

# V-Contact VSC

## Installation and service instructions

### 7.2/12 kV - 400 A

This instruction booklet refers to the following models:  
VSC/F-VSC/FN-VSC/P-VSC/PG-VSC/PN-VSC/PNG  
VSC-S/F-VSC-S/G-VSC-S/PG-VSC-S/PNG

For your safety!	1		
I. Introduction	2		
II. Programme for environmental protection	2		
III. Application of the standards for X-ray emission	3		
IV. Safety information	3		
V. Qualified personnel	3		
VI. Interventions in the field	3		
1. Description	4		
1.1. "MAC" magnetic drive	4		
1.2. Versions available	5		
1.3. Characteristics	6		
1.4. Weights and overall dimensions	6		
1.5. Performances	8		
1.6. Contactor auxiliary contacts	8		
1.7. Compliance with Standards	9		
1.8. Protection against short-circuit	9		
2. Checking on receipt	10		
3. Handling	11		
3.1. Handling and lifting using a crane	12		
4. Storage	13		
5. Installation	14		
5.1. General	14		
5.2. Installation and operating conditions	14		
5.3. Normal conditions	14		
5.4. Special conditions	14		
5.5. Overall dimensions	15		
5.6. Assembly and making the connections	21		
5.7. Description of the closing and opening operations	30		
5.8. Manual emergency opening operation	33		
6. Putting into service	34		
6.1. General procedures	34		
6.2. Racking the VSC/P contactor in and out	35		
7. Maintenance	36		
7.1. General	36		
7.2. Handling the MAC-R2 electronic card	36		
7.3. Inspection	37		
7.4. Servicing	38		
		7.5. Servicing following a short-circuit or overload	38
		7.6. Repairs	38
		7.7. Instructions for dismantling or replacing fuses	39
		7.8. Replacement of the contactor fuses	40
		7.9. Mounting and dismantling the short-circuit busbar	43
		7.10. Putting the contactor back into service	43
		7.11. Checking the degree of vacuum of the interrupter	43
		8. Spare parts and accessories	44
		8.1. List of spare parts	44
		9. Product quality and environmental protection	44





# 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, operation 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 danger 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.**

## I. Introduction

The instructions in this manual refer to the fixed and withdrawable versions of the VSC series of contactors. For correct use of the product, please read it carefully.

For the electrical and construction characteristics and the overall dimensions of the V-Contact VSC contactors, please also see technical catalogue 1VCP000165.

Like all the apparatus we manufacture, the V-Contact vacuum contactors are designed for different installation configurations. Furthermore, this apparatus allows further technical and construction modifications (at the customer's request) to adapt to special installation requirements. Consequently, this manual may not provide information concerning special configurations of the apparatus.

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 standardised configurations.

Only use original spare parts for maintenance operations. The use of non-original spare parts can cause hazardous malfunctions and the apparatus warranty will no longer be valid.

Please refer to the technical sheets of the Kits for correct assembly of the accessories and/or spare parts. For further information, also see the 1VCP000165 technical catalogue of the contactor and the spare parts catalogue.

This manual and all the enclosed drawings must be considered an integral part of the apparatus. They must be easily to hand at all times for revision and reference.

These instructions do not intend to cover all the details, configurations or variants of the apparatus, storage or installation. For this reason, the information given below may sometimes not contain the instructions regarding special configurations. This does not relieve the user from their responsibility for using good technical working practices in application, installation, service and maintenance of the apparatus purchased. Should further information be required, please contact ABB.



**WARNING**



**Dangerous voltages. Risk of death, serious injury to people, damage to the apparatus or other objects.**

**Before carrying out any maintenance operations, turn the power supply off and earth the apparatus.**

**Read and understand this instruction manual before installation, service or maintenance of the apparatus.**

**Maintenance must only be carried out by skilled personnel.**

**The use of unauthorized spare parts for repairs to the apparatus, modification of the apparatus itself, or tampering by unskilled personnel creates hazardous conditions which may cause death or serious injury to people, or damage to the apparatus or other objects. Carefully follow all the safety instructions given in this manual.**

## II. Environmental protection programme

The V-Contact VSC vacuum contactors 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.

### III. 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 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  $\mu\text{Sv/h}$ . It follows that:

- at the rated service voltage the use of vacuum interrupters is absolutely safe;
- application of the withstand voltage at power frequency, according to the IEC 62271-1 Standard, is safe;
- application of a voltage higher than the withstand voltage at power frequency or of a direct current test voltage, specified in the IEC Standard, cannot be used;
- limitation of the above-mentioned local phenomena, on interrupters with open contacts, depends on keeping the specified distance between the contacts. This condition is intrinsically guaranteed by correct operation of the drive and by transmission system adjustments.

### IV. Safety information

All the installation, putting into service, running and maintenance operations must be carried out by suitably qualified personnel with in-depth knowledge of the apparatus. Make sure that the personnel working on the apparatus have this manual to hand and all the information required for correct intervention.

Strictly follow the information given in this instruction manual.

Make sure that during the installation, service and maintenance stages the standard and legal requirements for constructing the installations in accordance with the regulations for safety in the workplace are respected.

Check that the rated performance of the apparatus is not exceeded during service.

### V. Qualified personnel

For the purposes of this manual and the product rating plates, a qualified person is intended as a person who:

- 1) carefully reads the instruction manual all the way through.
- 2) has in-depth knowledge of the installation, construction and service of the apparatus and knows about the risks connected with any interventions.
- 3) is qualified and authorised to energise, de-energise, earth and identify the circuits according to the safety procedures and the local regulations in force.
- 4) is qualified and authorised to put this apparatus into service, and to carry out maintenance and repair operations on it.
- 5) is trained in correct use of protective equipment, such as rubber gloves, hard hats, protective goggles, face shields, flameproof clothing, etc. according to the safety procedures and the local regulations in force.
- 6) is trained in first-aid procedures.

### VI. Interventions in the field

ABB can provide competent and well-trained personnel for assistance in the field to give technical guidance and consultancy regarding installation, full servicing, repair and maintenance of apparatus.

# 1. Description

The medium voltage V-Contact VSC contactors are pieces of apparatus suitable for operating in alternating current and are normally used to control users requiring a high number of hourly operations.

The basic contactors consist of:

- moulded polyester resin monobloc containing the vacuum interrupters
- bistable electromagnet actuator
- multi-voltage feeders
- auxiliary contacts
- mechanical status indicator (open/closed)
- manual emergency opening device.

Apart from what is specified for the fixed contactors, the withdrawable contactors also consist of:

- fuseholders preset for DIN or BS fuses (according to the customer's requirements)
- automatic opening device for intervention of even a single fuse
- truck
- lock which prevents closing during the racking-in/out operation.

The V-Contact VSC contactor introduces the drive with permanent magnets - already widely used, experimented and appreciated in medium voltage circuit-breakers - into the worldwide panorama of medium voltage contactors.

The experience acquired by ABB in the field of medium voltage circuit-breakers fitted with drives with "MABS" permanent magnets, has made it possible to develop an optimised version of the actuator (Bistable MAC drive) for medium voltage contactors.

The drive is operated by means of an electronic feeder able to cover all the power supply voltages required by the major international Standards.

## 1.1. "MAC" magnetic drive

Based on the experience gained in the field of circuit-breakers with magnetic drive, ABB has implemented this technology in the field of contactors.

The magnetic drive adapts perfectly to this type of apparatus thanks to its precise and linear travel.

This means that a simple and direct axial transmission of the movement to the moving contacts of the vacuum interrupter can be realised, with both electrical and mechanical benefits.

The drive, which is of bistable type, is fitted with an opening and a closing coil.

The two coils - individually energised - allow the drive core to be moved from one of the two stable positions to the other.

The drive shaft is solid with an iron core which is immersed and held in position in a field generated by two permanent magnets (fig. A).

Energising the coil opposite to the magnetic latching position (fig. A) of the core, the magnetic field (fig. B) is generated, which attracts and moves the core into the opposite position (fig. C).

Every opening and closing operation creates a magnetic field concordant with the one generated by the permanent magnets, with the advantage, during service, of keeping the intensity of the field itself constant as the number of operations carried out increases.

The energy needed for operation is not supplied directly by the auxiliary power supply, but is always "stored" in the capacitor which acts as an energy accumulator, and therefore operation always takes place with constant speeds and times, regardless of the divergence of the power supply voltage from the rated value.

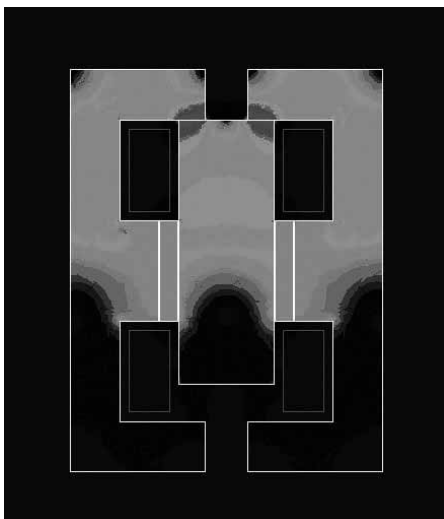


Fig. A  
Magnetic circuit in the closed position.

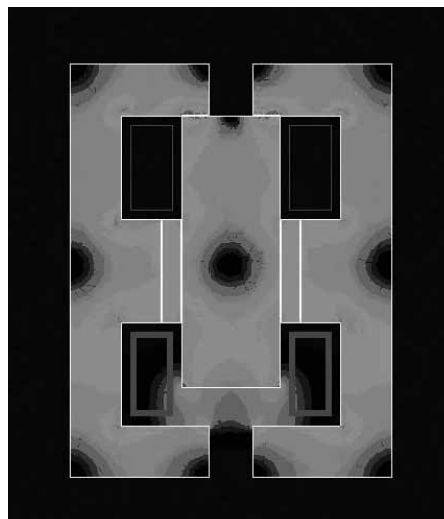


Fig. B  
Magnetic circuit with opening coil supplied.

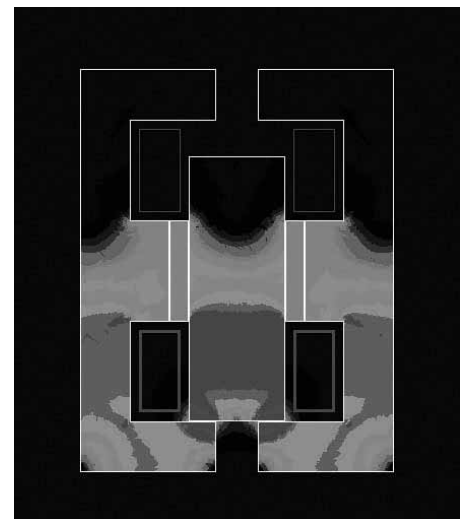


Fig. C  
Magnetic circuit in the open position.

The auxiliary power supply only has the aim of keeping the capacitor charged.

Consumption is therefore minimal.

The power required by the electronic device is indicated in the table below:

Power supply voltage	Starting (1)		After closing	After opening	Continuous power consumption
	Inrush for 2 ms	Inrush for 6 sec	Inrush for 1.2 sec	Inrush for 1.2 sec	
24...60 V cc 110...250 V cc	42 A (2)	35 W	25 W	30 W	5 W
110...250 V ac					

(1) This value refers to a discharged capacitor.

(2) The value drops to 8 A for voltage values between 24...30V

Supply from voltage transformer or from UPS (Uninterrupted Power System) not available.

Use the ABB S282UC-C3 thermal-magnetic circuit-breaker or an equivalent type to protect the secondary circuits.

After powering, the electronic board takes 15 seconds to perform self-diagnosis and then prepares for normal operation, depending on the configuration. Do not operate the contactor during this phase. Contact DO1 will remain open, signal “not ready” and will only close after self-diagnosis has terminated (“ready” state).

Careful selection of the components and a precise design make the electronic multi-voltage feeder extremely reliable, unaffected by electromagnetic interference generated by the surrounding environment and free of any emissions which may affect other apparatus placed in the vicinity.

These characteristics have made it possible for the V-Contact VSC contactors to pass the electromagnetic compatibility tests (EMC).

## 1.2. Versions available

The V-Contact VSC are available in:

- fixed version without fuseholder
- fixed versions with fuseholder: VSC/F e VSC/FN.
- four withdrawable versions with fuseholder:
  - VSC/P (IEC) and VSC/PG or VSC-S/PG (IEC/GB-DL) withdrawable versions for UniGear, PowerCube, CBE and PowerBloc with manual or motorized truck
  - VSC/PN (IEC) and VSC/PG or VSC-S/PNG (IEC/GB-DL) both versions withdrawable for UniGear MCC with manual truck.

## 1.3. Characteristics


Contactor		Reference IEC 62271-106	VSC7 VSC7/F <sup>(1)</sup> VSC7/P <sup>(1)</sup> VSC7/PN <sup>(1)</sup> VSC7/FN	VSC12 VSC12/F <sup>(1)</sup> VSC12/P <sup>(1)</sup> VSC12/PN <sup>(1)</sup>
Rated voltage	[kV]	4.1	7.2	12
<b>Rated insulation voltage</b>				
Withstand voltage at 50 Hz	[kV]	6.2	23	28
Impulse withstand voltage	[kVbil]	6.2	60	75
Rated frequency	[Hz]	4.3	50-60	50-60
Rated service current	[A]	4.101	400	400
<b>Short-time withstand current</b>				
Short-time withstand current for 1 s	[A]	6.6	6,000	6,000
Short-time withstand current for 2 s	[A]			
Short-time withstand current for 4 s	[A]			
Short-time withstand current for 30 s	[A]	6.6	2,500	2,500
Rated peak current	[kA]	6.6	15	15
<b>Rated values</b>				
Operations / hour (SCO - DCO)	[Nr.]	4.102.4	1,200	1,200
Rated voltage of the voltage characteristics in category of use				
(Category AC4) 100 closing operations	[kA]	6.102.4	4,000	4,000
(Category AC4) 25 opening operations	[kA]	6.102.5	4,000	4,000
<b>Switching devices and auxiliary circuits</b>		4.8, 4.9		
Feeder 1 24÷60 V dc basic			•	•
Feeder 2 24÷60 V dc full option			•	•
Feeder 3 110÷250 V dc/ac basic			•	•
Feeder 4 110÷250 V dc/ac full option			•	•
Normal current	[A]	6.4.6.5	400	400
Mechanical life	[Nr.]	6.101	1,000,000 <sup>(2)</sup>	1,000,000 <sup>(2)</sup>
Short-circuit breaking capacity (O-3min-CO-3min-CO)	[A]	6.104	5,000	5,000
Short-circuit making capacity (O-3min-CO-3min-CO)	[A]	6.104	13,000	13,000
Opening time	[ms]		35..60	35..60
Closing time	[ms]		60..90	60..90
Tropicalisation		IEC 721-2-1	•	•

(1) It is possible to combine current limiting fuses with breaking capacity up to 50 kA (IEC 62271-106 - 4.107) - Damage classification "C" (IEC 62271-106 - 4.107.3).

(2) With replacement of auxiliary contacts every 250,000 closing-opening operations.

(3) 42 kV for fixed versions and in dedicated Unigear switchgear

## 1.4. Weights and overall dimensions

Contactor		VSC7	VSC12 VSC-S/G	VSC7/F	VSC7/FN	VSC12/F VSC-S/F
Weight	[Kg]	23	23	35 <sup>(1)</sup>	35 <sup>(1)</sup>	35 <sup>(1)</sup>
Overall dimensions	 [mm] H	371	424	494	598	532
	[mm] W	350	350	466	466	466
	[mm] D	215	215	622	623	702

(1) Without fuses



Reference		VSC7/PNG (1)	VSC12/PNG (1)	VSC-S/G VSC-S/F (1) VSC-S/PG (1) VSC-S/PNG (1)
GB/T 14808-2001	DL/T 593-2006			
4.1		7.2	12	12
6.2	•	32	42	28 (2)
6.2		60	75	75
4.3		50-60	50-60	50-60
4.101		400	400	250
			6,000	600
6.6		4,000	4,000	
	•	4,000	4,000	
6.6		2,500	2,500	2,500
6.6		15	15	15
4.102.2		1,200	1,200	1,200
6.102.4		4,000	4,000	
6.102.5		4,000	4,000	
4.8, 4.9		•	•	•
		•	•	•
		•	•	•
		•	•	•
6.4, 6.5		400	400	400
6.101		1,000,000 (2)	1,000,000 (2)	200,000
6.104		5,000	5,000	-
6.104		13,000	13,000	-
		35...60	35...60	35...60
		60...90	60...90	60...90
•		•	•	•

VSC7/P	VSC12/P - VSC12/PG VSC-S/PG	VSC7/PN	VSC7/PNG	VSC12/PN	VSC12/PNG VSC-S/PNG
52 (1)	52 (1)	45 (1)	45 (1)	45 (1)	45 (1)
636	636	653	653	653	653
531	531	350	350	350	350
657	657	673	673	673	673

## 1.5. Performances

<b>Contactor</b>		VSC7 VSC7/F VSC7/P VSC7/PN VSC7/PNG VSC7/FN		VSC12 VSC12/F VSC12/P VSC12/PN VSC12/PNG		
Rated voltage	[kV]	2.2/2.5	3.6	3.6/7.2	6.2/7.2	12
<b>Ultimate performances for:</b>						
Motors	[kW]	1,000	1,500	1,500	3,000	5,000
Transformers	[kVA]	1,100	1,000	2,000	4,000	5,000
Capacitors	[kVAR]	1,000	1,500	1,500	3,000	4,800 (!)

<b>Contactor</b>		VSC-S/G VSC-S/F VSC-S/PG VSC-S/PNG				
Rated voltage	[kV]	2.2/2.5	3.6	3.6/7.2	6.2/7.2	12
<b>Ultimate performances for back-to-back capacitors banks</b>						
Rated current	[A]	250	250	250	250	250
Max. transient current of the capacitor	[kA]	8	8	8	8	8
Max. transient frequency of the capacitor	[kHz]	2.5	2.5	2.5	2.5	2.5
(1) Overvoltage surge arresters are compulsory between phases and between phase and earth.						

## 1.6. Contactor auxiliary circuits

10 auxiliary contacts (5 normally open and 5 normally closed) are available on the contactor for the customer's use, with the following characteristics.

<b>Auxiliary contacts characteristics</b>		
Rated voltage	24 ... 660	V
Rated normal current	10	A
Rated short time current (30 ms, 20 times)	100	A
Rated frequency (for AC only)	50	Hz
Rated insulation voltage (DC)	800	V
Rated insulation voltage (AC)	660	V
Insulation test voltage	2500	V
Number of contacts	5	-
Stroke	6 ... 7	mm
Maximum contact resistance	10	mΩ
Storage temperature range	-20 ... +120	°C
Operating temperature range	-20 ... +70	°C
Temperature rise of contacts	30	K
Breaking capacity (single contact $\tau = 20$ ms, 250 V dc)	250	W
Breaking capacity (single contact $\tau = 20$ ms, 110 V dc)	440	W
Breaking capacity (two contacts in series $\tau = 20$ ms, 250 V dc)	440	W

## Characteristics of the contacts of the “Coil Continuity Control” and “Capacity Survey” devices

<b>Technology</b>	Relay with air-insulated contacts
<b>Breaking characteristics:</b>	
Maximum breaking power	1200 VA (on resistive load)
Maximum breaking voltage	277 V AC, 30 V DC
Maximum breaking current	3 A
Rated current	5 A @ 4 s
<b>Contact characteristics:</b>	
Maximum resistance with contact open	150 mohm (measure of voltage drop 6 V DC 1)
Maximum capacity	1.5 pF
<b>Trip times:</b>	
During closing	5.0 ms
During release	2.0 ms
<b>Insulation:</b>	
Between contacts and coil	3000 V rms (50 Hz / 1 min.)
Between open contacts	750 V rms (50 Hz / 1 min.)
Resistance with contacts open	Min. 103 Mohm at 500 V DC

### 1.7. Compliance with Standards

V-Contact contactors comply with the Standards of the major industrialised countries and in particular with the following Standards:

- IEC 62271-106 (2011);
- IEC 62271-1 (2007);
- GB/T 14808-2001;
- DL/T 593-2006;
- IEC 60278 replaced by IEC 62271-200;
- IEC 60694 (2002) replaced by IEC 62271-1;
- IEC 60056 (4.104) replaced by IEC 62271-100;
- IEC 60470 replaced by IEC 62271-106.

### 1.8. Protection against short-circuit

The value of the installation short-circuit current could exceed the breaking capacity of the contactor. The contactor must therefore have adequate protection against short-circuit.



**Fuse replacement must only be carried out by qualified personnel.**

## 2. Checking on receipt



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

Any operation carried out on the contactor must be done without the presence of voltage and with the main protection device open: danger of electrocution and/or severe burns.

Make sure that operations are carried out with the main and auxiliary power off.

On receipt, immediately check integrity of the packing and the colour of the "SHOCKWATCH" indicator (Fig. 1) placed on it. If the "SHOCKWATCH" impact indicator is WHITE, it means that the packing has not received any notable shocks during transport. Open the packing, remove the contactor as indicated below, and check the state of the apparatus and its correspondence with the nameplate data (see fig. 2) with what is specified in the accompanying shipping note and in the order confirmation sent by ABB.

If the "SHOCKWATCH" impact indicator is RED, follow the instructions indicated on the plate.

Opening the packing does not damage its components and it can therefore be re-instated using the original material. The contactor 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. To remove the contactor from the packing, proceed as follows:

- open the plastic bag
- remove the contactor, avoiding any stress to the functional insulating parts and the terminals of the apparatus.
- use the special lifting plates for the withdrawable version
- check the rating plate characteristics to make sure that the performances are suitable for the destined application and that they are those indicated in the order confirmation.

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.

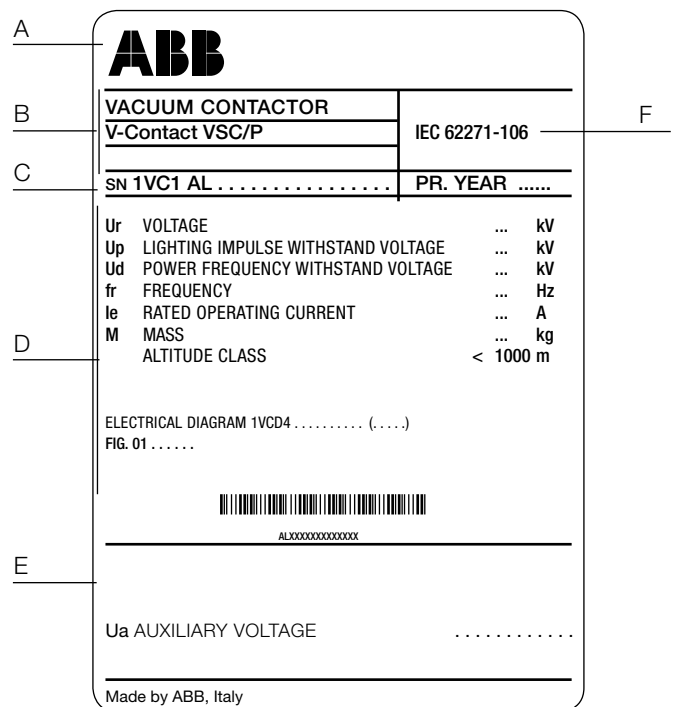
The accompanying documents inserted in the shipping packing are:

- instruction manual (this document)
- test certification
- identification label
- fiscal copy of the shipping advice note
- electric wiring diagram.



Shock indicator

Fig. 1



- A Trademark
- B Type of apparatus
- C Serial number
- D Characteristics of the apparatus
- E Characteristics of the control auxiliaries
- F Reference standards

Fig. 2

Other documents which are sent prior to shipment of the apparatus are:

- order confirmation
- original shipping advice note
- any drawings or documents referring to special configurations/conditions.

# 3. Handling

The contactor can be lifted using a lifting truck or a fork-lift truck.

The following precautions must be taken during contactor handling:

1. Keep the contactor in the upright position.
2. Make sure that the load is balanced on the truck or on the transport plate/pallet.
3. Interpose protective material between the contactor and the truck to avoid any damage or scratches.
4. Fix the contactor onto the truck or onto the transport plate/pallet to prevent it moving or tilting over.
5. Avoid excessive speed, sudden starts and stops or sharp changes in direction during contactor handling.
6. Only lift the contactor enough to avoid any obstacles on the floor.
7. Take care to avoid any impacts with structures, other apparatus or with personnel when handling the contactor.
8. Never lift a contactor over an area where there are people.
9. During handling of the apparatus, do not stress the insulating parts and the contactor terminals.

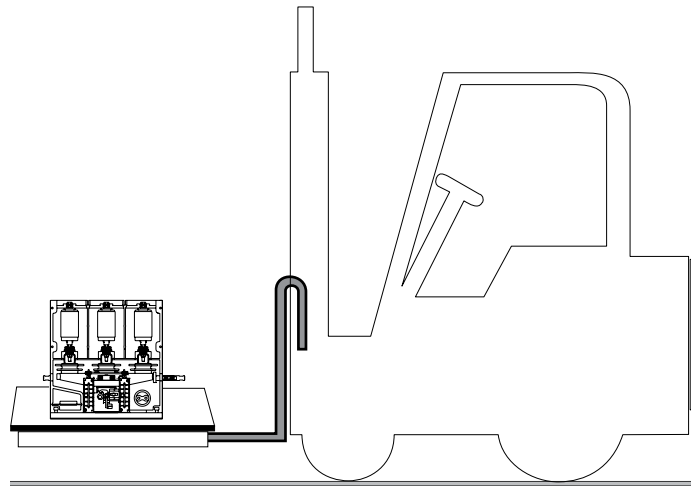


Fig. 3a - Handling using a lifting or fork-lift truck.

### 3.1. Handling and lifting using a crane

- Insert the lifting plates
- Lift
- After the unpacking and lifting operations, remove the lifting accessories.

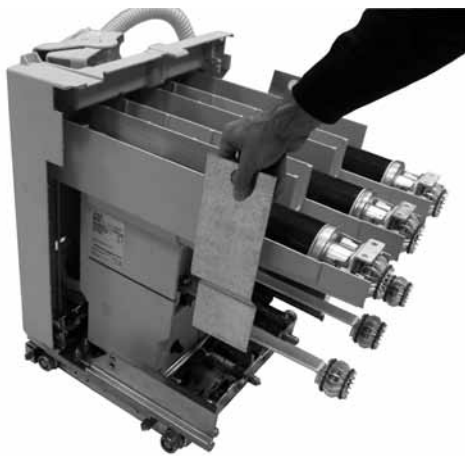
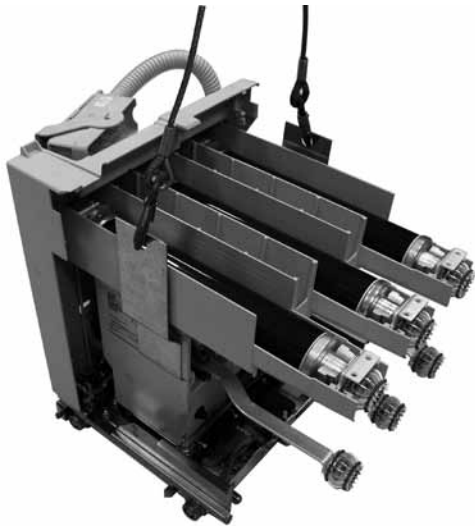
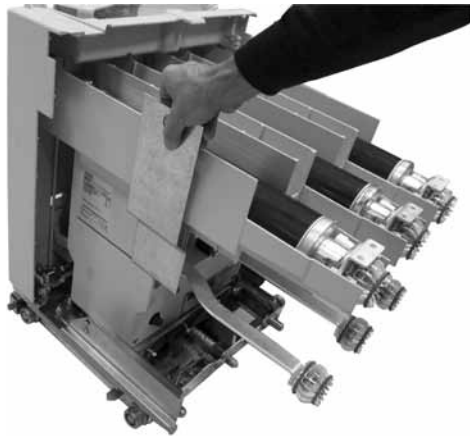


Fig. 3b - Removal of the contactor from the packing and dismantling the lifting tools.

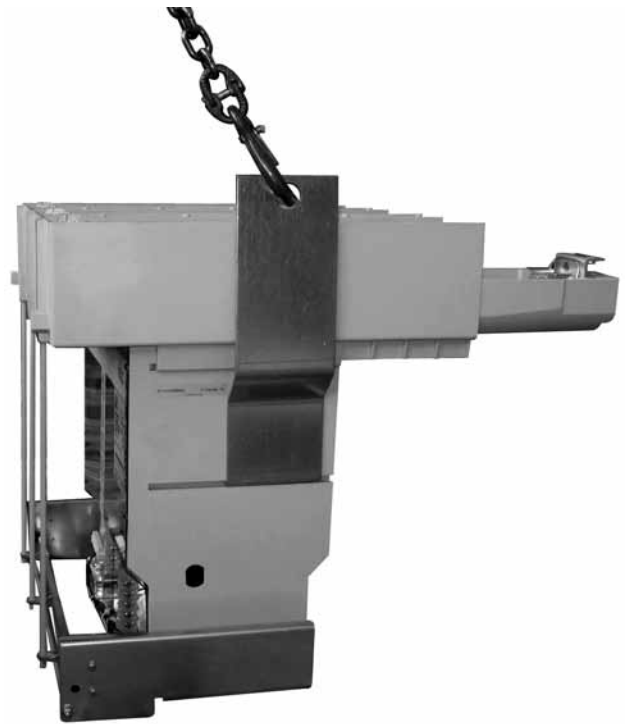


Fig. 3c - Fixed contactor with fuses



Fig. 3d - Withdrawable contactor

# 4. Storage

When a period of storage is foreseen, the original packing must be put back. Store the contactor in a dry dust-free area. It must not be left outside or in adverse micro-climatic conditions: if it is left without protection, rust and deterioration of the insulation can occur.

Insert special hygroscopic packets inside the packing, with at least one standard packet per piece of apparatus. Replace the packets approximately every 6 months.

Should the original packing no longer be available and immediate installation is not possible, store in a covered, well-ventilated, dry, dust-free, non-corrosive ambient, with a dry atmosphere, away from any flammable materials and at a temperature between  $-5\text{ }^{\circ}\text{C}$  and  $+40\text{ }^{\circ}\text{C}$ .

In any case, avoid any accidental impacts or positioning which stresses the structure of the apparatus.

# 5. Installation

## 5.1. General

Correct installation is of primary importance. The manufacturer's instructions must be carefully studied and followed. It is good practice to use gloves for handling the pieces during installation.



**The areas involved in the passage of power conductors or conductors of auxiliary circuits must be protected against access of any animals which might cause damage or disservices.**

The contactor enclosure must be installed in a clean, dry and heated place with good ventilation. It must be easily accessible for cleaning and inspection, and must be levelled, placed on the supporting foundations and securely fixed into position.

When the contactor is connected to a capacitive load, make sure that there is a heating element to keep the humidity down and of suitable size for the compartment where the contactor is installed. The contactor must always be installed associated with a suitable protection device (e.g.: fuses).



**The fixed version of the V-Contact VSC contactors must be installed by the customer so as to guarantee a minimum degree of protection of IP2X.**

## 5.2. Installation and operating conditions

The following Standards must be taken into particular consideration during installation and service:

- IEC62271-1/DIN VDE 0101
- VDE 0105: Operation of electrical plants
- DIN VDE 0141: Earthing systems for electrical installations with rated voltage higher than 1 kV
- All the accident prevention regulations in force in the relative countries.

## 5.3. Normal conditions

Follow the recommendations in the IEC 62271-1 and 62271-106 Standards. In more detail:

### Ambient temperature

Maximum	+ 40 °C
Average maximum over 24 hours	+ 35 °C
Minimum (according to class – 5), apparatus for indoor installation	– 5 °C

### 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 water vapour pressure, 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 water vapour pressure, measured for a period longer than 1 month, must not exceed 1.8 kPa

### Altitude

< 1000 m above sea level.

## 5.4. Special conditions

### Installations above 1000 m a.s.l.

Possible within the limits allowed by reduction of the dielectric resistance of air.

For altitudes over 2000 m ask ABB.

### Climate - Increase in temperature

In order to avoid the risk of corrosion or other damage in areas with high humidity and/or rapid large fluctuations in temperature, take appropriate measures (for example, using suitable electric heaters) to prevent any condensation phenomena.

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



## 5.5. Overall dimensions

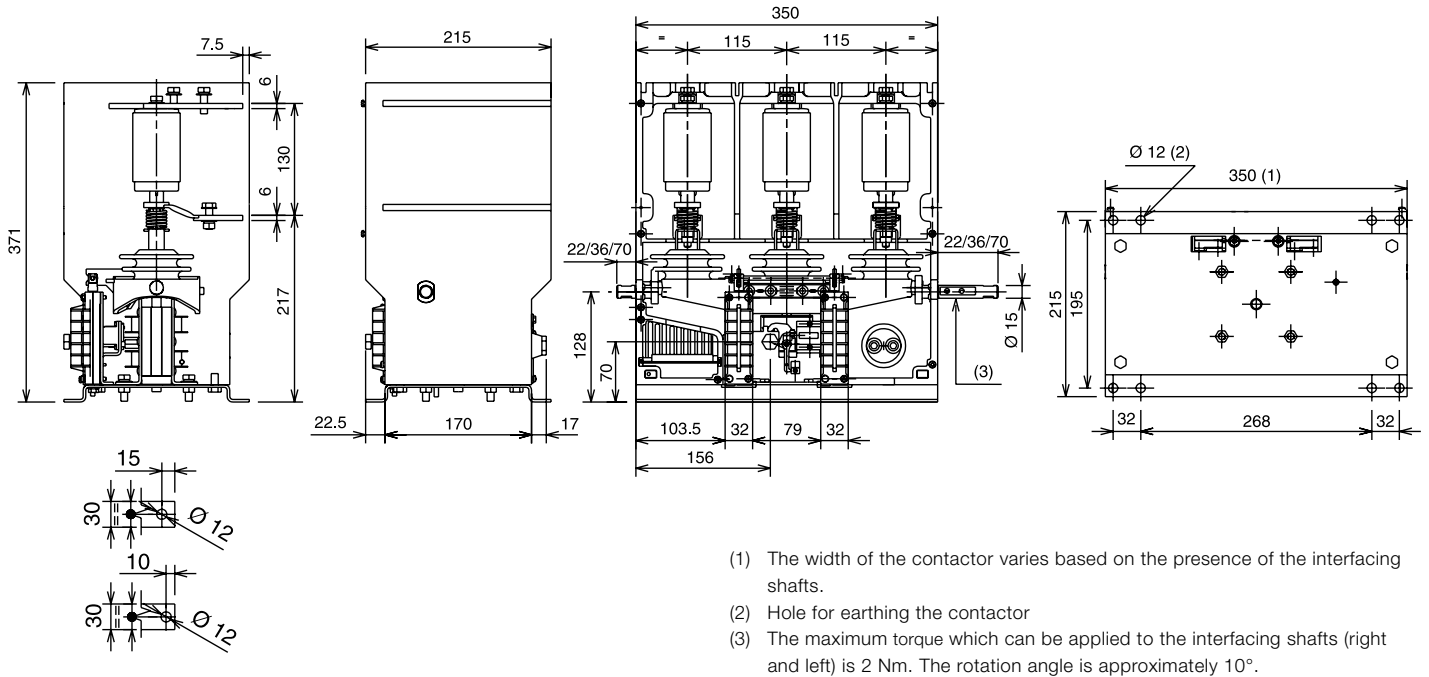
### 5.5.1. VSC fixed contactor

For the overall dimensions and distances between fixing holes, refer to figure 4a.

In any case, avoid stressing the supporting structure of the contactor: if necessary, arrange slots in the fixing area to facilitate correct positioning of the apparatus.

The assembly positions can be selected between the two shown in figure 4b.

#### VSC7



#### VSC12

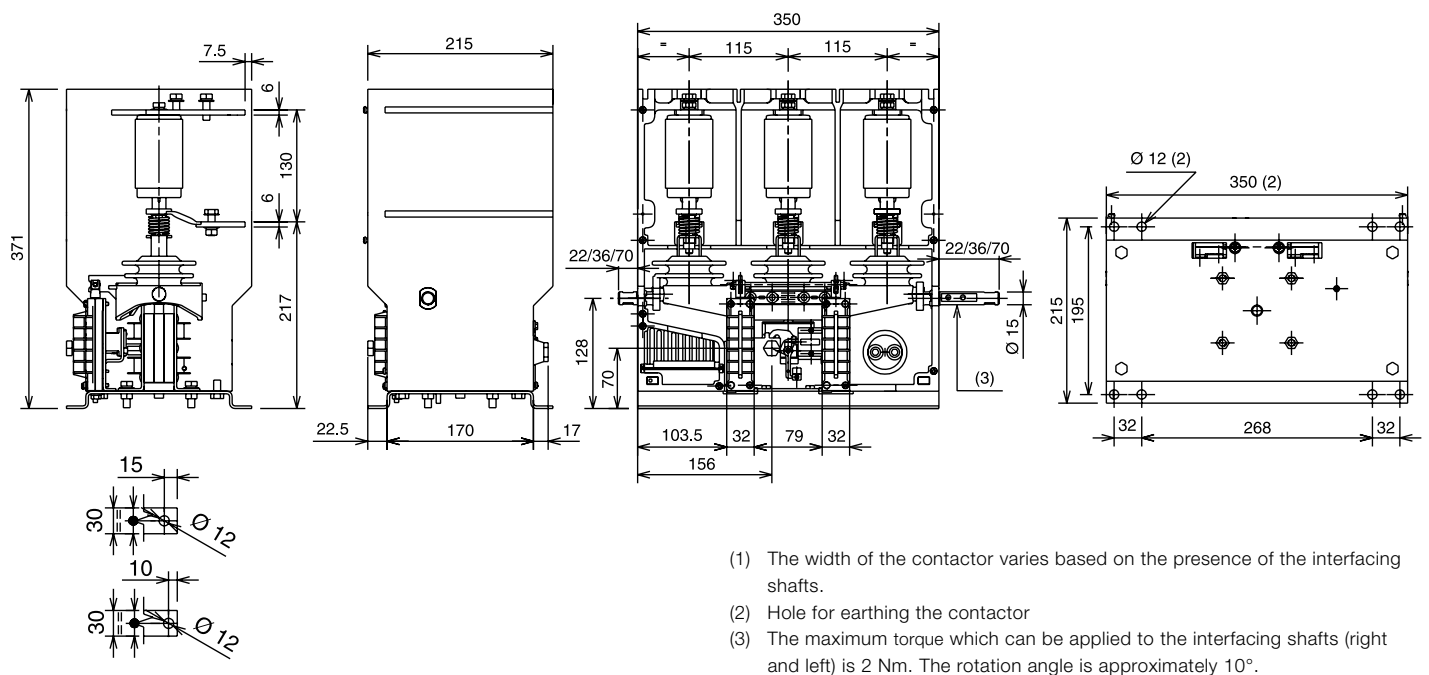


Fig. 4a

## Installation of fixed contactors

The performance of the contactor remains unaltered in the installation positions indicated below:

### VSC 7 - VSC 12

- A) Floor-mounted with moving contacts at the bottom.
- B) Wall-mounted with horizontal moving contacts and terminals at the bottom.
- C) Wall-mounted with horizontal moving contacts and terminals at the top.
- D) Wall-mounted with horizontal moving contacts with interrupters on the front (or rear) with vertical terminals.
- E) Ceiling-mounted with moving contacts at the top.

### VSC 7/F - VSC 12/F - VSC 7/FN

- A) Floor-mounted with moving contacts at the bottom.

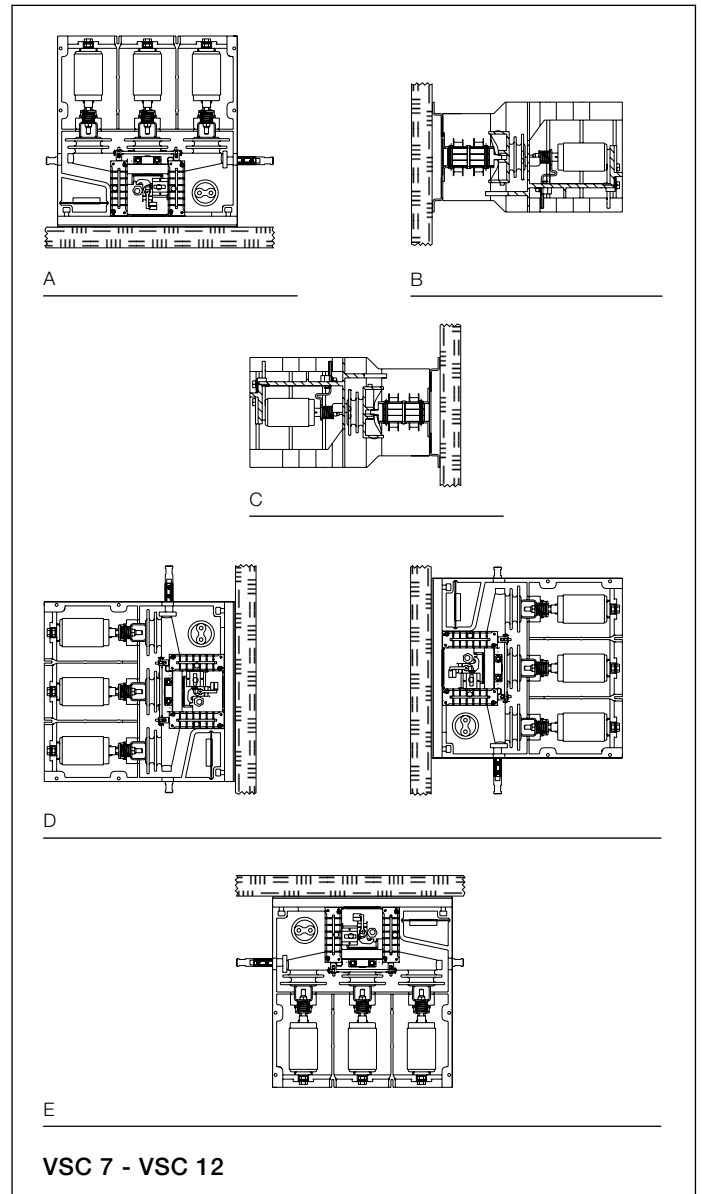


Fig. 4b

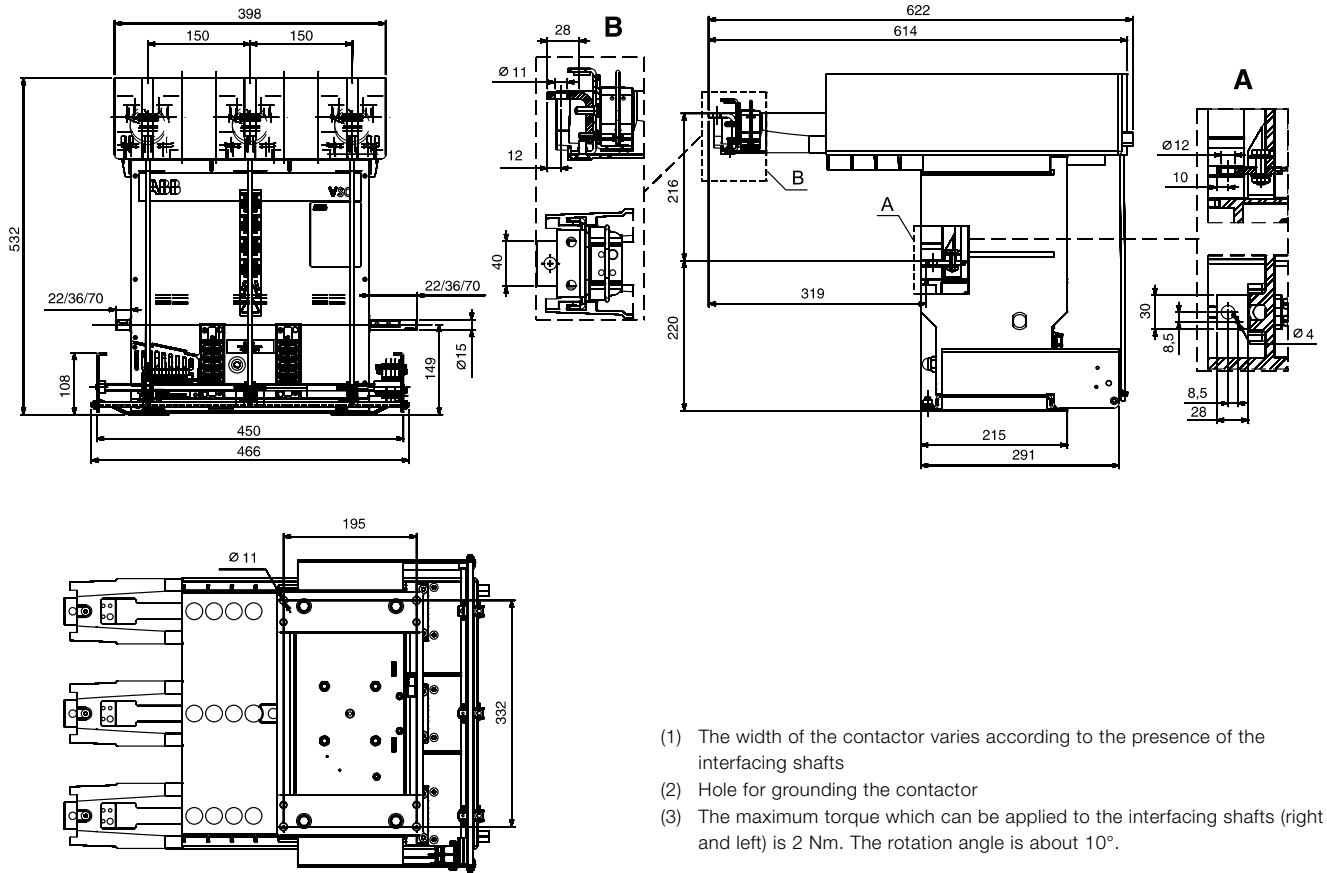
### 5.5.2. VSC/F contactor in fixed version with fuses

Please refer to figures 5a - 5b for the overall dimensions and the distances between the fixing holes.

In any case, avoid stressing the supporting structure of the contactor: if necessary, prepare slots in the fixing area to facilitate correct positioning of the apparatus.

The contactor must be installed on the floor with moving contacts at the bottom (figure 5c).

VSC7/F



- (1) The width of the contactor varies according to the presence of the interfacing shafts
- (2) Hole for grounding the contactor
- (3) The maximum torque which can be applied to the interfacing shafts (right and left) is 2 Nm. The rotation angle is about 10°.

Fig. 5a

VSC7/FN

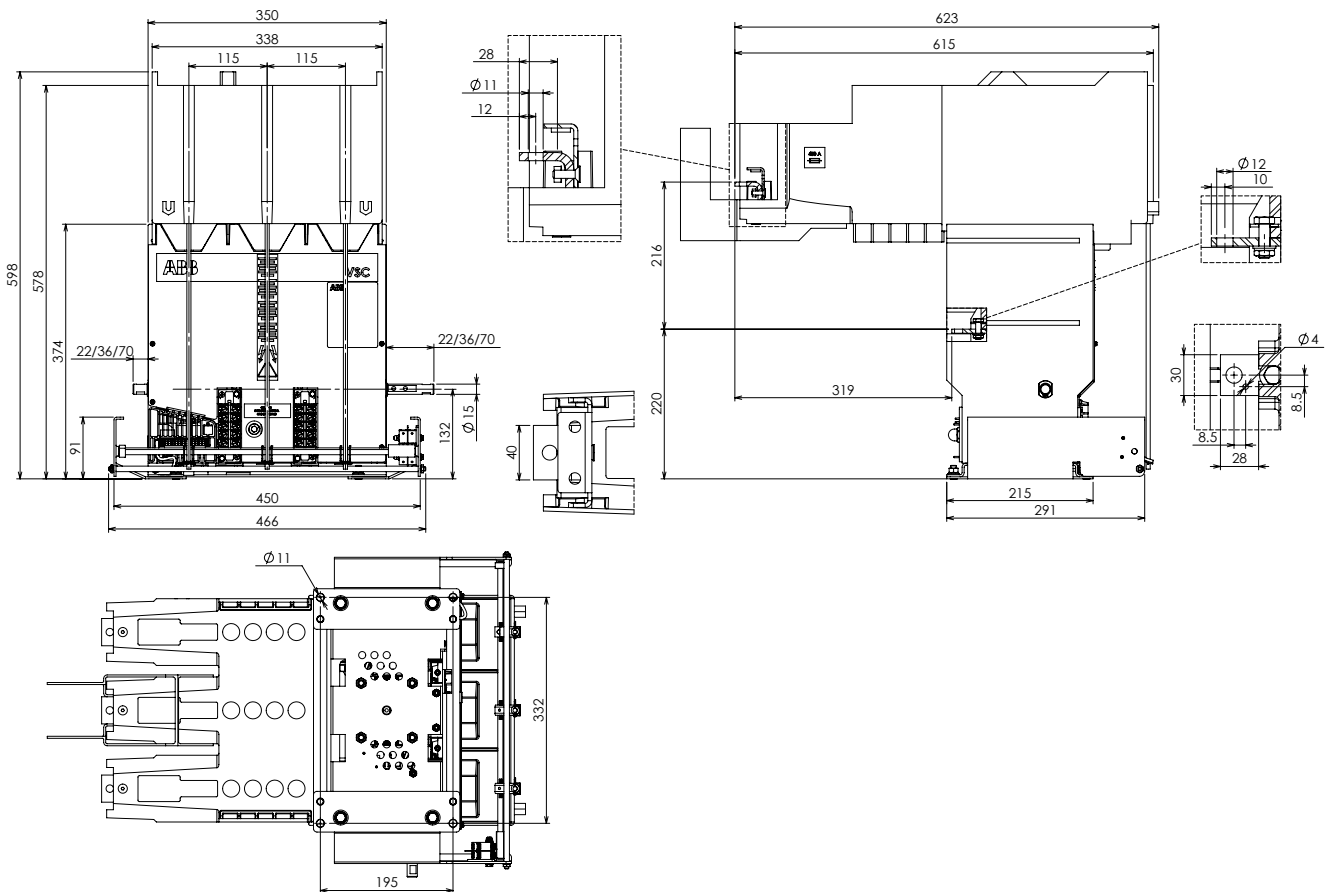
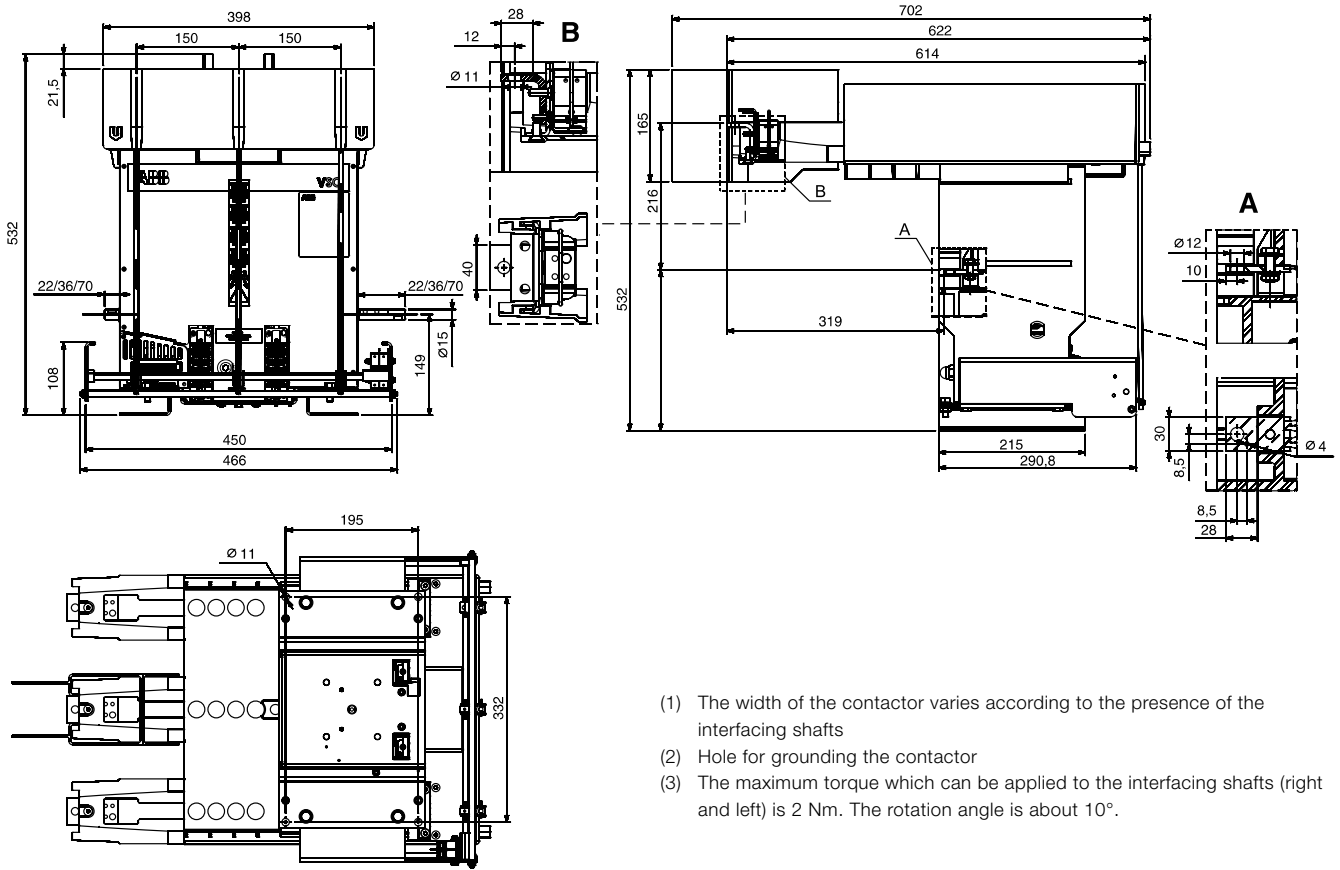


Fig. 5b



- (1) The width of the contactor varies according to the presence of the interfacing shafts
- (2) Hole for grounding the contactor
- (3) The maximum torque which can be applied to the interfacing shafts (right and left) is 2 Nm. The rotation angle is about 10°.

Fig. 5c

Installation of the fixed contactor with VSC/F - VSC/FN fuses

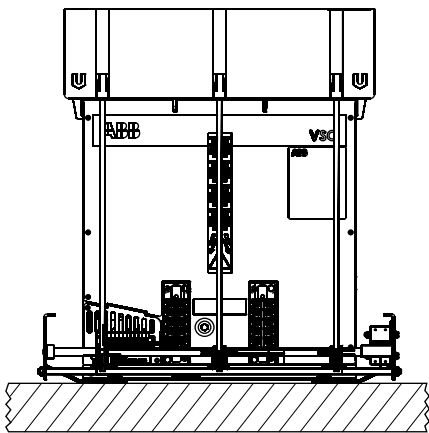


Fig. 5d

5.5.3. Withdrawable contactor with VSC/P - VSC/PG - VSC/PN - VSC/PNG fuses

VSC7/P - VSC7/PG - VSC12/P - VSC12/PG

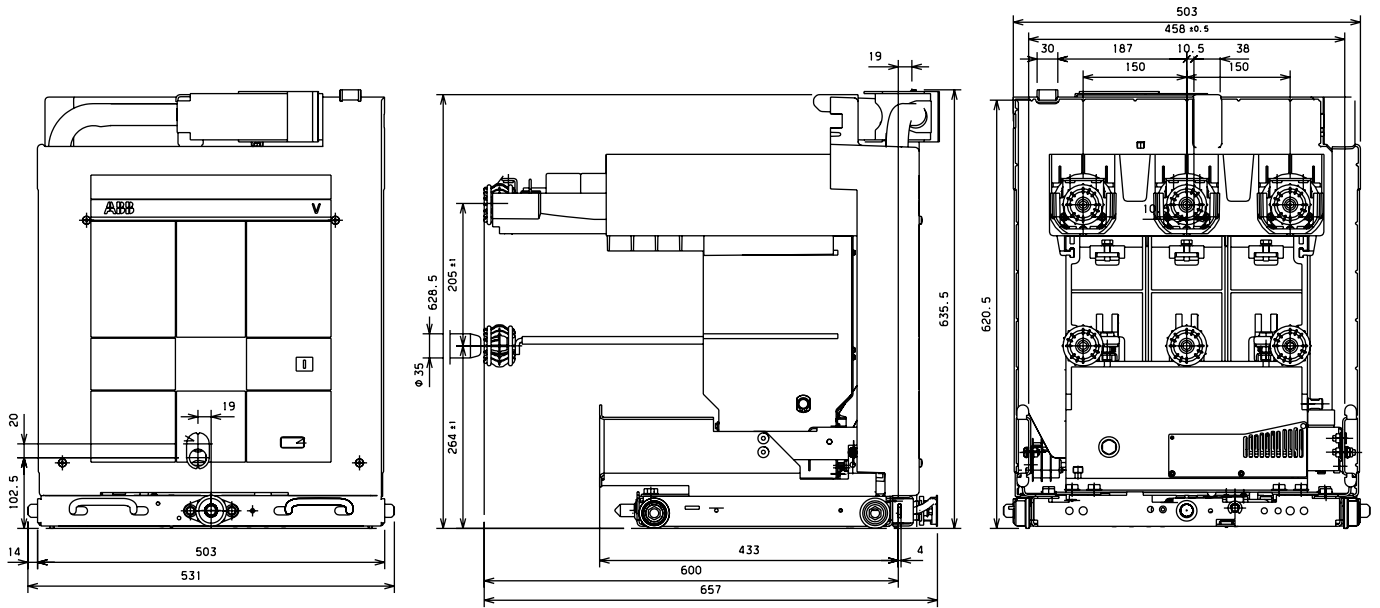


Fig. 6a

VSC7/PN

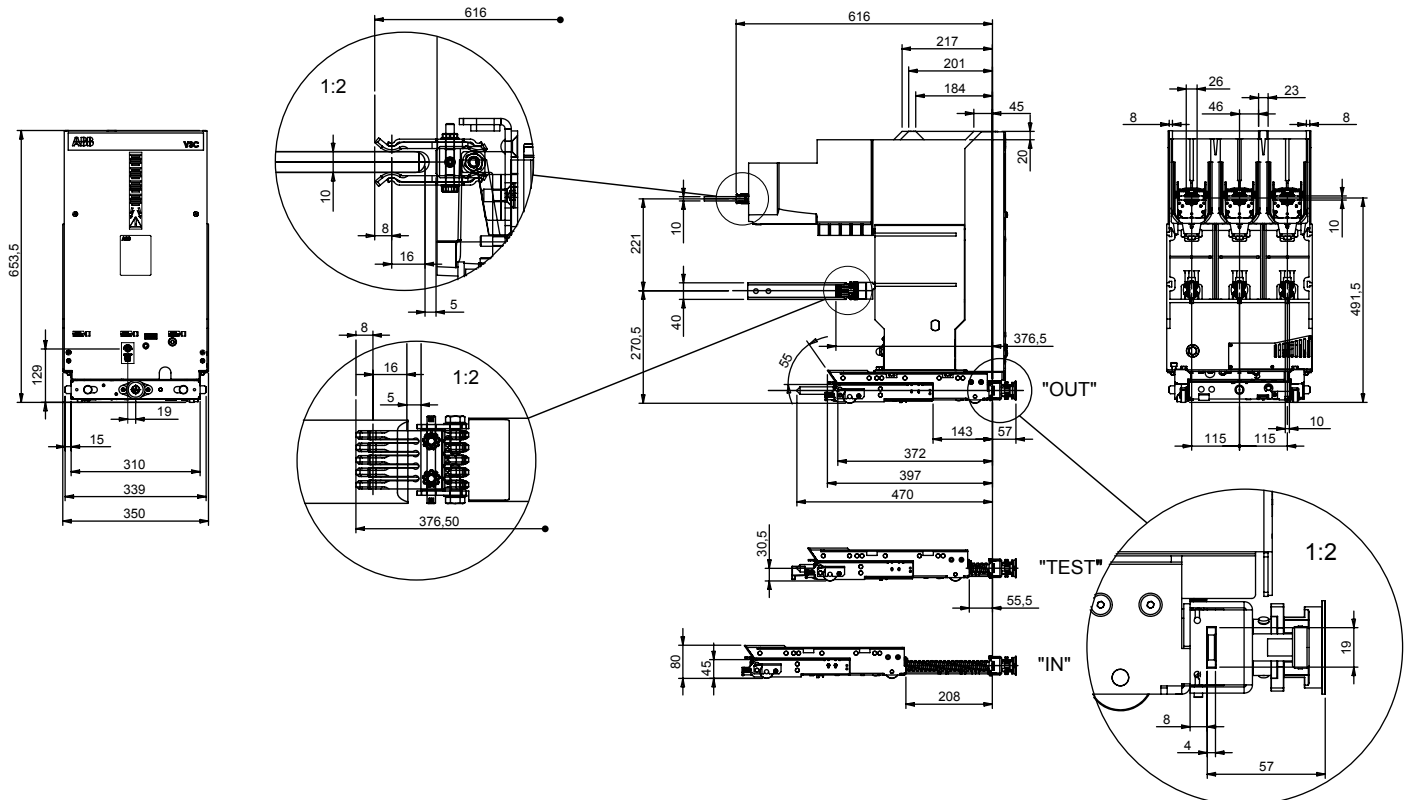
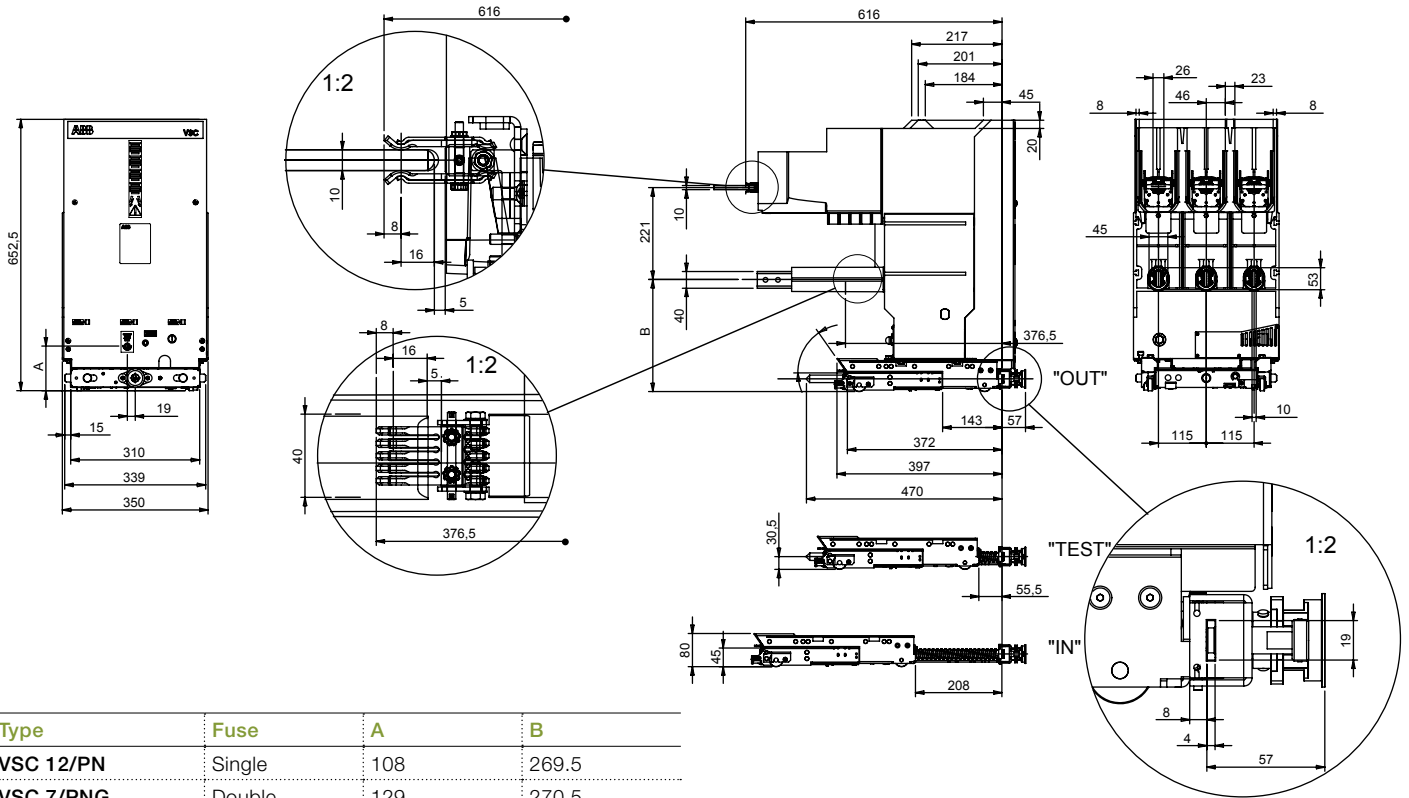


Fig. 6b



Type	Fuse	A	B
VSC 12/PN	Single	108	269.5
VSC 7/PNG	Double	129	270.5
VSC 12/PNG	Double	108	269.5

Fig. 6c

VSC 12/P contactor for marine environments

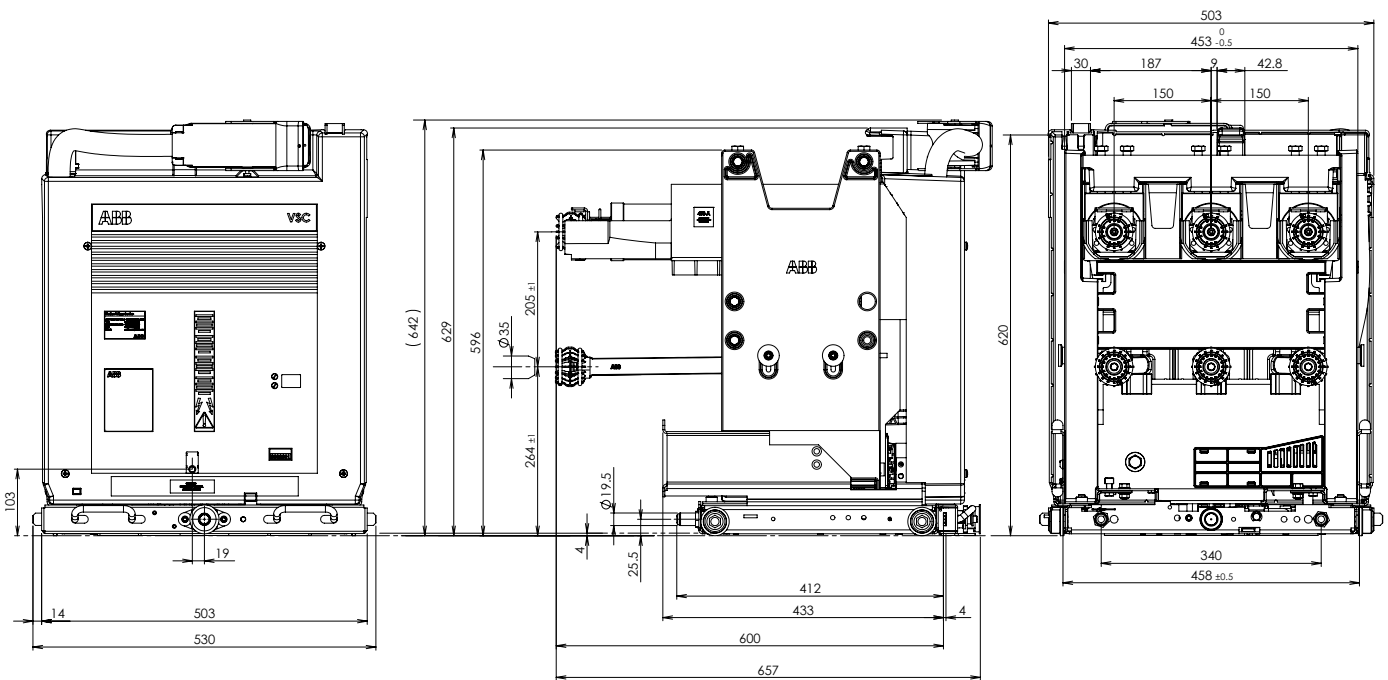




Fig. 6d

## 5.6. Assembly and making the connections

### 5.6.1. Fixed contactors

	<b>WARNING</b>
	<p><b>Dangerous voltages. Risk of death, serious injury to people, damage to the apparatus or other objects.</b></p> <p><b>Remove the power supply, ground and put all the power and control voltage sources under safe conditions before starting the work on this or any other electrical apparatus.</b></p> <p><b>Installation must only be carried out by qualified personnel.</b></p>

#### Introduction

Before carrying out any installation operations:

- Test all the power terminals to check that they are not supplied with voltage. Only use high voltage testing equipment approved for checking the voltage on the power terminals. **Do not attempt to measure the high voltage (above 600 volt) with a volt-ohm/meter.**
- Check all the control and secondary circuit terminals with a voltmeter to ensure that all the control and secondary input voltage sources have been turned off.
- Connect the safety earthing to the power terminals after having turned the power supply to the system off and before working on the apparatus.
- Carry out all the operations for turning off the voltage and earthing according to the established safety procedures.

#### Power circuit

##### General precautions

- Check that the connections of the fixed contactor or the isolating contacts of the withdrawable contactor are clean and free of any deformation caused by shocks received during transport or storage in the warehouse.
- Select the cross-section of the conductors according to the service current and the short-circuit current of the installation.
- Prepare special pole insulators, near the terminals of the contactor, sized according to the electrodynamic forces deriving from the short-circuit current of the installation and avoid stressing the connections laterally.

#### Surface treatment of the connections

The connections can either be made of bare copper or bare aluminium. In any case, it is always advisable to silver-plate the contact surfaces. The surface treatment must have a constant and even thickness.

#### Assembly procedures for fixed contactors

- Check that the contact surfaces of the connections are flat, and are free of any burrs, traces of oxidation or deformation caused by drilling or impacts received.
- Carry out the operations indicated on the contact surface of the conductor (silver-plated copper):
  - clean with a rough dry cloth
  - only in the case of obstinate traces of oxidation, clean with a very fine grain emery cloth taking care not to remove the surface layer
  - if necessary, restore the surface treatment (consult ABB)
  - put the connections in contact with the contactor terminals, taking care to avoid mechanical stresses produced, for example, by the conductor busbars on the terminals themselves.
- Interpose a spring and a flat washer between the head of the bolt and the connection.
- The use of bolts according to DIN class 8.8 Standards is recommended, also referring to what is indicated in the table.
- In the case of cable connections, strictly follow the manufacturer's instructions for making the terminals.

Bolt	Recommended tightening torque (1) Without lubricant
M6	10.5 Nm
M8	23 Nm
M10	50 Nm
M12	86 Nm

(1) The nominal tightening torque is based on a friction coefficient of the thread of 0.14 (distributed value the thread is subjected to which, in some cases, is not negligible). Take into account the deviations from the general Standards table (for example, for contact systems or terminals) as foreseen in the specific technical documentation. The thread and surfaces in contact with the heads of bolts must be slightly oiled or greased, so as to obtain a correct nominal tightening torque. The tightening torques indicated can only be applied to metal parts.

#### Earthing and cabling procedures

VSC conforms to level 3 of the IEC 61000-4-x EMC Standards. With regard to medium voltage switchgear, the plants where the VSC contactors are to be installed must conform to the IEC 60694:2002-01 and IEC 62271-1 ed. 1.0 Standards, to ensure adequate electromagnetic immunity. Pay great attention during earthing and cabling operations of the auxiliary circuits. Follow the procedures indicated. For further advice, please contact the ABB Service office.

## Grounding

A good connection to earth guarantees correct operation of all the apparatus installed. However, even earthing carried out correctly is not a sufficient measure to ensure a good connection between the VSC control module and earth. In fact, since the control module of the contactor is connected to the metallic base of the VSC by means of a copper connection (Fig. 7), it is always necessary to check that the connection is intact.

Furthermore, earthing must always be carried out between the VSC frame and the main earthing system of the plant. Use cables with a suitable cross-section and of the minimum length needed.

## Connection of metallic structures to exposed conductive parts

In the case of painted parts of the supporting structure, the various parts must always be scraped to eliminate the paint and connected with busbars or copper braids so as to guarantee low inductance connections.

To make a low inductance earthing connection, use cables or busbars with an appropriate cross-section, preferably rectangular. Scrape away the paint of the metallic parts over a sufficiently large area, tighten the fixing screws and cover the connected parts with Vaseline grease.

The length of the earthing cables must be as short as possible. Connection to earth of the parts must guarantee the same electric potential and low impedance.



Fig. 7 - Grounding



Figs. 8a - 8b show a grounding operation carried out correctly.



Fig. 8a

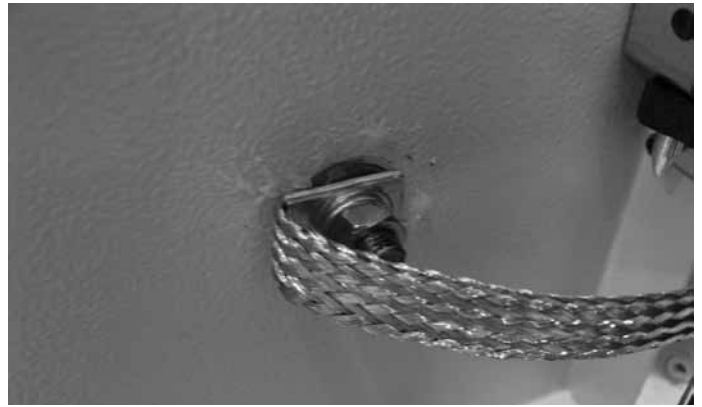


Fig. 8b

Figs. 8c - 8d show a grounding operation not carried out correctly and which, apart from being dangerous, does not guarantee correct operation of the VSC.

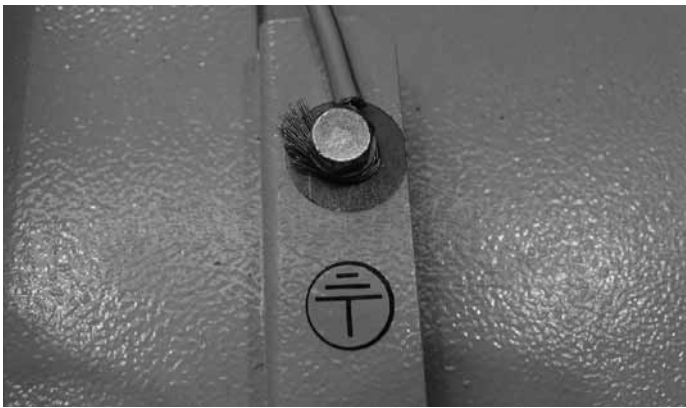


Fig. 8c

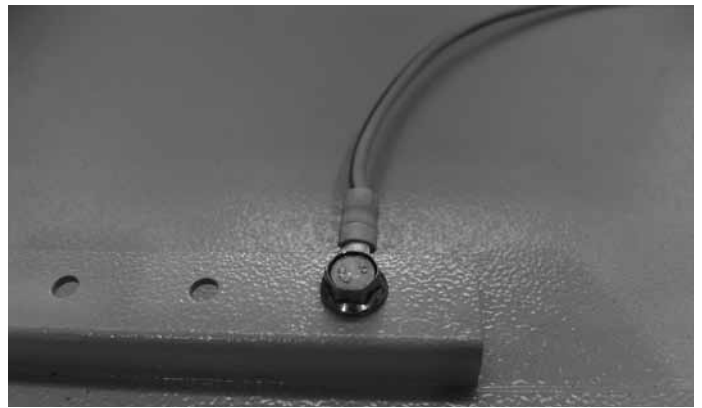


Fig. 8d

### Cabling

Make short connections (maximum 1 metre) inside the medium voltage units and avoid positioning them close to the medium voltage busbars.

All long connections must follow paths as close as possible to the metallic frame. The connections must also be fitted with ferrite rings to suppress high frequency interference.

It is good practice to run the cables inside metallic pipes or ducts (earthed at several points) when they are subject to or may be a cause of interference.

Cabling and earthing procedures according to IEC 61000-5-2 Standards: "Technical report: Installation and mitigation guidelines".

Where possible, the power supply and auxiliary circuit cables must be braided. Their length must be calculated appropriately to prevent any surplus and the maximum length must be:

- 135 m for 24 to 130 V auxiliary voltage
- 400 m for 220 to 250 V auxiliary voltage

Longer lengths require an additional filter for every operating input used (consult ABB).

In any case, any surplus parts of cables must be wound separately and taken into the low voltage apparatus compartment. Always avoid placing them in the vicinity of the medium voltage cables or close to cables which may generate interference or disturbances, such as current or voltage transformer cables or power supply cables.

### Connection of the auxiliary circuits

The cables to be used for connection of the auxiliary circuits must have a rated voltage  $U_0/U$  of 450/750 V and be insulated for 3 kV test.

**Note:** before carrying out the test, disconnect the earthing connection of the electronic feeder.

Also remember that the auxiliary circuits must be checked at the maximum voltage of 2 kV for 1 second in accordance with what is prescribed in the Standards.

The cross-section of the connection cables must not be less than 1.5 mm<sup>2</sup>.

Connection of the contactor auxiliary circuits must be made by means of the socket with terminal box mounted on the front of the electronic card.

Outside, the wires must run through metallic pipes or ducts suitably earthed.

### Connection to be made by the customer (\*)

Pins XDB10-1 and XDB10-2 must always be supplied, both in the SCO and DCO version (also see par. 5.8.). The polarity is not important since the internal circuits take both AC or DC signals. For further details, consult the electric circuit diagram enclosed with the apparatus.

N. of pin	Connections	Abbr. of binary outputs/inputs	Meaning of each pin (*)	
			Basic version	"Full option" version
-XDB10-1	Auxiliary power supply	-	Auxiliary power supply AC or DC (pole 1)	Auxiliary power supply AC or DC (pole 1)
-XDB10-2	Auxiliary power supply	-	Auxiliary power supply AC or DC (pole 2)	Auxiliary power supply AC or DC (pole 2)
-XDB10-3	Binary output n° 1	-PFG	Indication of unit ready and coil continuity control (pole 1)	Indication of unit ready and coil continuity control (pole 1)
-XDB10-4	Binary output n° 1		Indication of unit ready and coil continuity control (pole 2)	Indication of unit ready and coil continuity control (pole 2)
-XDB10-5	Binary output n° 2	-PFR	Not used	Indication of capacitor state (pole 2)
-XDB10-6	Binary output n° 2		Not used	Indication of capacitor state (pole 1)
-XDB10-7	Binary input n° 1	-SFC	Closing (pole 1)	Closing (pole 1)
-XDB10-8	Binary input n° 1		Closing (pole 2)	Closing (pole 2)
-XDB10-9	Binary input n° 2	-SFO	Opening (pole 1)	Opening (pole 1)
-XDB10-10	Binary input n° 2		Opening (pole 2)	Opening (pole 2)
-XDB10-11	Binary input n° 3	-SFL2	Undervoltage (pole 1)	Undervoltage (pole 1)
-XDB10-12	Binary input n° 3		Undervoltage (pole 2)	Undervoltage (pole 2)

(\*) For availability, ask ABB.

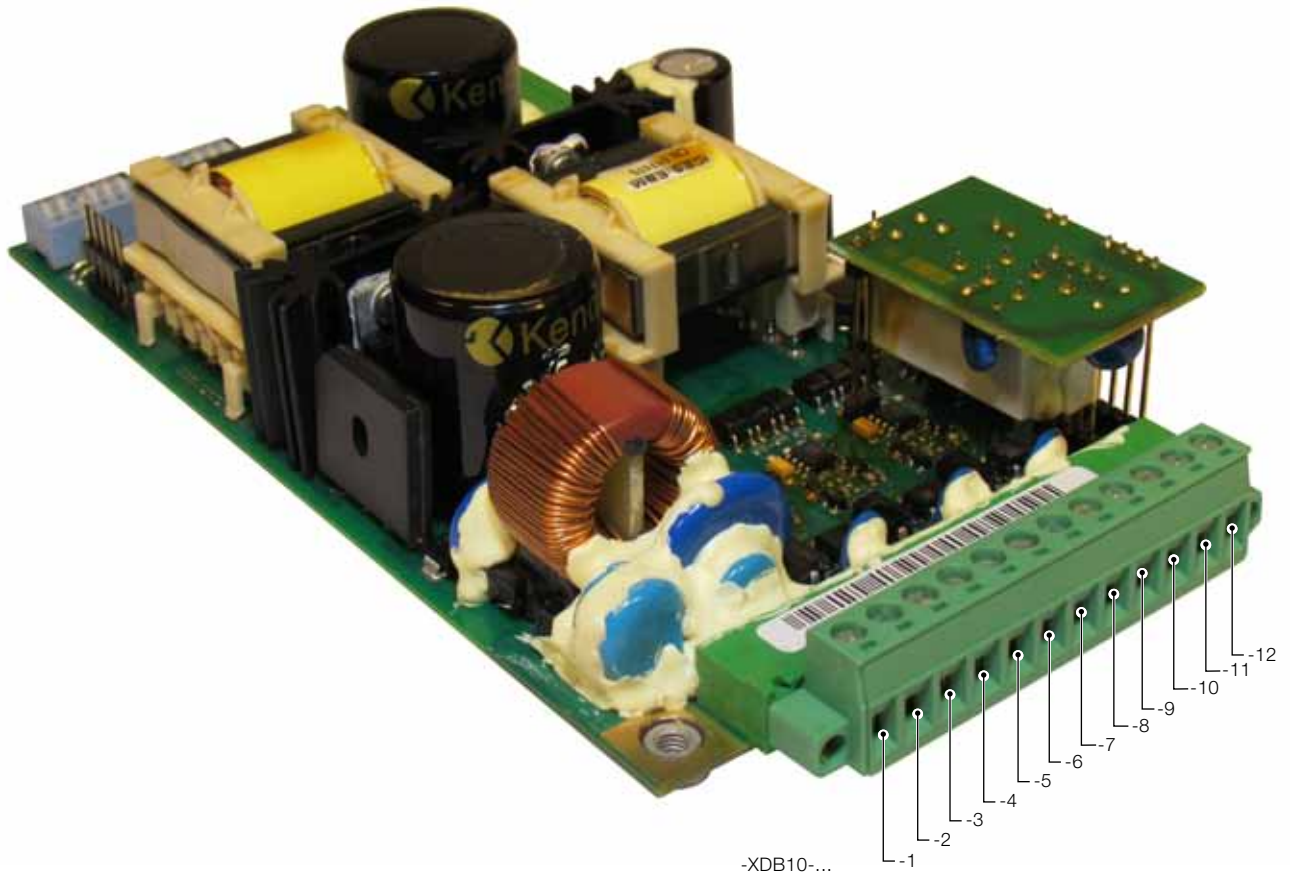


Fig. 9

**Checks**

After the above-mentioned operations, carry out the following checks:

- check that the connections do not exert any force on the terminals
- check tightness of the connections.

**5.6.2. Withdrawable contactors and enclosures**

The withdrawable contactors are used in the UniGear ZS1 type switchgear and in the PowerCube modules. Appropriately fixed together in the configurations defined by the customer, the enclosures build up medium voltage switchgear consisting of various units.

**Rules for designing the switchgear**

Arc proofing

The ABB enclosures are supplied with a reinforced door, suitable for making arc proof switchgear.

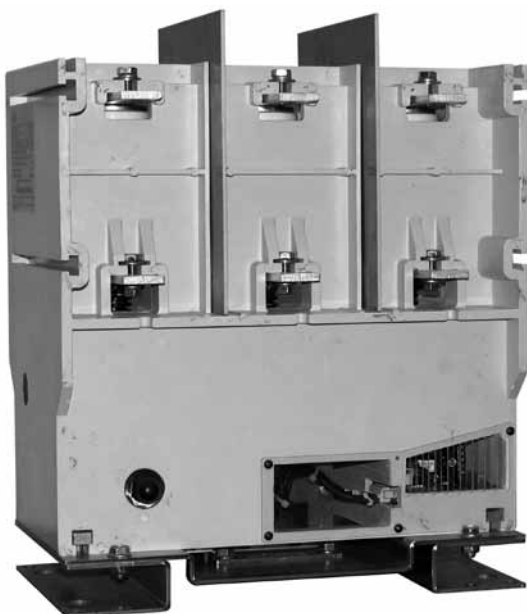


Fig. 10



- The reinforced enclosure alone cannot guarantee arc proofing of the switchgear designed by the customer. To guarantee this, some representative configurations, selected by the customer, must be subjected to the tests according to the prescriptions indicated in the IEC 62271-200 Standards.
- For UniGear ZS1 type switchgear, all the door knurls must be tightened to guarantee arc proofing.

## Degree of protection

Limited to the front part, the ABB enclosures guarantee the following degree of protection:

- IP30 on the external housing;
- IP20 inside the switchgear with the door open.

Special versions up to IP41.



**The enclosure alone supplied by ABB cannot guarantee the degree of protection of the switchgear designed by the customer. It must undergo the tests according to the prescription indicated in the IEC62271-200 Standards.**

## Heating

Refer to technical catalogue 1VCP000165 for the rated capacity of the contactors, bearing in mind that apparatus heating is affected by the following variables:

- layout of the enclosures in the switchgear designed by the customer;
- degree of protection (ventilation slats);
- current density of the power supply busbars (busbar duct - branches);
- ambient temperature.

For any needs, please contact ABB Service.

### 5.6.2.1. Withdrawable VSC/P contactors

The contactors are used for rated voltages from 7.2 to 12 kV, rated normal currents up to 400 A and fault levels up to 1000 MVA (with suitable protection fuses in series with the contactor).

The VSC/P contactor is made up of:

- a three-pole contactor with SCO or DCO function
- mechanical signalling of open/closed
- two pairs of auxiliary contacts signalling open/closed
- feeder able to operate in DC and AC
- a truck on which the supporting structure of the contactor is fixed, consisting of two supports, closed at the front by the protection with characteristics nameplate.  
In the top part of the protection there are strikers 30a and 30b (fig. 11) for actuating the enclosure contacts to signal the connected/isolated position.

The pin (34) for locking contactor racking-in with the earthing switch closed on the enclosure, comes out on the right side of the truck.

The crosspiece for hooking up the contactor to the enclosure for operation of the truck is mounted on the front of the truck (3);

- two supports (102) house the slide for actuation of the segregation shutters of the fixed medium voltage contacts of the enclosure and the locking slide of operation of the switch itself with the contactor in the connected position or during the isolation stage;
- when it is not inserted in the socket located on the enclosure, the plug connector for the auxiliary circuits of the contactor must be hooked up to the pin (101);
- mechanical signalling of open/closed (103);
- fuseholder complete with connections for fuses (104);
- input and output tulip isolating contacts (105);
- locks as per par. 5.6.2.2.;
- three current-limiting fuses (supplied on request) with high breaking capacity connected in series to the contactor, with dimensions according to:
  - DIN 43625 Standard with maximum cartridge length  $e = 442$  mm;
  - BS 2692 Standard with maximum centre fixing distance  $L = 553$  mm;
- an impulse counter (supplied on request) which indicates the number of operations carried out by the contactor (106);
- manual emergency opening device (107)
- device for opening when a fuse blows.

### 5.6.2.2. Description of the locks for withdrawable VSC/P contactors

- Electric lock which prevents the contactor being closed when the truck is not in the racked-in and isolated positions.
- Mechanical lock which prevents the contactor being racked-in and out when it is closed and closing of the contactor when the truck is not in the racked-in and isolated positions.
- Electric lock which prevents closing of the contactor when a fuse is missing or blown.
- Lock which prevents putting a contactor into service in an enclosure preset for a circuit-breaker (\*).
- Locking electromagnet on the contactor truck which when there is no voltage, prevents racking-in or racking-out (-RL2).
- Mechanical lock which prevents contactor racking-in if the enclosure door is not closed (requires the same interlock in the fixed part) (108).
- Mechanical interlock with earthing switch placed on the enclosure - with earthing switch closed the contactor cannot be racked-in and with the contactor racked-in or in intermediate positions between racked-in and isolated, it is not possible to close the earthing switch (34).
- Mechanical lock of the shutters when the contactor is racked-out.

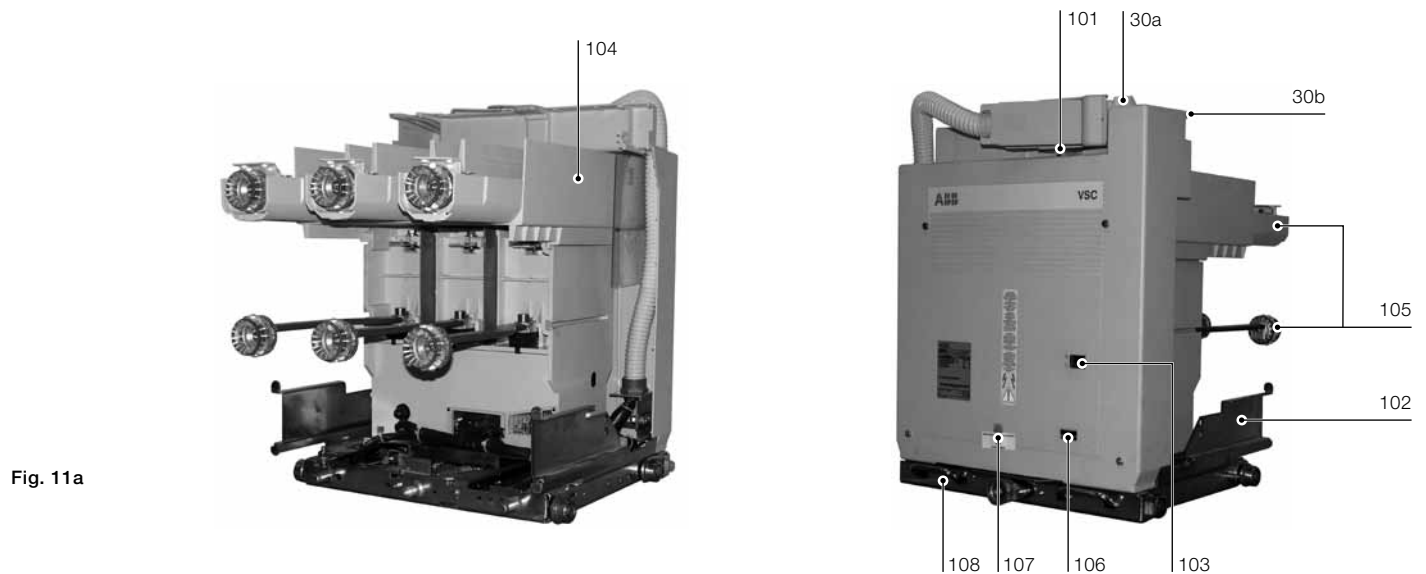


Fig. 11a

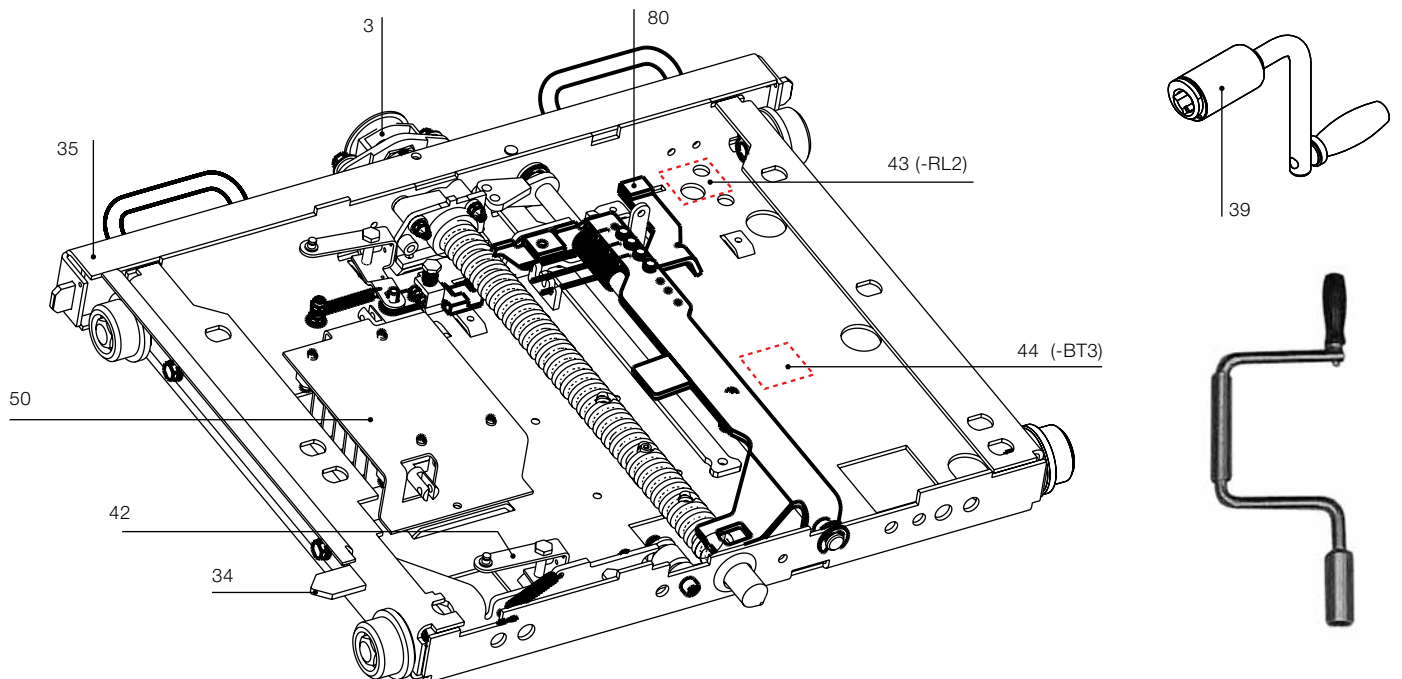


Fig. 11b - Locking devices on the racking-out truck



- Key lock on contactor racking-in - it is only possible to activate the lock and free the key preventing contactor racking-in with the contactor in the isolated position.
- Key lock with earthing switch open - this can only be activated with the earthing switch open. The key can only be removed with the electric lock activated.
- Key lock with earthing switch closed - this can only be activated with the contactor in the isolated position and with the earthing switch closed. The key can only be removed with the lock activated.
- Preset for independent padlocks on the shutters and in the closed and/or open position.
- Electric lock on racking-in and racking-out with the door open (microswitch on the door) of the enclosure connected in series with the locking electromagnet on the contactor truck.
- Key lock on earthing truck racking-in - with the lock activated all the operations with the contactor are possible, but positioning the earthing truck in the isolated position starting from the racked-out position is not allowed.
- Mechanical lock which prevents racking-out of the connector of the auxiliaries when the contactor is racked-in and during racking-in and racking-out.
- Electro-mechanical lock on de-energisation for the earthing switch, which when there is no voltage prevents the earthing switch operations.
- Electro-mechanical lock on the compartment door.

#### 5.6.2.3. VSC/PN and VSC/PNG withdrawable contactors

The VSC/PN contactors are used for rated voltages from 7.2 to 12 kV, rated thermal currents up to 400 A and fault levels up to 1000 MVA (with suitable protection fuses in series with the contactor). In the same way, the VSC/PNG contactor is used for 7.2 kV rated voltage and 400 A rated thermal current.

Both the VSC/PN and the VSC/PNG versions of contactors consist of:

- a three-pole contactor with SCO or DCO operation
- a fuseholder complete with terminals for fuses (121). In the upper part there are strikers 1a, 1b and 1c (fig. 12 - page 29) for activating the enclosure contacts for signalling the connected/test/isolated position
- a mechanical open/closed signalling device (120)
- two pairs of auxiliary contacts signalling open/closed
- feeder able to operate in d.c. and a.c.
- a truck on which the base plate of the contactor is fixed and the front protective screen by means of two supports. At the rear, two pins are positioned on the side walls of

the truck for locking contactor racking-in with the earthing switch open on the enclosure, whereas the 45° slides operate the segregation shutters of the medium voltage fixed contacts of the enclosure. The crosspiece for hooking the contactor onto the enclosure for truck operation is mounted on the front of the truck

- the jaw-type input and output isolating contacts (122)
- the locks as per par. 5.6.2.4.
- three current-limiting fuses (supplied on request) with high breaking capacity connected in series with the contactor, with dimensions according to:
  - DIN 43625 Standard with maximum cartridge length  $e = 442$  mm (single cartridge)
  - BS 2692 Standard with maximum fixing distance  $L = 553$  mm (single and/or double cartridge)
- a mechanical operation counter which indicates the number of operations carried out by the contactor (122)
- a manual emergency opening device even when energised with medium voltage (125)
- a device for opening when a fuse blows, with relative fuse blown indication.

#### 5.6.2.4. Description of the locks for VSC/PN and VSC/PNG withdrawable contactors

- Electric lock which prevents the contactor being closed when the truck is not in the “racked-in” (200 mm), “test” (47.5 mm) and “racked-out” (0 mm) positions (-BGT3) (fig. 12a).
- Mechanical lock which prevents the contactor being racked-in and out when it is closed, and contactor closing when the truck is not in the “racked-in”, “test” and “racked-out” positions (1) (fig. 12a).
- Electric lock which prevents contactor closing when a fuse is missing or blown.
- Locking electromagnet on the contactor truck which, when there is no voltage, prevents racking-in or racking-out (-RL2) (fig. 12a).
- Mechanical lock which prevents contactor racking-in if the enclosure door is not closed (requires a reciprocal interlock in the fixed part) (126).
- Mechanical lock for the “test” position (2) (fig. 12a).
- Lock for different currents (5) (fig. 12a).

(\*) This lock consists of some pins assembled in the plugs of the auxiliary circuits which, with a suitable code, prevent connection of the plug in the enclosure socket. The lock also foresees compulsory application of the locking magnet in the truck.

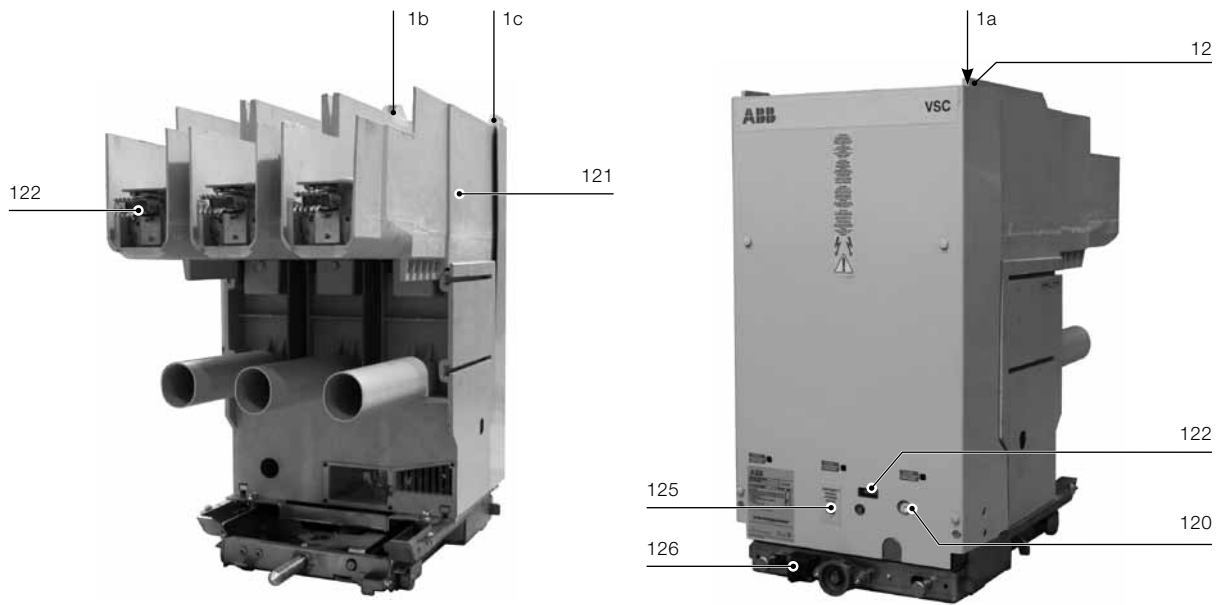


Fig. 12

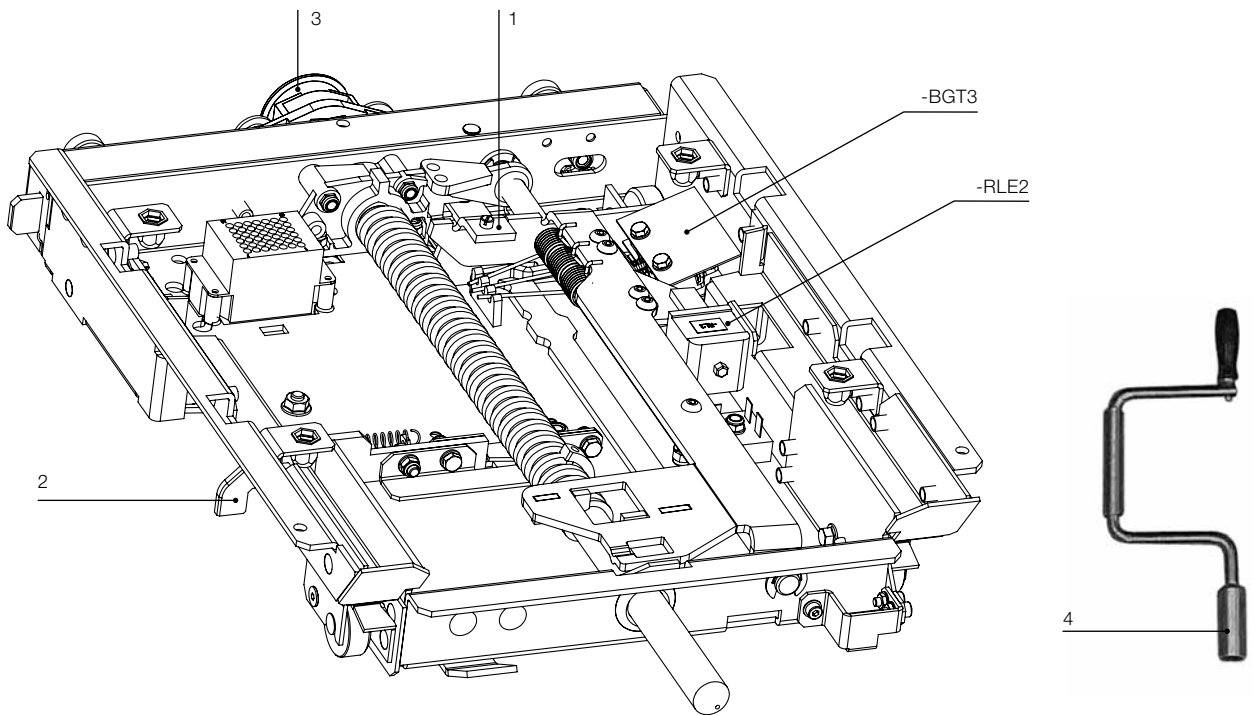


Fig. 12a - Locking devices on withdrawable truck.

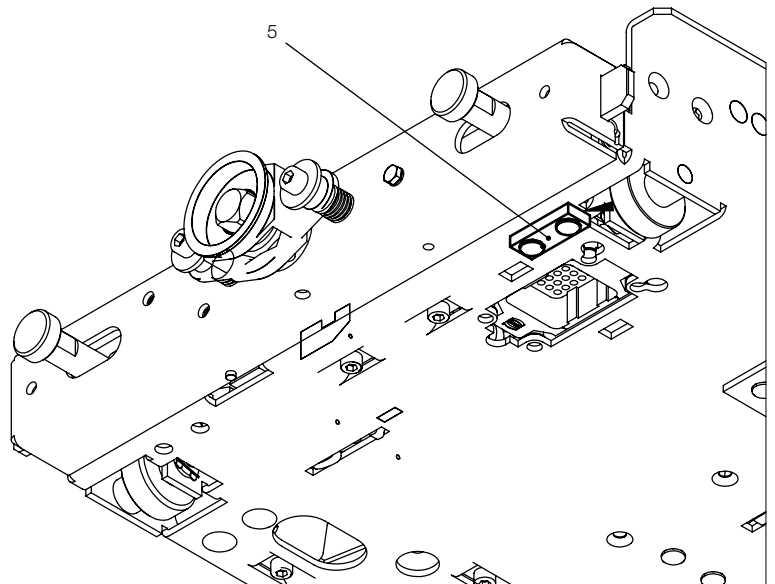


Fig. 12b - Interlocking devices on withdrawable truck.

## 5.7. Description of the closing and opening operations

The contactor drive operates in two different ways as shown in Table 1.

For the DCO version, further personalisation of the apparatus can be made. In fact – the first of its kind – the V-Contact VSC contactor is fitted (on request) with an undervoltage

function (UV) with delays which can be set according to the requirements of the installation.

For a more detailed description of the behaviour of the apparatus according to the version, see table 2.

Supply the contactor with auxiliary voltage and operate it several times electrically. The contactor must carry out the opening and closing operations correctly in accordance with the threshold values defined in the IEC 62271-106 Standards.

**TABLE 1**

Version	Description	Inputs		
		Closing -XDB10-7, -XDB10-8	Opening -XDB10-9, -XDB10-10	Undervoltage -XDB10-11, -XDB10-12
SCO (Single Command Operated)	This version operates according to the state of the command signal at terminals -XDB10-11 and -XDB10-12. Contactor closing takes place when the voltage applied to terminals -XDB10-11 and -XDB10-12 corresponds with the values indicated in Table 2a	Not used	Not used	Used
DCO (1) (Double Command Operated)	This version operates by means of two independent signals for closing and opening applied to terminals -XDB10-7 and -XDB10-8 for opening and -XDB10-9 and -XDB10-10 for closing. The values of the signals are indicated in Table 2b. Furthermore, on request, automatic delayed opening of the contactor is available in the case of a drop or lack of voltage at terminals -XDB10-11 and -XDB10-12 (configurable delay filter). See Table 2b.	Used	Used	If the undervoltage function is required (2)

(1) The contactor is restarted if the supply voltage of the board drops below 18V for more than 300ms.

(2) The undervoltage with time-delay function is guaranteed with 18V minimum residual voltage.

**TABLE 2a**

**SCO (Single Command Operated) version**

**Terminals -XDB10-1 and -XDB10-2 must always be supplied at the rated voltage (tolerance: 85% ... 110%)**

Closing operation		Power supply, in continuous mode, to the UV input
Opening operation (3)	Release voltage (drop out)	A voltage drop occurs at terminals -XDB10-11 and -XDB10-12 for power supply voltage values between 75% and 10% of the rated voltage.

**TABLE 2b**

**DCO (Double Command Operated) version**

**Terminals -XDB10-1 and -XDB10-2 must always be supplied at the rated voltage (tolerance: 85% ... 110%)**

Closing operation		Supply terminals -XDB10-7 and -XDB10-8 with power. An impulse lasting at least 100 ms is recommended. Note: an impulse lasting a shorter time may also cause contactor closing.
Opening operation	Opening operation (switching)	Supply terminals -XDB10-9 and -XDB10-10 with power. An impulse lasting at least 100 ms is recommended. Note: an impulse lasting a shorter time may also cause contactor closing. In the case of simultaneous power supply of terminals -XDB10-7 and -XDB10-8 and terminals -XDB10-9 and -XDB10-10, the opening command prevails.
	Release voltage (undervoltage)	– Function available on request (UV = Undervoltage). – Opening takes place for voltage values applied to terminals -XDB10-11 and -XDB10-12, between 70% and 35% of the rated voltage (4)

(3) The opening operation is only instantaneous.

(4) The opening operation can be instantaneous or delayed (adjusting the delay by means of the special selectors) a 0.3 - 1 - 2 - 3 - 4 - 5 s. It is set to 0 s by default.

### Setting for DCO

UV time (s)	S1-3	S1-4	S1-5
Instantaneous (1)	0	0	0
0.3s	0	0	1
1s	0	1	0
2s	0	1	1
3s	1	0	0
4s	1	0	1
5s	1	1	1

S1-6 → Reserved – (1) See opening time par. 1.3.



### 5.7.1. Diagnostics

Two types of electronic cards are available, "Basic board" and "Full option", differing from each other in the diagnostic functions they have available.

Both have:

- coil continuity control connected to the card
- capacitor voltage level control.

The "Full option" card also makes the following available:

- control of the state of capacitor efficiency, which is fundamental for correctly carrying out the opening and closing operations
- checking and indicating the temperature inside the contactor.

The alarms corresponding to the above functions are made available to the user by means of two contacts (3-4 and 5-6) of the -XDB10 terminal box.

The cards periodically carry out the controls without preventing the opening and closing operations.

The table below indicates the functions available.

#### Basic board - Full option board

Ready DO1 -XDB10 (3-4)	Continuity control	Capacitor voltage level and VSC internal temperature	Anomaly	No anomaly
	- After each operation - Start-up - Every 12 hours	Continuously	DO1 open	DO1 closed

#### Full option only

CBC DO2 -XDB10 (5-6)	Control of state of capacitor efficiency	-	Anomaly	No anomaly
	- Start-up - Every 12 hours	-	DO2 open	DO2 closed

### 5.7.2. Contactor power supply

The contactor has been tested for all the auxiliary operating voltages foreseen and indicated in the table:

Feeder 1-2 V c.c.	Feeder 3-4 V c.c. / V c.a. (50/60 Hz)	
24	110	220
30	120	230
48	125	240
60	127	250
	130	

The contactor is, however, set with the operating voltage defined in the order confirmation. The power supply voltage is indicated on the contactor rating label.

The tolerances over the voltage values conform to what is defined in the IEC 62271-106 Standard.

### 5.7.3. Coil continuity control (CCC) and temperature monitoring

The unit checks actuator connection continuity so as to reduce the risk of failure to operate following disconnection. It also monitors the temperature of the board to reduce the risk of operating beyond the board's design limits.

This function is provided for both the basic MAC R2 board and the "full option" version.

The test is performed:

- Every 2 minutes (irrespective of whether the apparatus is in the open or closed condition)
- 15 seconds after starting
- After each operation

The test is not performed:

If the voltage of the external capacitance is less than 75 V ("not ready" signal already given)

If the ambient temperature is less than -30° ("not ready" signal already given)

An alarm signal is given by opening contact DO1 if errors occur.

### 5.7.4. Capacitor ageing control (CBC)

The unit supervises bulk capacitor discharging so as to check capacitor life.

The unit supervises main capacitor discharging so as to check capacitor life.

This function is only available for the MAC R2 "full option" version.

The test is performed:

- Every 12 hours when the apparatus is in the open condition.
- 15 seconds after starting.
- Two seconds after each opening operation if the contactor has remained closed for 12 hours.

The test is not performed:

- If the voltage of the external capacitance is less than 75 V ("not ready" signal already given).
- If the ambient temperature is less than -5° ("not ready" signal already given).

The "not ready" state is signalled when the CBC function is being performed and the function has priority over the closing operation.

An alarm signal is given by opening contact DO2 if errors occur.

### 5.7.2.1 Changing the supply voltage of the contactor (within the reference range)



Fig. 13a



Fig. 13b



Fig. 13c

- This operation must be carried out by ABB personnel or by suitably qualified customer personnel with in-depth knowledge of the apparatus (IEC 62271-1, par. 10.4.2.).
- Always check that the apparatus is in the open position before carrying out any activities. Check that the medium voltage and auxiliary power supplies have been removed. Maintenance of the apparatus must only be carried out with the contactor de-energized, racked-out of the compartment of the enclosure and with the capacitor of the auxiliary circuit discharged. To discharge the capacitor, remove power from the -XDB10 terminal box and connect the mobile two-pole -XDB50 connector to the ABB type CFD device (fig. 13c). Completion of discharging is signalled by the red light going completely off.
- The auxiliary circuit can be configured for all the direct and alternating current voltages within the reference range. To change the voltage value defined during the ordering stage, proceed as follows: 1) remove the rear plastic protection (fig. 13a); 2) access the MAC R2 electronic card (fig. 13b); 3) prepare the dip-switches according to the indications given on the last page of the electric circuit diagram.
- After having set the desired value, the label with the new voltage value must be overlaid the front rating plate of the contactor.

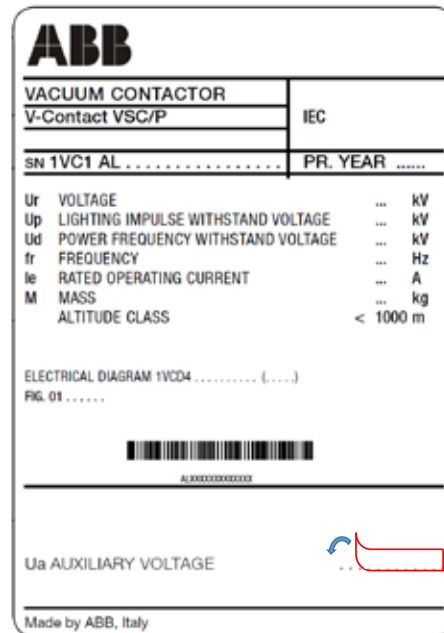


Fig. 13d

- The small plate with the correct voltage value is in the document envelope accompanying the product, along with the electric circuit diagram and this manual.
- Contactor functional check is mandatory after the new voltage setting; the qualified customer's personnel should carry out this check, responsibility for the interventions lies with the customer.

## 5.8. Emergency opening operation



**The contactor is fitted with manual emergency operation which must be carried out by suitably qualified personnel with in-depth knowledge of the apparatus.**

**The following Standards must be taken into particular consideration during installation and service:**

- IEC 62271-1/DIN VDE 0101
- VDE 0105: Operation of electrical plants
- DIN VDE 0141: Earthing systems for electrical installations with rated voltage higher than 1 kV
- All the accident prevention regulations, in force in the relative countries.

To manually open the contactor, it is necessary to work on operating part A, consisting of a 8 mm hexagonal-head bolt, working clockwise with a torque of about 5 Nm and at an angle of about 30° (see fig. 14a).

If the contactor (in the fixed version) is placed inside the switchgear, it is necessary to use a transmission made of insulating material of suitable length, which allows safe operation. The transmission device is to be provided by the customer.

For the withdrawable VSC/P contactors placed in UniGear ZS1 switchgear or PowerCube modules and for the withdrawable VSC/PN and VSC/PNG contactors in UniGear MCC switchgear, carry out the emergency operation with the compartment door closed. To carry out the operation, work towards the opening on the compartment door using the special tool provided, fitted on the end with an 8 mm hexagonal spanner. Apply a torque of 5 N with an operating angle of about 30° clockwise. The point to operate in is shown by the special plate located on the contactor shield (see detail 1 - fig. 14b and 14c).



**For fixed contactors, if the operations are carried out with the medium voltage protection “B” removed, pay great attention to the moving parts.**

**For withdrawable contactors, do not remove the front shield to carry out the emergency opening operation.**

**In any case, if auxiliary voltage is present, take special care not to remove the protective shield of the stored energy capacitor and not to touch the capacitor itself in any way.**



Fig. 14a

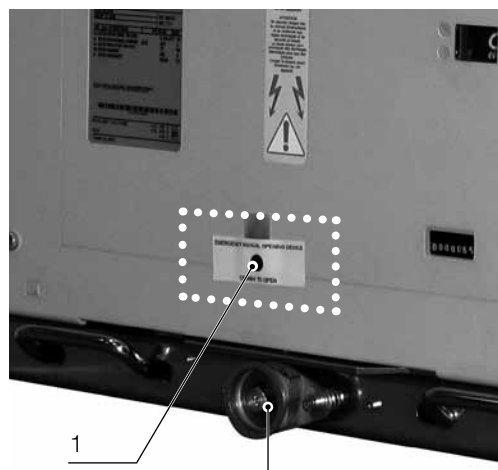



Fig. 14b



Fig. 14c

# 6. Putting into service

## 6.1. General procedures




**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.**

Before putting the apparatus into service, carry out the following operations as well as those indicated in the table:

- check that the voltage and current applied are within the specified rated values
- check tightness of the power connections of the fixed contactors and integrity of the isolating contacts of the withdrawable contactors
- carefully clean the sheets and insulating parts with brushes and clean dry cloths. Avoid using jets of compressed air
- check the earthing connection of the fixed contactors
- check that no foreign bodies, such as bits of packing, have got into the moving parts

- check that the value of the power supply voltage of the circuits is between 85% and 110% of the rated auxiliary voltage of the apparatus
- check that the contactor vacuum interrupter has not been damaged due to accidental impacts. In case of doubt, carry out the check indicated in paragraph 7.3. Table 4.
- make sure that all the barriers and protective shields are correctly installed
- carry out the inspections indicated in table 3.

On completion of the operations indicated, check that everything is put back in its original position.



**The check can only be considered as passed if all the tests indicated have had a positive outcome.**  
**In the case of a negative check, do not put the apparatus into service and, if necessary, contact ABB Service.**

**TAB. 3**

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.
2 Drive. Open/closed indicator, operation counter (if provided)	Carry out a few closing and opening operations of the contactor.	Operations and signals normal.
3 Auxiliary circuits	Check that the connections to the control circuits are correct: proceed with the relative power supply.	Operations and signals normal.
	With the contactor open, check that the thickness between the body of the contact and the stem is 0.5 mm.	Tighten the fixing screws.



## 6.2. Racking the VSC/P contactor in and out



- **Should operations be carried out with the contactor racked-out of the switchgear, pay great attention to the moving parts.**
- **The contactor must only be racked into the unit in the open position. Racking-in and racking-out must be gradual to avoid shocks which might deform the mechanical interlocks.**

### 6.2.1. Contactor with manual truck

For the racking-in and racking-out operations of the manual contactor, refer to the following manuals:

- PowerCube PBF fixed part – code: 1VCD600530
- PowerCube PBE and PBM module - code: 647652001
- UniGear ZS1 switchgear – code: 1VLM000363.

### 6.2.2. VSC/P contactors with motorised withdrawable truck

Carry out the racking-in/out test of the motorised truck in the same way as for a manual truck, following the instructions below:

- Rack the contactor into the switchgear in the open position. Motor power supply circuit de-energized.
- Supply the truck motor circuit with power.
- Activate the command for the electrical racking-in operation. When racking-in has been done, check correct changeover of the relative auxiliary contact.
- Afterwards, activate the command for the electrical racking-out operation. When racking-out has been done, check correct changeover of the relative auxiliary contact.

- In the case of a fault in the motor during a racking-in or racking-out operation, the truck can be taken to the run end manually in an emergency, first cutting off the voltage to the motor power supply circuit and then using the manual lever (Fig. 15) to operate in the same way as for the manual truck.
- Insert the manual racking-in lever (Fig. 15) in the special coupling (B - Fig. 14b).  
The torque needed to carry out truck handling is < 25 Nm.  
Checks:
  - a) clockwise rotation of the motor during circuit-breaker racking-in.
  - b) anti-clockwise rotation of the motor during circuit-breaker racking-out.
- Remove the manual crank.

#### Note

By means of the chain transmission, truck handling carried out with the manual lever causes rotation of the truck motor rotor which, behaving like a generator, can cause reversal of voltage at the connection terminals. This can damage the permanent magnet of the motor, therefore all the truck racking-in and racking-out operations carried out with the manual lever must be done with the motor circuit de-energized.



Fig. 15



# 7. Maintenance

Maintenance operations are aimed at ensuring trouble-free operation of the apparatus for the longest possible time. The following operations must be carried out in accordance with the IEC 61208/DIN 31051 Standards:

- Inspection: Assessment of the actual conditions  
Servicing: Measures to be taken to maintain the specified conditions  
Repairs: Measures to be taken to restore the specified conditions.

## Notes

- The following rules must be respected for all maintenance operations:
- the relative specifications indicated in the “Standards and specifications” chapter;
  - the regulations for safety in the workplace indicated in the “Putting into service and running” chapter;
  - the regulations and specifications in the country of installation.

## 7.1. General

It is good practice to keep a maintenance card and a service book where all the operations carried out can be noted down in detail, together with the date, description of the anomaly and the references of data needed to identify the apparatus, etc. (see chapter 2).

Experience gained in use of the apparatus will allow the optimal time intervals for interventions to be established. In any case, inspection of the apparatus not more than one year after it has been put into service is recommended.

In case of need and for further details, please refer to what is prescribed in article 10.4.2 of the Standard (IEC 62271-1).

In any case, for any problems, please do not hesitate to contact us.

## 7.2. Handling the MAC-R2 electronic card

Management of sensitive devices outside protected areas is considered to be “field work” and normally includes product packing, unpacking, installation and maintenance.

In all these cases, handling the devices must be carried out taking care to keep the potential of your hands and that of the work surface earthed, with an equipotential connection to the main grounding branch point.

It is advisable for the operator to wear conductive shoes and overalls and to wear earthed conductive arm bands.

Fig. 13a-13b shows a maintenance kit consisting of an arm band and ground connection, both fitted with a 1 MW integrated resistance.

Using suitable protective means to protect the electronic devices is an indispensable task requiring diligence and attention. Inserting these procedures in the normal service activities allows optimization of resources and underlines their importance.

The main activities which allow an efficient protection system to be maintained are:

- making personnel aware of the problems regarding protection against electrostatic discharges, with reference to the IEC 61340-5-1 Standards (these problems are often unknown or underrated)
- training personnel in correct use of protection equipment and on its perfect working order
- selecting protection materials suitable for the effective production requirements and using them
- marking the protected area and highlighting the presence of sensitive devices so as to attract the attention of operators on correct use of the protection devices
- technicians must always set an example by respecting the rules and using protection devices appropriately

Observe the following basic rules:

- avoid using tools which are unsuitable for removing the electronic cards (e.g. screwdrivers, etc.)
- handling the electronic card during maintenance or replacement operations must be limited to the minimum time possible
- always hold the electronic card at the edges
- avoid touching the components mounted on the card
- pay attention when cables or connectors have to be connected or disconnected
- avoid bending the card while inserting it in its seat or during connector cabling
- avoid damaging the connectors, aligning the pins before connecting the cable



Fig. 16

### 7.3. Inspection

- Carry out regular inspections to check that the interruption devices are in good condition.
- The checks must include a visual inspection to find any contamination, traces of corrosion or electrical discharge phenomena (according to what is prescribed in table 4.
- When there are unusual service conditions (including adverse climatic conditions) and/or in the case of environmental pollution (e.g. heavy contamination or an atmosphere with aggressive agents), the frequency of inspections must be increased.
- Visual examination of the main contacts. The contact areas must be cleaned if there are signs of overheating (discoloured surface) (also see the paragraph on “Repairs”).

If any anomalous conditions are found, appropriate maintenance measures must be taken (see the “Servicing” paragraph).

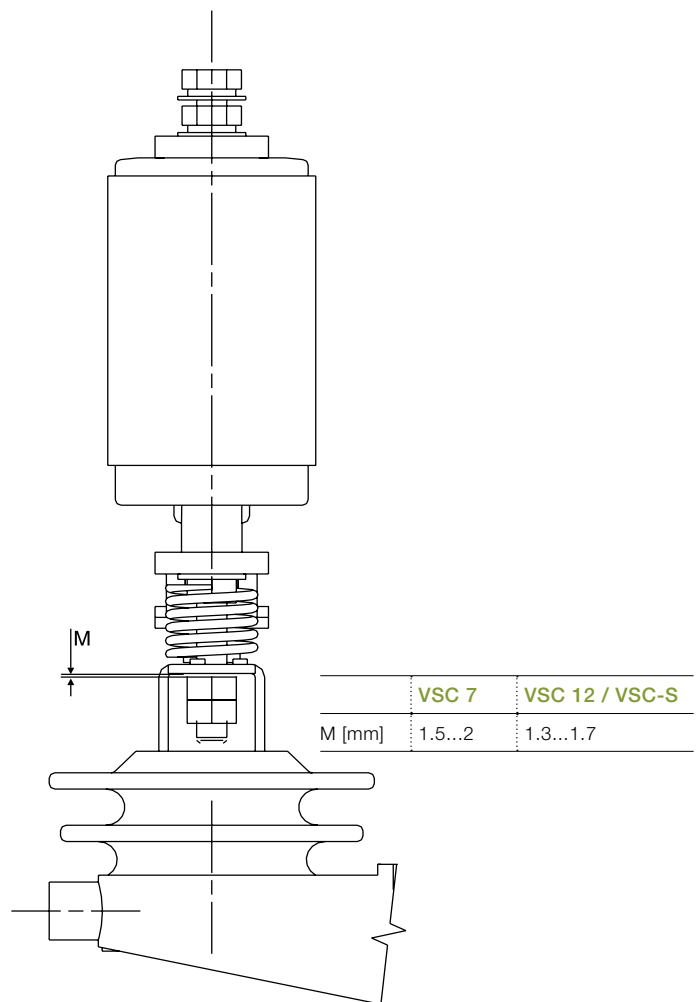


Fig. 17

TABLE 4

Item to be inspected	Interval	Operation to be carried out
1 Insulating parts.	1 year or 50,000 operations.	Visual inspection of the insulating parts. The insulating parts must be free of any accumulation of dust, humidity, dirt (clean), cracks, traces of surface discharges or damage.
2 Structure..	1 year or 50,000 operations.	Visual inspection of the structure and mechanisms. The components must be free of any deformation, accumulation of dust, dirt or damage. The screws, nuts and bolts must be correctly tightened. Avoid touching the ceramic surface.
3 Interrupter.	1 year or 50,000 operations. In case of accidental impacts.	Check that the interrupter is free of accumulation of dust, dirt (clean), cracks (replace), traces of surface discharges or damage. Carry out a voltage test with the contacts open at 15 kV - 50 Hz for one minute. If there is a discharge during the test, the interrupter must be replaced because this type of phenomenon corresponds to deterioration in the degree of vacuum. In case of need, contact ABB Service.
4 Interrupter contacts.	1 year or 50,000 interruptions at the rated current.	Refer to fig. 17. The contact material vaporises from the surfaces during each interruption and condenses elsewhere inside the vacuum interrupter. This is a normal process, and is foreseen by the overrun, or by the wear tolerance. As the contacts wear, the overrun distance "M" decreases. When distance "M", of any pole, goes below 0.5 mm with the contactor in the closed position, all the sub-assemblies must be replaced. Use a fork-shaped gauge 0.5 mm thick to carry out this measurement. <b>Caution! Never attempt to adjust the nuts of the vacuum interrupters for any reason whatsoever.</b> The overrun distance must be checked, but not adjusted.
5 Auxiliary contacts.	1 year or 50,000 operations.	Check correct operation and the signals. Check that there are no burnt or worn contacts (replace).
6 Auxiliary circuit conductors.	1 year or 50,000 operations.	Check whether any cabling straps are loose or broken and check connection tightness. Examine all the wire or cable connections to make sure that none of them are loose and that there is no overheating.
7 Visual inspection of the isolating contacts (withdrawable contactors)	5 years.	The isolating contacts must be free of any deformation or erosion. Lubricate the contact elements with 5RX Moly type grease.

## 7.4. Servicing

Carry out the checks described below.

Item to be serviced	Interval	Operation to be carried out
1 Contactor.	2 years or 100,000 operations.	Carry out five mechanical closing and opening operations. The contactor must operate regularly without stopping in intermediate positions.
2 Contactor springs.	2 years or 100,000 operations.	Check integrity of the springs.
3 Power connections.	2 years or 100,000 operations.	Check tightness: M8 bolt = 23 Nm; M10 bolt = 33 Nm. Check there are no traces of overheating or oxidation.
4 Earthing contact (fixed contactors)	2 years or 100,000 operations.	Check tightness of the connections.
5 Insulation resistance.	2 years or 100,000 operations.	See par. 6.1.
6 Racked-in/isolated auxiliary contacts in the truck.	2 years or 100,000 operations.	Check that the signals are correct.
Furthermore provide:	– replacement of the auxiliary contacts after 250,000 operations.	

## 7.5. Servicing following a short-circuit or overload

### General

It is foreseen that the VSC contactor be protected by power fuses and/or by a circuit-breaker. In any case, the value of a short-circuit can exceed the threshold of damage to the vacuum bottles.

After interruption of a short-circuit at the maximum rated MVA of the contactor, put the cause of the fault right, inspect all the apparatus and carry out the repairs or replacements necessary before putting the apparatus back into service.

Make sure that all the spare parts (when required) are suitable for the application.

In case of any doubts, please contact ABB.



**Have a complete check of the contactor carried out by ABB personnel after 1,000,000 operations or 10 years of operation. Contact ABB Service Assistance.**

### Vacuum interrupters

A dielectric test by itself cannot be confirmation that the interrupters have to be put back into service after a fault. However, if there is no physical sign of stress and if the distance M exceeds a minimum of 0.5 mm, the interrupters can be tested dielectrically as mentioned in point 3 of table 4. Should this test also be positive, it is reasonable to put the interrupters back into service following a fault.

### Enclosures

External evidence of deformation of the enclosure is usually indicative of damage inside it. Extensive damage will require replacement of the enclosure parts and of the apparatus contained in it.

### Terminals and internal conductors

Replace the damaged parts which show discolouration, melting or damage caused by electric arcs.

Pay special attention to the moving parts.

Carry out the “Checking” procedures indicated in par. 6. of this manual before putting the apparatus back into service.

## 7.6. Repairs

Replacement with spare parts and accessories must only be carried out by ABB personnel or by suitably qualified personnel with appropriate training.

All the power supply sources must be turned off and the capacitor must be discharged.

Always work with the contactor open, with the work area insulated and made safe.



**Should maintenance be carried out by the customer's personnel, responsibility for the interventions lies with the customer.**



## 7.7. Instructions for dismantling and replacing fuses

### 7.7.1. General



- All the operations described below must be carried out by suitably qualified personnel with in-depth knowledge of the apparatus.
- Do not rack the contactor out unless the enclosure is securely fixed in the switchgear or to a stable base.
- Check that the contactor is open before proceeding with isolation and its racking-out from the enclosure.
- Check that the contactor is open before proceeding with replacement of the fuses.
- The contactor is preset to house ABB CMF/BS and ABB CEF/BS fuses.



Fig. 18a

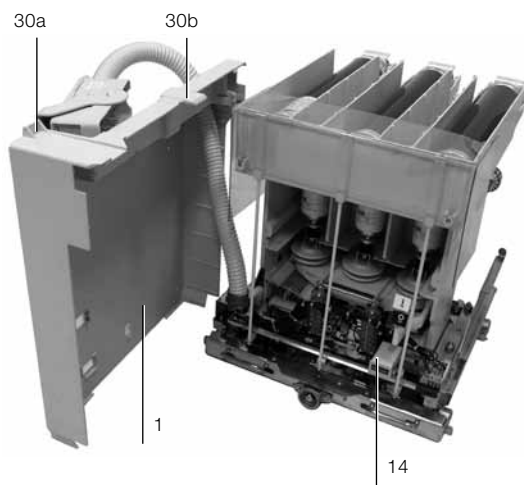


Fig. 18b

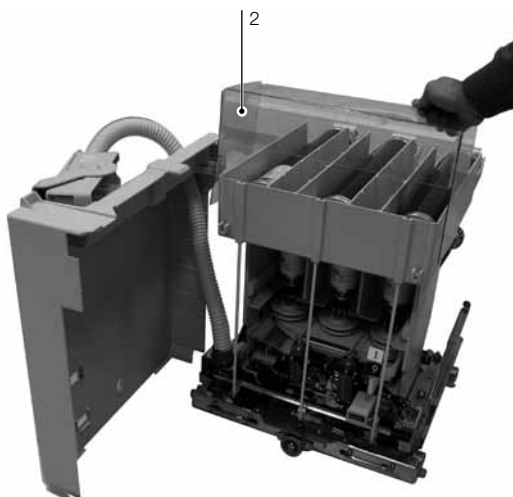


Fig. 18c

The fuseholder is preset for installation of fuses with the dimensions and average type of striker according to DIN 43625 (1983) and BS 2692 (1975) Standards and with electrical characteristics according to IEC 282-1 (1974) Standards.

The fuseholder is always fitted with an automatic opening device for a fuse blowing. This device prevents contactor closing when even a single fuse is missing.

### 7.7.2. Preliminary operations for fuse replacement

#### a) VSC/P

The contactor must be racked out of the enclosure for replacement of the fuses.

The instructions for the racking-out operations are given in the switchgear/enclosure manuals.

With the contactor racked out of the switchgear, unscrew the four fixing screws of the shield and relative DIN washers (fig. 18a) and position it as in fig. 18b. For 12 kV contactors, remove protection (2) and (fig. 18c) proceed to replace the fuses according to the instructions given in par. 7.8.

#### b) VSC/PN and VSC/PNG

To replace the fuses it is necessary to rack the contactor out of the enclosure. The instructions for the racking-out operations are given in the switchgear/enclosure manuals, then proceed to replace the fuses according to the instructions given in par. 7.8.

## 7.8. Replacement of the contactor fuses



Check that the rated normal current of the fuses to be installed corresponds with the value indicated on the nameplate on the rear of the fuseholder.

### Fuses according to DIN Standards

#### a) Mounting the adapters (fig. 19a)

The fuseholder is designed to take fuses with a length of 442 mm. For smaller sizes, two adapters are required:

- Adapter (45) for fuses with a length of 192 mm (A)
- Adapter (46) for fuses with a length of 292 mm (B).

Select the type of adapter in relation to the type of fuse to be used, and insert it fully over the fuse contact, opposite to the one of the striker.

Tighten the steel band (47) and fully tighten the screw (48).

To dismantle, proceed in reverse order.

The same instructions are given in the Kit sheet put in the adapter packing.

#### b) Dismantling the fuses (fig. 19b)

Open the locking rings (49) (fig. 19b) moving them in the direction shown by the arrows using the tool (50), and remove the fuse using the special tool (50).

#### c) Mounting the fuses (fig. 19c)

Open the locking rings (49) moving them in the direction shown by the arrows using the tool (50) (fig. 19b), fully insert the fuses with the contacts fitted with striker on the opposite side to the isolating contacts of the contactor. Close the locking rings again, moving them in the opposite direction to the opening one.

### Fuses according to BS Standards.



- Check that the rated normal current of the fuses to be installed corresponds with the value indicated on the nameplate on the rear of the fuseholder.
- When tightening the screws, do not force the connections (25 Nm maximum tightening torque).
- Fuse mounting and dismantling must only be done with the adapter (if required) already mounted on it.
- Only use the material specified, provided by ABB, for assembly.

69

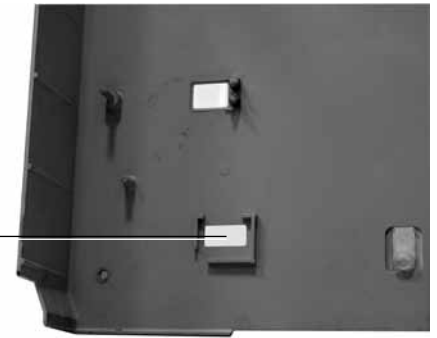


Fig. 18d



Fig. 18e

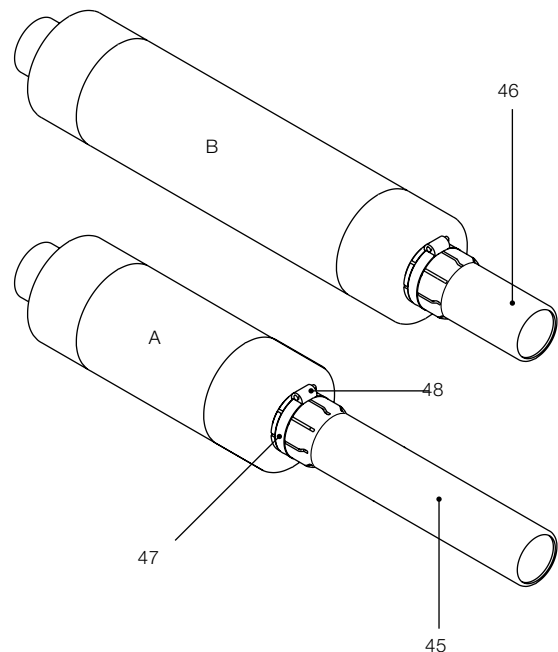


Fig. 19a

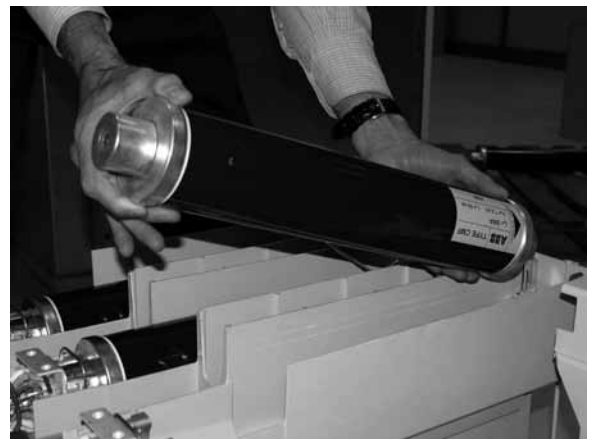
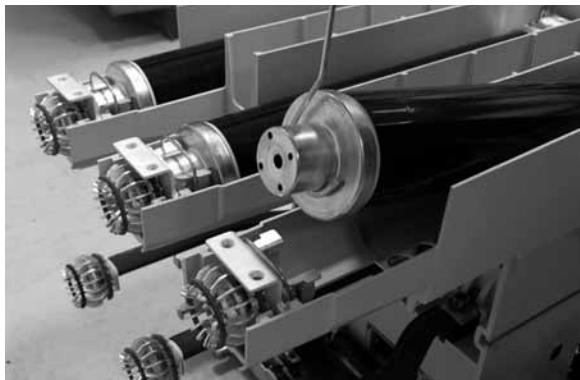
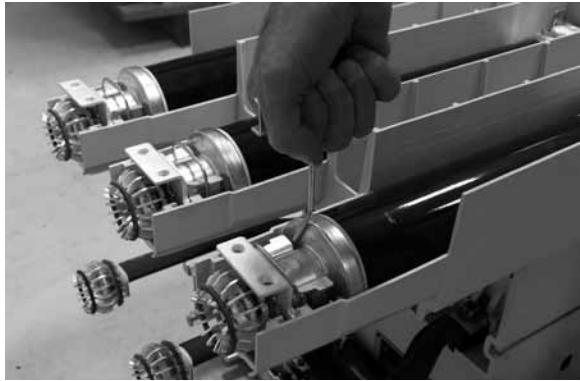
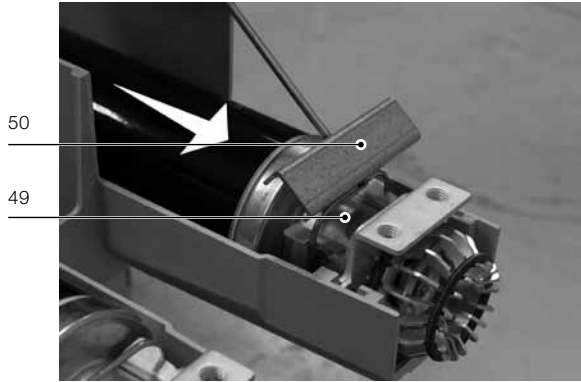
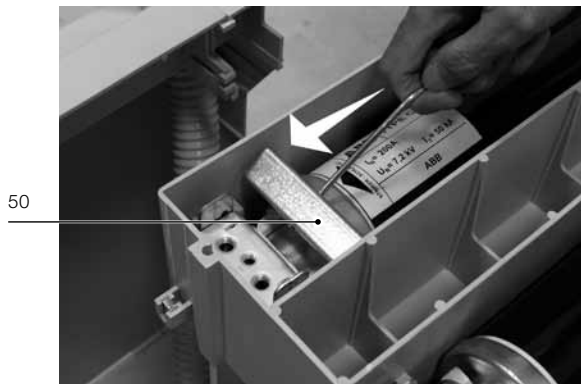


Fig. 19c

Fig. 19b

### a) Mounting the adapters (fig. 20a)

The fuseholder (32) (fig. 20b) is preset to take fuses with fixing centre distance of 553 mm. For smaller sizes, three adapters are needed, as indicated below:

- adapter (51) for fuses with fixing centre distance  
l = 235 mm
- adapter (52) for fuses with fixing centre distance  
l = 305 mm
- adapter (53) for fuses with fixing centre distance  
l = 454 mm.

Select the type of adapter, fix it onto the fuse on the striker side by means of the grub screws (54), the cup springs (55) and the short nuts (58). Mount the adapter with the extension, with the cap facing the striker.

The same instructions are given in the Kit sheet put in the adapter packing.

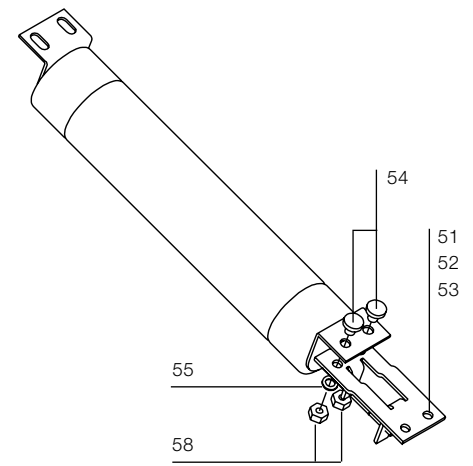
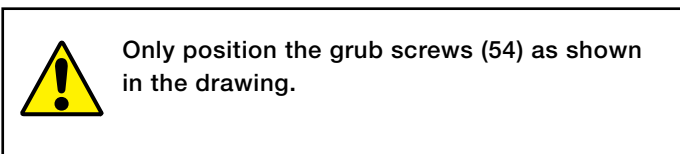


Fig. 20a



### b) Mounting the fuses (fig. 20b)

Mount the fuses or the adapter (preassembled as indicated in par. a) with the striker, (indicated by the arrow) facing the opposite side to the one of the contactor tulips and fix them by means of the screws (56) and the spring washers (57).

### c) Dismantling the fuses

To dismantle the fuses and relative adapters, proceed in reverse order to par. b) and a).

### d) Assembling and dismantling the VSC/PN and VSC/PNG contactor fuses

It is also possible to use BS fuses with double cartridge connected in parallel in the VSC/PN and VSC/PNG contactors (fig. 20c) and therefore in series with the contactor. The assembly and dismantling operations are the same as what is described in sections a) , b) and c) above, with the only difference being to handle a pair of fuses per phase at the same time (fig. 20c) connected by means of a suitable adapter.

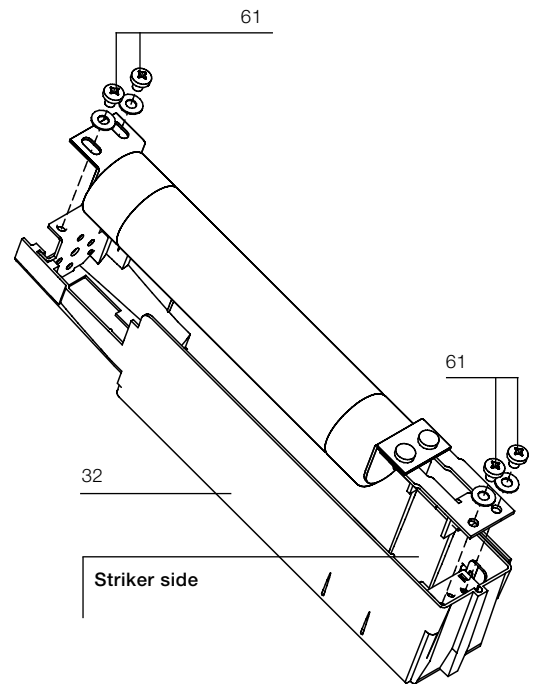


Fig. 20b



Fig. 20c

## 7.9. Mounting and dismantling the short-circuit busbar

### a) Mounting (fig. 21)

Mount the busbar with the feeler pin (60) on the opposite side to that of the tulips and fix it with the screws (61).

### b) Dismantling (fig. 21)

To dismantle, proceed in reverse order.

The same instructions are given in the Kit sheet put in the short-circuit busbar packing.

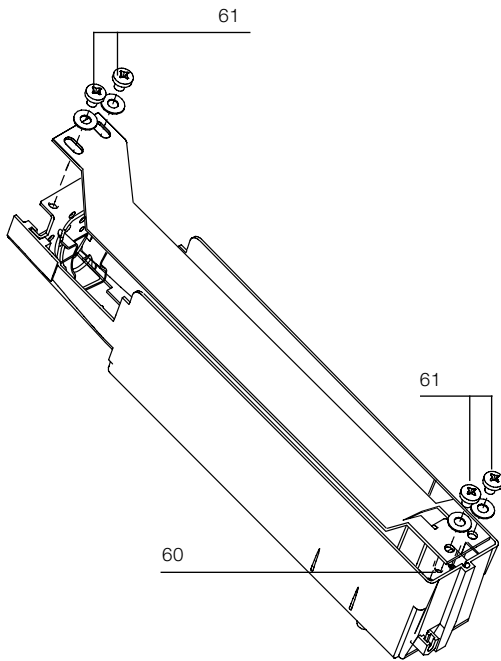


Fig. 21

## 7.10. Putting the contactor back into service

### 7.10.1. Mounting the shield and insulating guard (fig. 18)

Reposition the protection (1) (fig. 18b), repeating the operations indicated in par. 7.7.2. in reverse order.

Remount the shield. Check that the impulse counter (14) (fig. 18c) inserts itself into the special seat (69) (fig. 18d) and fix the shield with the screws (70) and DIN washers (71) (fig. 18a).

### 7.10.2. Checking apparatus functions

Rack the contactor into the enclosure, working as indicated in par. 6.

In the "isolated for test" position, check the correctness and functionality of the contactor "open/closed" signalling by carrying out a few operations.

## 7.11. Checking the degree of vacuum of the interrupter

This test is not required for normal maintenance. Should it become necessary for extraordinary maintenance, carry out the test on the interrupter without dismantling it from the contactor and use the VIDAR tester, of the Programma Electric GmbH, Bad Homberg v.d.H. company, for the vacuum test.

To check the vacuum air tightness of the interrupter, prepare the following VIDAR tester test values:

Contactor rated voltage	DC test voltage
7.2 kV	16 kV
12 kV	22.5 kV

The test must always be carried out with the contactor open, with the contacts at the nominal distance.

Procedure for testing the vacuum of the interrupter of the contactor poles:

- turn off the power and make the working area safe according to the safety regulations of the IEC/DIN VDE standards;
- open the contactor;
- ground a terminal of each contactor pole;
- connect the ground terminal of the VIDAR tester to the structure of the contactor (grounding point of the contactor);
- connect the high voltage terminal of the VIDAR tester to the terminal not connected to ground of the contactor pole (phase L1) and carry out the test. Repeat the test for phases L2 and L3.



**The tester connection cables can produce an indication due to capacitive effect. In this case, the cables must not be removed.**



# 8. Spare parts and accessories

To order contactor spare parts/accessories, refer to technical catalogue 1VCP000165 and always state the following:

- type of contactor
- rated voltage of the contactor
- rated normal current of the contactor
- serial number of the contactor
- rated voltage and frequency of any electrical spare parts.

For availability and to order spare parts, please contact ABB Service.

## 8.1. List of spare parts

- Vacuum interrupter assembly (replacement to be carried out by ABB)
- MAC-R2 electronic card
- Auxiliary contacts (5 normally open and/or 5 normally closed)
- Capacitor
- Interfacing shaft (only fixed contactors)
- 12 kV insulation partitions (only fixed contactors)
- Actuator assembly (replacement to be carried out by ABB).
- Operation counter
- Fuses
- Adapters for fuses
- Fuseholders (replacement to be carried out by ABB)
- Tulip and jaw-type isolating contacts
- Locking magnet in the truck
- Microswitches.

# 9. Product quality and environmental protection

The pieces of apparatus are produced in compliance with the requirements of the international standards regarding quality and environmental management systems. In these fields, the excellent level is proved by availability of the ISO 9001 and ISO 14001 certificates.

### End of product life

ABB is committed to respecting the requirements and laws for protection of the environment laid down according to the ISO 14001 Standard.

ABB offers its competency and collaboration in facilitating recycling and disposal of the products at the end of their life. It is always necessary to act in compliance with the local regulations in force for disposal of the products.

### Methods of disposal

Disposal can either be carried out with thermal treatment in an incineration plant or by storage in special areas

Material	Recommended method of disposal
Metals (Fe, Cu, Al, Ag, Zn, W, others)	Separation and recycling
Thermoplasts	Recycling or disposal
Epoxy resin	Separation of metal parts and disposal of resin parts
Rubber	Disposal
Dielectric oil (oil for transformers)	Recovery and recycling or disposal
Wood for packing	Recycling or disposal
Aluminium foil for packing	Recycling or disposal



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