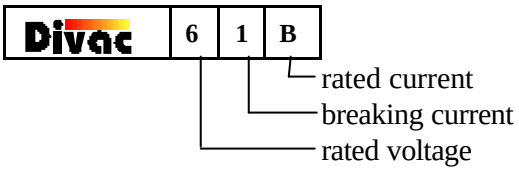


fig. 1 - Divac circuit-breakers (fixed installation version)

3. Technical data

3.1 Designation

Divac circuit-breakers range is designated by the common name *Divac* followed by three specification characters.
Example:



3.2 Electrical ratings and dimensions

Rated voltage	Rated insulation level		Rated current	Short-circuit breaking current	Breaker designation	Height (A)	Depth (P)	Width (L)	Distance between poles (EP)
	Lighting pulse	Power frequency (1 min.)							
kV	kV	kV	A	kA		mm	mm	mm	mm
12	75	28	630	16	Divac 41 B	662	456	550	200
			1250		Divac 41 D				
			630	25	Divac 42 B				
			1250		Divac 42 D				
			1600		Divac 42 E				
			2000		Divac 42 F				
			1250	31,5	Divac 43 D	728	456	700	250
			1600		Divac 43 E				
			2000		Divac 43 F				
17,5	95	38	630	16	Divac 51 B	662	456	650	250
			1250		Divac 51 D				
			630	25	Divac 52 B				
			1250		Divac 52 D				
			1600		Divac 52 E				
			2000		Divac 52 F				
			1250	31,5	Divac 53 D	728	456	700	250
			1600		Divac 53 E				
			2000		Divac 53 F				
24	125	50	630	16	Divac 61 B	662	456	650	250
			1250		Divac 61 D				
			630	25	Divac 62 B				
			1250		Divac 62 D				
			1600		Divac 62 E				
			2000		Divac 62 F				
			1250	31,5	Divac 63 D	728	456	700	250
			1600		Divac 63 E				
			2000		Divac 63 F				

Making current (kA peak)	2,5 times the breaking current for all the range
Short withstand current	equal to the breaking current held for 1 or 3 seconds
Operating cycles	O - 3 min - CO - 3 min - CO O - 0,3 s - CO - 15 s - CO - 15s - CO

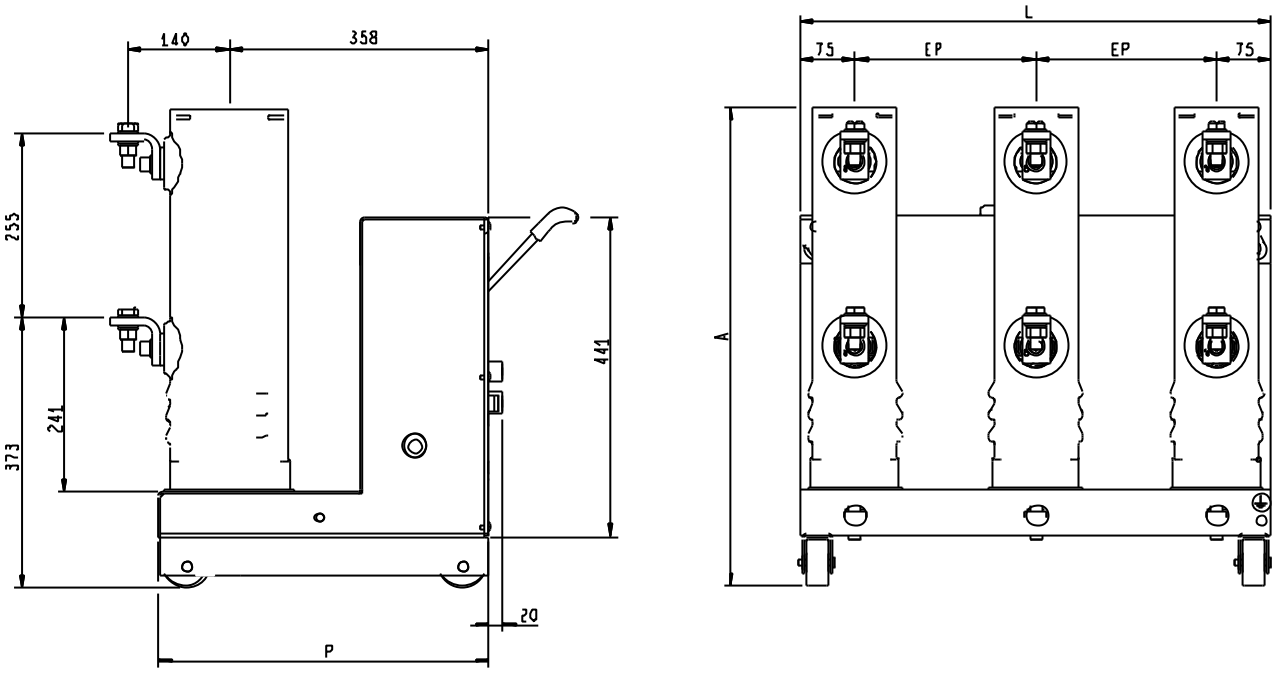


fig. 2 - Divac fixed installation versions 630..2000 A, 16...25 kA, up to 24 kV.

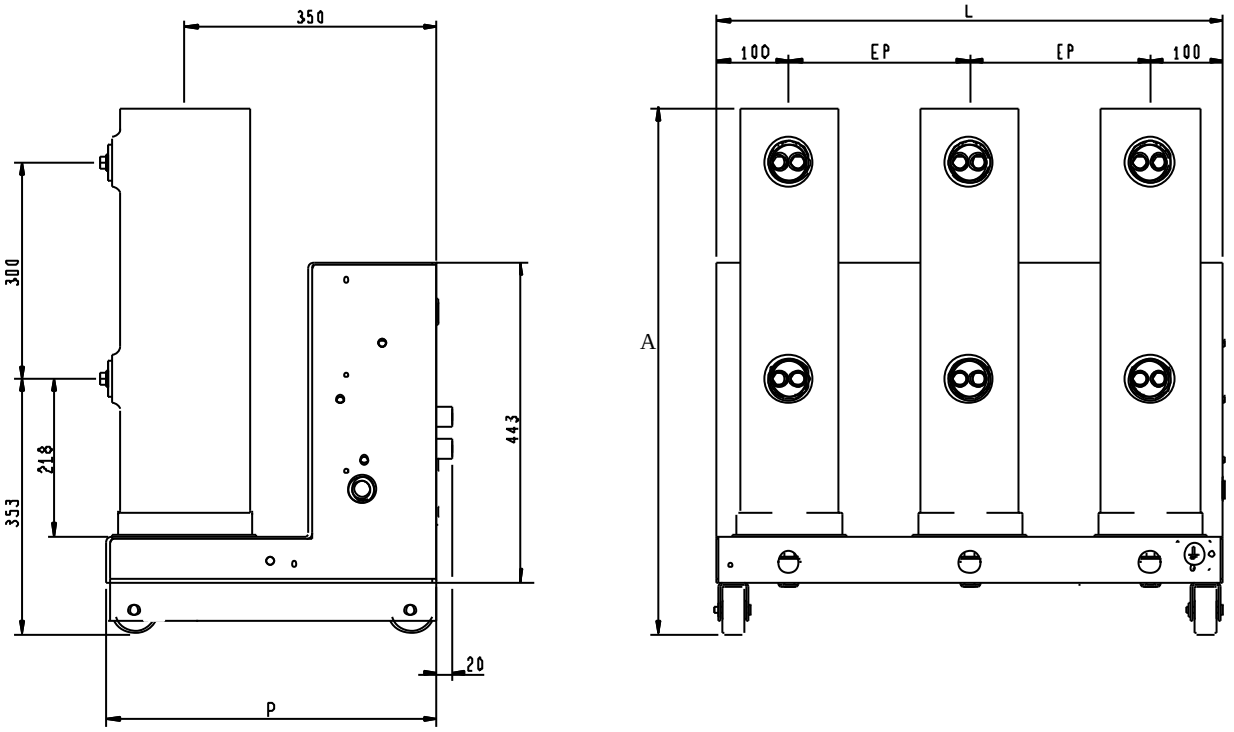


fig. 3 - Divac fixed installation versions 1250...2000 A, 31,5 kA, up to 24 kV

3.3 Fixation (top views)

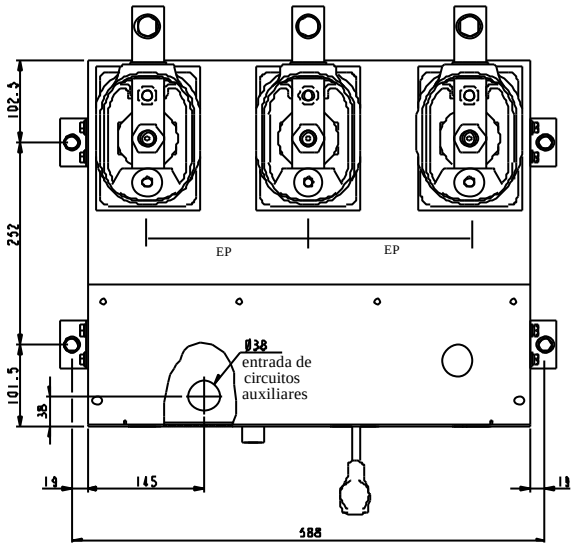


fig. 4-1: Divac fixed inst. version 630..2000 A, 16...25 kA, up to 17,5 kV.

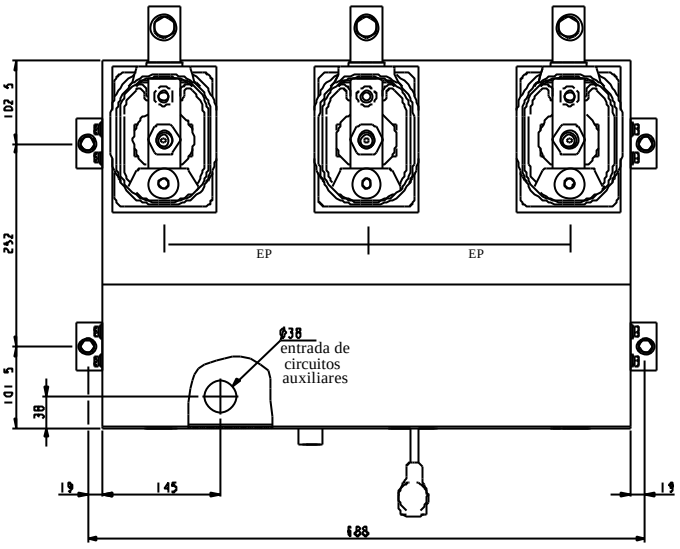


fig. 4-2: Divac fixed installation version 630..2000 A, 16...25 kA, 24 kV.

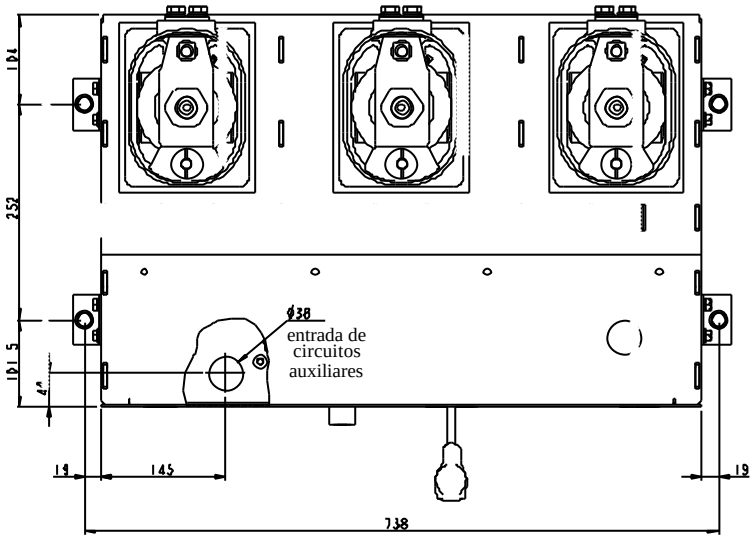


fig. 4-3: Divac fixed installation version 630..2000 A, 31,5 kA, up to 24 kV.

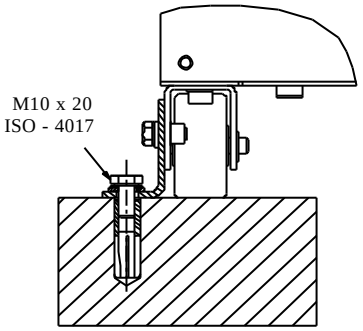


fig. 4-4: fixation detail

3.4 Connecting terminals

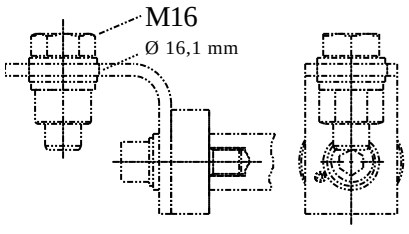


fig.5-1 : up to 630 A - 16 kA

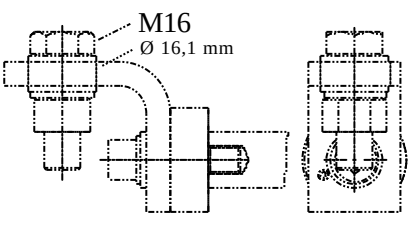


fig. 5-2 : up to 1250 A - 25 kA

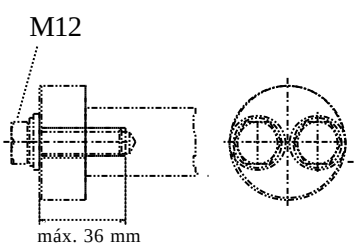


fig.5-3 : up to 2000 A - 31.5 kA

3.5 Standard equipment and options

Divac circuit-breakers with manual operating mechanism

- Opening and closing[1] mechanical push-buttons
- Opening solenoid
- Mechanical switch position indicator
- Mechanical closing springs charging condition indicator
- Auxiliary switches for shunt release and switch position signalling

Divac circuit-breakers with recharging motor (in addition to manual recharging mechanism)

- Closing springs electrical recharging motor with protection fuses
- Closing solenoid
- Anti-pumping relay
- Auxiliary switches for recharging motor control

Other options available

- Undervoltage tripping solenoid
- Additional opening solenoid
- Magnetic striker release device, working without any auxiliary energy source
- Mechanical switching operation counter
- Auxiliary switches for closing springs status indication
- Additional breaker position auxiliary switches
- Connection terminals

Standard colours RAL 7032 (frame) and RAL 7026 (front cover)

3.6 Switching times and power consumption

Divac circuit-breakers switching times	**(typical values)**	
Opening time	< 50 ms	
Arcing time	< 20 ms	
Breaking time	< 70 ms	
Making time	< 50 ms	
Closing springs charging time	< 15 s	
Equipment power consumption	**VA/W**	**Voltage range**
Charging motor	95	85-110 % Un
Closing solenoid	170	85-110 % Un
Opening solenoid	65	70-110 % Un
Undervoltage tripping solenoid: - switching - permanent	 100 26	 35 % - 70% Un

3.7 Operating conditions

Divac type vacuum circuit-breakers are indoor equipment suitable for fixed installations or Withdrawable units for air- insulated switchboards. The indoor installation place should not have excessive moisture, dust or corrosive fumes and sufficient heat and air circulation should be provided to prevent condensation.

Satisfactory performance of these breakers is contingent upon proper application in accordance with IEC 694 standard:

Ambient temperature range	-5 to + 40 °C
Maximum 24-hour average temperature	+ 35 °C
Maximum installation altitude above sea level	1000 m
Maximum average relative humidity measured - during 24 hours - during a month	 95% 90%

For any other operating conditions, please consult the manufacturer.

4. Description and operation

4.1 Closing and opening operations :

- manual operation, using front cover mechanical push-buttons - see fig. 6:
  - **Closing**: press the green push-button ⓘ.
  - **Opening**: press the red push-button ◎.
- electrical operation, using opening solenoid and optional closing solenoid

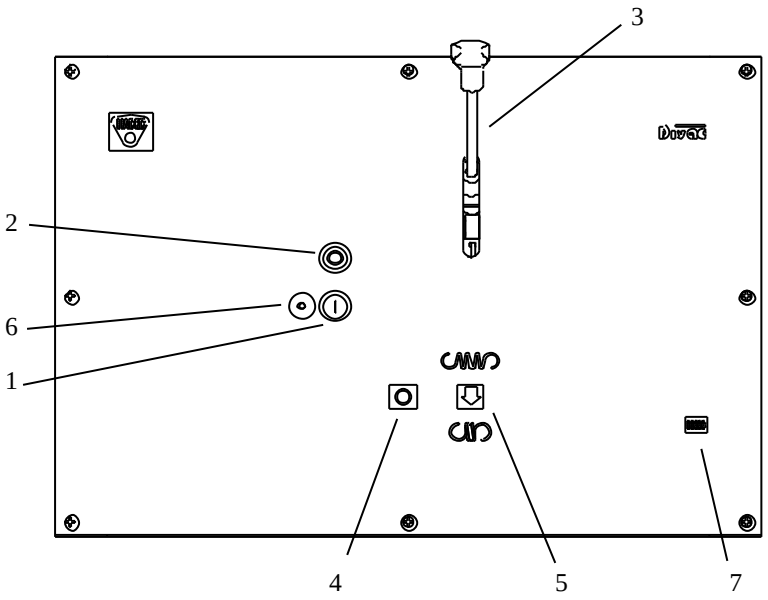


fig. 6 -front cover

1) Mechanical closing push-button
2) Mechanical opening push-button
3) Withdrawable manual charging lever
4) Switch position mechanical indicator
5) Closing springs charging condition mechanical indicator
6) Optional closing push-button key interlock
7) Optional mechanical switching operation counter

[1] On request, closing push-button can be interlocked with a key.

4.2 Closing springs (re)charge

Divac circuit-breakers are fitted with a standard closing springs manual (re)charge mechanism. Manual charging operation is made applying a pumping action with the charging lever, as in fig. 7. After about ten pumping movements, the (re)charging will be completed and signalised by the charging condition indicator and lever action stops to charge closing springs.

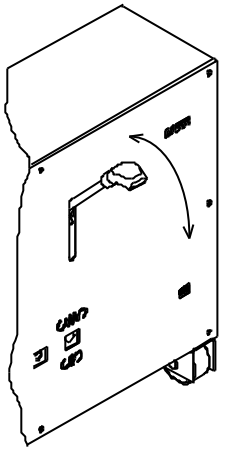


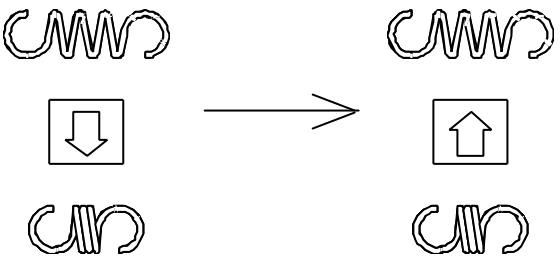
fig. 7- manual (re)charge

In order to perform an automatic reclosing sequence, closing springs must be previously charged. In manual versions, a hand -made (re)charge operation is necessary.

After each closing operation, automatic closing springs recharge is made in versions fitted with a recharging motor, making these versions specially suitable for auto-reclosing sequences.

If power failure occurs during automatic recharge, manual recharge could be performed to complete the operation .

The completion of each (re)charge operation is signalised by the charging condition indicator



4.3 Front cover indicators

- The possible operating mechanism positions and circuit-breaker switch positions, as well as front cover indicators meaning, are presented in Table I:

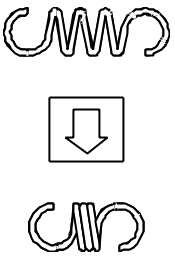
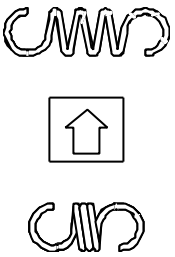
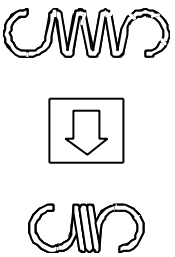
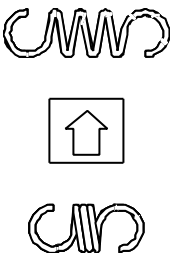
Position	operating mechanism	switch indicator	closing springs charging indicator	electrical position
A	Breaker Open Closing springs discharged			
B	Breaker Open Closing springs charged			
C	Breaker Closed Closing springs discharged			
D	Breaker Closed Closing springs charged			

Table I

- Whenever fitted, and after each cycle completion, mechanical switch counter increases by one the prior reading.

4.4 Structure of the poles

Each pole is formed by an epoxy resin insulating column-form envelope (1), fixed to the breaker base frame with screws (2).The circuit-breaker live parts, including the vacuum interrupters (3), are housed inside the envelope, eliminating the possibility of phase to phase and phase to ground arcing faults.

The main circuit is formed by the upper (4) and lower (5) terminals, the vacuum interrupter and rigid (6) and flexible connectors (7).

The vacuum interrupters make use of the excellent dielectric properties of high vacuum, being able to ensure high insulation levels for very short contact distances. In order reduce to a negligible value the contact erosion, vacuum interrupters fitted in Divac circuit breakers produces an axial magnetic field between the contact surfaces, causing the rotation and diffusion of electrical arcs.

The opening spring (8) and contact pressure spring (9) are mounted under the lower terminal . The insulating rod (10) transmit to the vacuum interrupters the operating mechanism switching motion.

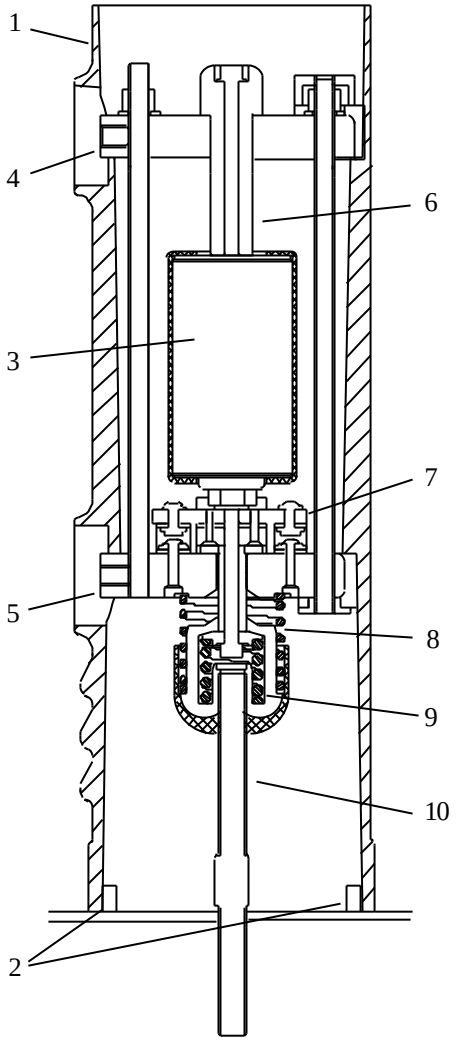


fig. 8

4.5 Operating mechanism structure

The Divac range uses a stored energy spring operating mechanism. The opening and closing operations are made applying the springs stored energy to the breaker main shaft, connected to the vacuum interrupters moveable contacts.

Depending on the version, after each closing operation, closing springs (1) charge can be made either manually, using the charging lever (2), or automatically by an optional charging motor (3).

The opening (4) and closing (5) shunt solenoids allow the electrical remote breaker operation, while the front panel push-buttons always provide a direct mechanical operation. The mechanical switch position indicator (6) and the charging condition indicator (7) provide information about the circuit breaker condition,

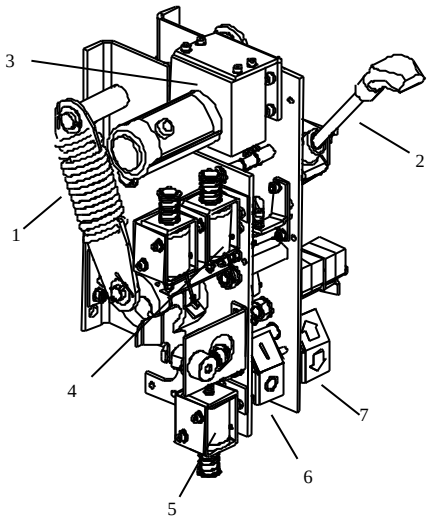
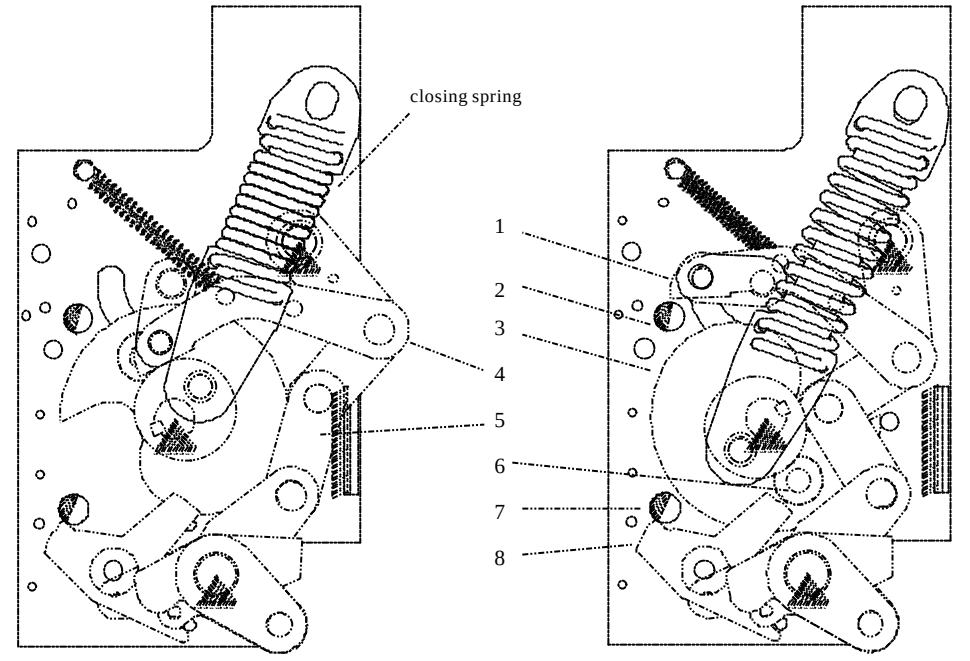


fig.9

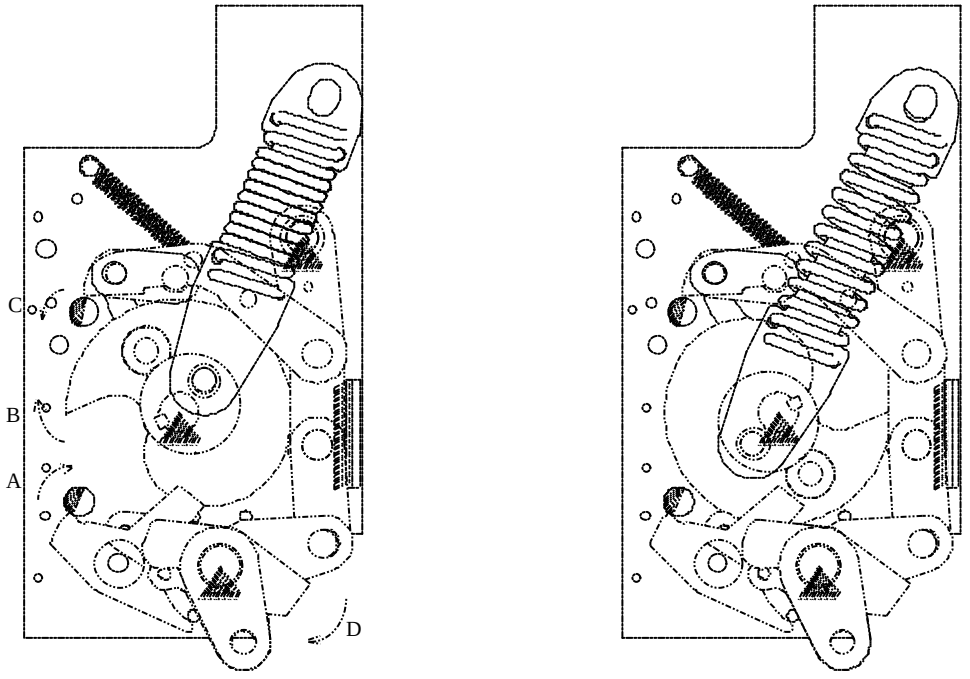
4.5.1 Operating mechanism positions

According Tab. I, the operating mechanism has four possible positions:



A) Breaker open
closing springs discharged

B) Breaker open ,
closing springs charged



C) Breaker closed,
closing springs discharged

D) Breaker closed,
closing springs charged

fig. 10

4.6 Operation

4.6.1 Charging of closing springs

In figure 10-A) the breaker is presented in the opened position with closing springs discharged.. In this situation, the operation of the closing or opening push-buttons does not make any change in the operating mechanism position. To make a closing operation, closing springs must be previously charged.

After a closing operation, the (re-)charging sequence will be automatic performed in versions fitted with a charging motor. In the manual type versions, the required charging by hand is made applying a pumping action with the charging lever, as in fig. 7. After about ten pumping movements, the (re-) charging will be completed and signalised by the charging condition indicator.

In either versions during the (re-)charge operation, the closing springs charging mechanism transmits the (re-)charging movement to the main cam (3) by a lever with an unidirectional roller-bearing that prevents the rotation of the main cam in a direction opposite to the (re-)charge one (B) when the closing springs are being charged. When main cam reach its final position, the charging condition indicator provide the charged closing springs information, while a micro-switch cut off the charging motor operation.

Closing springs charge condition is maintained by the roller (6) and cam (8), while opening latch is recharged.

An immediate closing operation is possible, as the operating mechanism has now closing springs charged (fig.10-B)

4.6.2 Closing

The closing push-button or the closing solenoid operation will cause closing latch (7) rotation in (A) direction, freeing cam (8) and the closing springs stored energy, that will be applied as a torque in main cam (3).

As a result, this will rotate in (B) direction, making through connection (5) main shaft rotate in (D) direction, leading the breaker to a closed position and charging the opening latch (see fig.10-C).

4.6.3 Opening

The opening push-button or the opening solenoid operation will cause opening latch (2) rotation in (C) direction, freeing cam (4) together with connection (5). The opening and contact pressure springs stored energy will cause the main shaft rotation in an opposite to (D) direction, making the breaker open.

4.6.4 Trip-free feature

The Divac operating mechanism will always make an opening command prior to a closing one (trip-free feature). If during the closing process an opening command takes place, the opening and contact pressure stored energy free by opening latch (2) will take the breaker to an opened position.

4.6.5 Automatic reclosing sequence

In order to perform an automatic reclosing sequence, closing springs must be previously charged. After each closing operation, automatic closing springs recharge is made in versions fitted with a recharging motor , while manual versions need a hand-made recharge operation.

After each opening operation, charged closing springs condition is kept in order to allow an immediate reclosing.

4.7 Safety disposals

4.7.1 Mechanical safety

Opening commands have always priority over closing ones (trip-free feature): if an opening command is being executed, any attempt to make the breaker close will lead to closing springs discharge without moving vacuum interrupter contacts.

4.7.2 Electromechanical safety

Depending on circuit breaker switch position, validation of opening or closing solenoid commands is made by the rotating switches connected to main shaft, thus preventing closing solenoid operation if the breaker is already closed and opening solenoid operation if breaker is already opened.

4.7.3 Auxiliary voltage connections

Auxiliary voltage connectors are provided in order to allow external commands. In Normacel panel Withdrawable versions, special plug-type connectors are used .

4.7.4 Normacel panel withdrawable versions

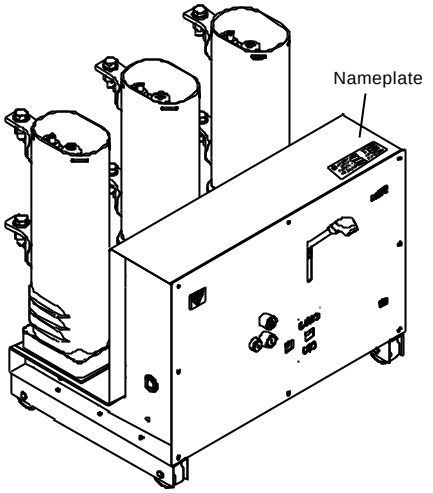
Trying to insert or withdraw a closed circuit-breaker placed in a Normacel panel will cause the breaker immediate opening, thus avoiding accidental interruptions or connections of the main circuit (see *Normacel Instructions Manual*).

5. Receipt , Transport and Storage

5.1 Receipt

The Divac circuit-breakers are mechanically and electrically inspected before despatch, in the opened position with discharged closing springs (see Tab. I- A) . They are supplied individually , sealed in plastic film and wood pallets, providing good transport and storage conditions.

During goods receipts the pallet must bee untouched



Check in the nameplate the compliance between the order and the received material .

5.2 Transport

The circuit-breaker should not be unpacked before installation, in order to profit from the mechanical protection of the package

Use always the wooden pallet during handling . Lifting tackle must never catch on the breaker poles or the operating mechanism.

The Divac circuit-breakers are supplied with lifting tools in the points marked with the symbol

In fixed installation versions, after unpacking, move the circuit-breaker to the installation place using the wheels .

5.3 Storage

If Divac circuit-breaker have to be stored prior to use , it should be done in the despatch position- circuit-breaker switched off with closing springs discharged (as Tab. I-A). Circuit-breaker should be stored in the original packing.

Store indoors, in a dry , dust-free , and well ventilated room, avoiding direct sunlight.

6. Installation

6.1. Preparatory activities

The construction works in the room must be finished, being the place dry, dust-free and having a good ventilation.

Connect the main terminals only after the circuit-breaker fixation in the normal service position .

Make a circuit-breaker general cleaning removing any contamination , specially on insulating parts. Check the integrity of primary and secondary connections and earth conductor connection .

6.2. Installation process (fixed versions)

Prior to begin circuit-breaker installation , check if the primary voltage is off

The operations are the following :

- Circuit-breaker fixation in the normal service position (see figs. 2, 3 e 4), using tensile class 8.8 screws with correct thread size and conical spring washers . Apply the recommended rated tightening torque .

- Connect the earth conductor with recommended section to the circuit-breaker frame, using terminal with symbol (⏚) - see figs. 2 e 3. In the Normacel panel Withdrawable version , the earth connection is always done when the breaker is in the panel.

- Connect the main terminals, avoiding any permanent tension or pressure forces exerted, for example, by the conductor bars .Use tensile class 8.8 screws with conical spring washers for fastening conductor bars together.

- After removing the front panel, insert the auxiliary conductors in the operating mechanism compartment using the hole (see figs. 4-1 a 4-3) in the frame base. Connect conductors according the electrical wiring scheme supplied with the circuit-breaker. The auxiliary conductors must have the necessary section and insulation for the fixed installation (test voltage 3 kV). Outside circuit-breaker, the auxiliary circuits should be protected and installed in gutters with an earth connection .

- Put the operating mechanism front cover in the original position

6.3. Commissioning - Preparatory checking

- Check the tightness of the connections.
- Check the primary and secondary connections and the earthing conductor connections .
- Manually charge the closing springs using the recharging handle .
- Perform a manual closing and opening operation on the circuit-breaker, using the front panel push-buttons . Observe the compliance between the operation and the switch position and closing spring charge conditions indicators (see Tab. I).

  Note: If the circuit-breaker is equipped with under voltage trip solenoid, it is necessary to attach the solenoid core in the spring compressed position, until the auxiliary circuits voltage be on, otherwise the circuit-breaker will open immediately after a closing operation.

- Check if the auxiliary circuits voltage is the same as the equipment .
- Connect the auxiliary voltage circuits.
- In versions fitted with a recharging motor, closing springs automatically recharging will be performed whenever closing are discharged.. Check for automatically recharging performance, making a closing and opening sequence .
- Check for opening and closing solenoids performance.

After the successful completion of these preliminary checkings, the circuit-breaker is ready for service.

7. Inspection and Maintenance

Maintenance work may only be performed in a careful manner by trained personal familiar with the characteristics of the circuit-breaker and safety regulations.

Before any circuit-breaker maintenance activity, observe the following procedure:

- Ensure that circuit-breaker is switched off with closing springs discharged , as Tab.I-A (in motorised versions disconnected all auxiliary voltage sources, to prevent automatic recharge).
- In fixed installation versions , disconnected the main and auxiliary voltage sources .
- For the Normacel panel versions, remove the circuit-breaker from the switchgear cubicle.

7.1 General

Divac circuit-breakers are characterised by a high reliability and long life expectancy due to their simple and robust construction .

As Divac vacuum circuit-breakers need low operation energy, the operating mechanism has low wear and that means a long useful life and longer intervals between maintenance inspection.

In normal operating conditions , the poles , including the vacuum interrupters , are maintenance free

7.2 Electrical working life

The vacuum interrupters electrical working life depends on the performed operating cycles number (n) and on the breaking current, as fig.11.

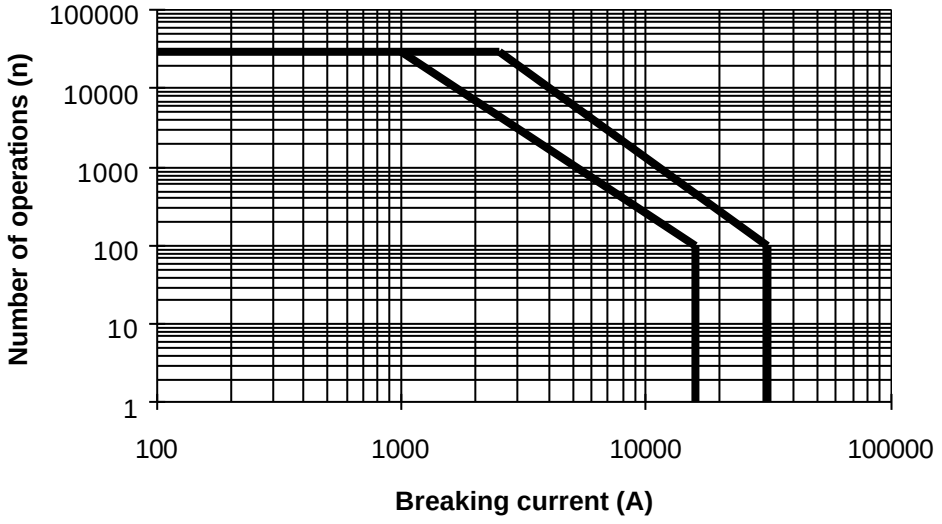


fig.11

7.3 Periodic inspection

A long working life and the interval of inspections , are determined by operating conditions , switching frequency, number of short-circuit breaking operations and environmental influences .

If the installation or operating conditions are more severe than the ones stated in this manual, the inspection interval must be shortened.

To have the guaranty of a good pole insulation , it will be necessary make a periodic careful cleaning , removing all the surface contamination.

The periodic inspections and preventive maintenance intervals, in a normal utilisation, are the following:

- **After 1 year or 2 000 switching operations**

Circuit-breaker:

- Visual inspection , checking damage signals or corrosion
- Carefully cleaning with a soft dry cloth, removing all the surface dust specially in the poles

Operating mechanism :

- Remove front cover
- Visual inspection , checking for excessive wear in the mechanical components
- Check the condition of lubrication

- **Every 5 years or after 5 000 switching operations**

Circuit-breaker:

- Visual inspection , checking for damage or corrosion signals
- Carefully cleaning of poles surface, removing all the dust from the poles with a soft dry cloth

Operating mechanism:

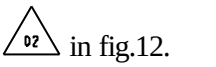
- Remove frontal cover
- Inspection , checking the wear in the mechanical components
- Clean with a cloth soaked in “white-spirit” the operating mechanism before lubrication
- Lubricate the points marked in fig.12 .

- **After 20 years or after 10.000 switching operations**

- Possible replacement of highly stressed parts.
- Possible replacement of vacuum interrupters.

For a more demanding degree of operations (e.g. 30 000 operations), periodic inspections and preventive maintenance intervals will be defined according each request.

7.4 Lubrication

Lubricate with a thin layer of Mobilgrease Special from Mobil the points marked with  in fig.12.

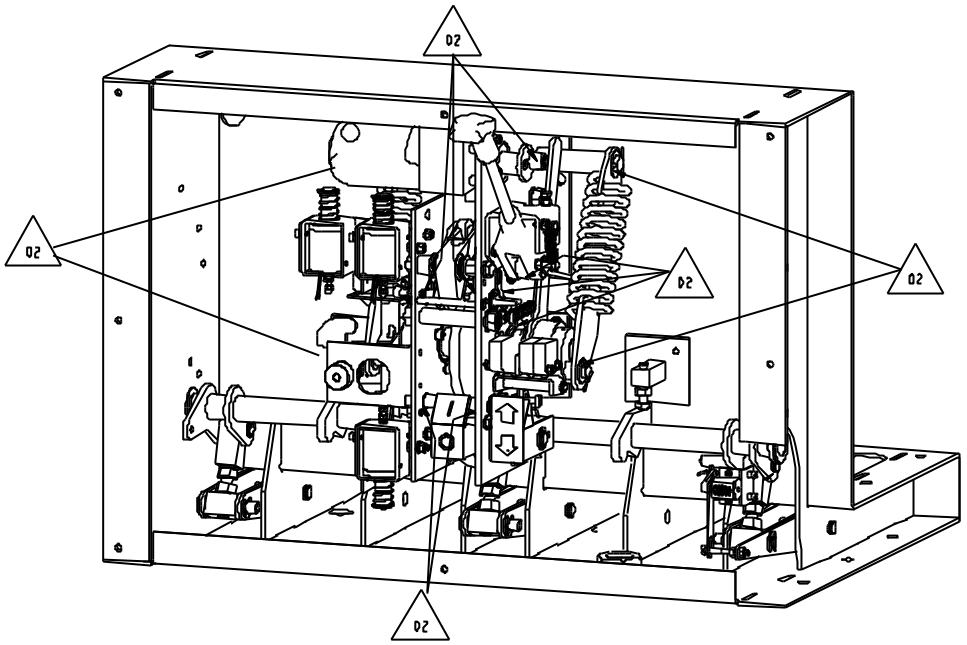


fig. 12

7.5 Replacement parts

The parts, signalled with * at the table, replacement must be performed by EFACEC Medium Voltage Switchgear Division - After-Sales department personnel.

Orders for replacement parts request the following information:

- All the information of circuit-breaker nameplates (type of circuit-breaker, serial number, work order ,etc.)
- Reference number (like Tab. II) and desired parts quantity
- Voltage source value and kind of current (d.c. or a.c.) of auxiliary circuits

Code		***Description***
1	*	Complete pole
2	*	Closing solenoid
3	*	Opening solenoid
4	*	Additional opening solenoid
9		Undervoltage tripping solenoid (AFT)
6		Recharging motor
7		Recharging motor fuse
8		Anti-pumping relay
9		Auxiliary contacts block
10	*	Damper
11		Closing interlock
12		Auxiliary contacts

Tab. II - Replaceable parts

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